BIODIVERSITY DEVELOPMENT ASSESSMENT REPORT

for a
Proposed Sand Extraction Facility and Site Office/Manager's Residence
at

Lot 591 DP 1191380
Nelson Bay Road
ANNA BAY
NSW

Prepared by:

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For:

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C/. Tattersall Lander Pty. Ltd.
PO Box 580
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Job No: 12462

March 2020

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ABN: 41 003 509 215

Project Name	Biodiversity Development Assessment Report for a proposed sand extraction facility and site office/managers residence within Lot 591 DP 1191380 Nelson Bay Road, Anna Bay NSW	
Project Number	12462	
Prepared By	Ben Ellis Ecologist	
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Reviewed By	Daryl Harman Senior Ecologist	
Status	Final – 9 March 2020	
Version Number	2	

Disclaimer

This report has been prepared in accordance with the proposal provided by the Client and outlined within this report. All findings, conclusions or recommendations contained within this report are based upon the data and results collected under the times and conditions specified in the report and are only applicable for the proposal considered within this report. This report has been prepared for use exclusively by the Client. No responsibility for its use by any other party is accepted by WILDTHING Environmental Consultants.

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LIST OF APPENDICES

Acronyms and Abbreviations used in this report

AOBV	Area of outstanding Biodiversity Value
BAM	Biodiversity Assessment Method
BC Act	Biodiversity Conservation Act 2016
BAR	Biodiversity Assessment Report
BCAR	Biodiversity Certification Assessment Report
BDAR	Biodiversity Development Assessment Report
BCT	Biodiversity Conservation Trust
BSA	Biodiversity Stewardship Site Agreement
BOAMS	Biodiversity offsets and Agreement Management System
BOPC	Biodiversity Offsets Payment Calculator
BOS	Biodiversity Offset Scheme
BOSET	Biodiversity Offsets Scheme Entry Tool
CEEC	Critically Endangered Ecological Community
CKPoM	Comprehensive Koala Plan of Management
DNG	Derived Native Grassland
DPIE	Department of Planning, Industry and Environment
DoEE	Department of Environment and Energy
EEC	Endangered Ecological Community
EPBC Act	Environmental Protection & Biodiversity Conservation Act 1999
EP&A Act	Environmental Planning & Assessment Act 1979
IBRA	Interim Biogeographic Regionalisation for Australia
LLS Act	Local Land Services Act 2013
NOW	NSW Office of Water
NPW Act	National Parks & Wildlife Act 1974
OEH	Office of Environment & Heritage (now DPIE)
PCT	Plant Community Type
REF	Review of Environmental Factors
SAII	Serious and Irreversible Impacts
SEPP	State Environmental Planning Policy
TBDC	Threatened Biodiversity Data Collection
TEC	Threatened Ecological Community
VIS	Vegetation Information System

1.0 INTRODUCTION

This Biodiversity Development Assessment Report (BDAR) has been prepared for Hay Enterprises to inform the preparation of an Environmental Impact Statement (EIS) for a proposed sand extraction facility and site office/manager's residence within Lot 591 DP 1191380 4226 Nelson Bay Road, Anna Bay NSW (the study area) (Figure 1.1).

1.1 OBJECTIVE

This BDAR has been prepared in accordance with the Biodiversity Assessment Methodology (BAM) (OEH 2017) by Wildthing Environmental Consultants on behalf of Hay Enterprises. The primary objective of this assessment is to use the guidelines and methodology provided in the BAM to determine the impact the project would have on biodiversity, avoid and mitigate these impacts and then calculate the project's biodiversity offset requirement.

This BDAR has two broad stages consistent with the BAM methodology:

Stage 1 – Biodiversity Assessment

- assessment of site context features,
- assessment of native vegetation; and
- assessment of threatened species and populations

Stage 2 – Impact Assessment

- avoid and minimise impacts on biodiversity values,
- consider impact and offset thresholds; and
- determine and calculate offset requirements

In addition, assessment was also undertaken having regard to Matters of National Environmental Significance (MNES) listed under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act), the NSW Biosecurity Act 2015 and relevant State Environmental Planning Policies.

All aspects of this biodiversity assessment have been undertaken in accordance with the BAM. This BDAR was originally prepared by Accredited Assessor Ben Ellis (BAAS18078) and has been reviewed and updated by Accredited Assessor Dr Kylie Bridges (BAAS20005) and Accredited Assessor Daryl Harman (BAAS17074).

1.2 THE PROPOSAL

The proposed sand extraction facility and site office/manager's residence will require the installation of several minor project components during its construction stage, which are:

- A minor realignment of a pre-existing access track running north through the study area to allow for the movement of reticulated vehicles accessing the sand dunes of Stockton Bight from Nelson Bay Road;
- The construction of a site managers shed with a development footprint of approximately 800m^2:

- The establishment of a bushfire asset protection zone with a radius of approximately 35m from the edge of the site managers shed.

Operational effects of the sand extraction process will be restricted to the bulk handling of sand material, utilising front end loaders and reticulated vehicles for the transport of the material to the required markets. The extraction of sand will be restricted to the area of Stockton Sand Dunes that has encroached into the study area (approximately 1 ha). It is anticipated, based upon previous observations made by the proponent, that the sand dune incursion within the study area will advance over time allowing for more sand material extent to be extracted. The operation will provide up to 50,000 cubic metres of quarried material per annum. The sand extraction will continue to be largely dependent on wind deposition and once the existing sand resource is retrieved, it will operate occasionally. When in operation the development is proposed to operate between the hours of 7:00 am and 6:00 pm Monday to Friday and between 8:00 am to 1:00 pm on Saturdays. No work is proposed on Sundays or on Public Holidays.

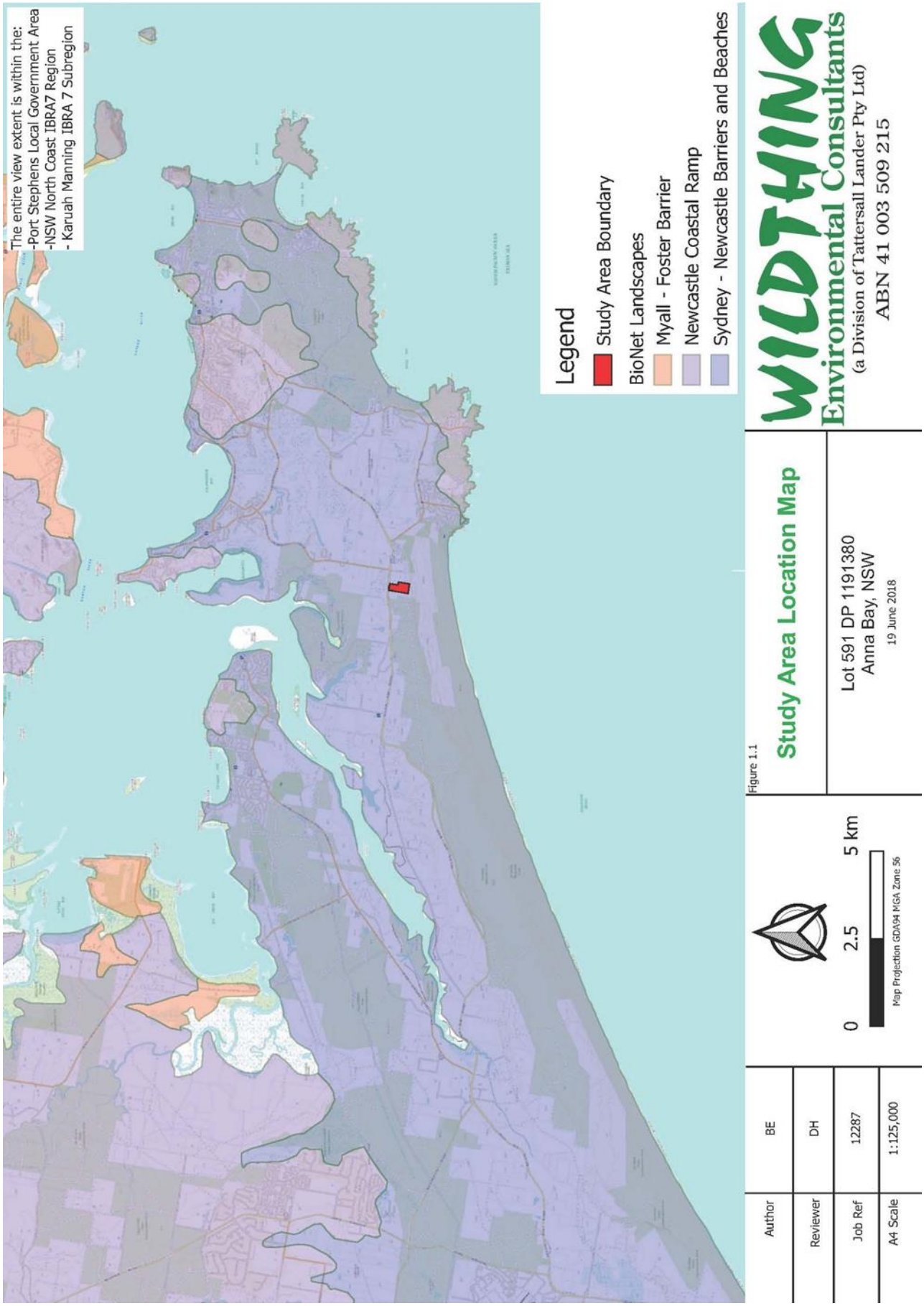
The above project components and operational effects of the sand extraction facility and site office/manager's residence and sand extraction area hereafter collectively referred to as the proposed development. The proposed development area is 1.82ha. The location of the study area and Development area is provided in Figure 1.2 and 1.3.

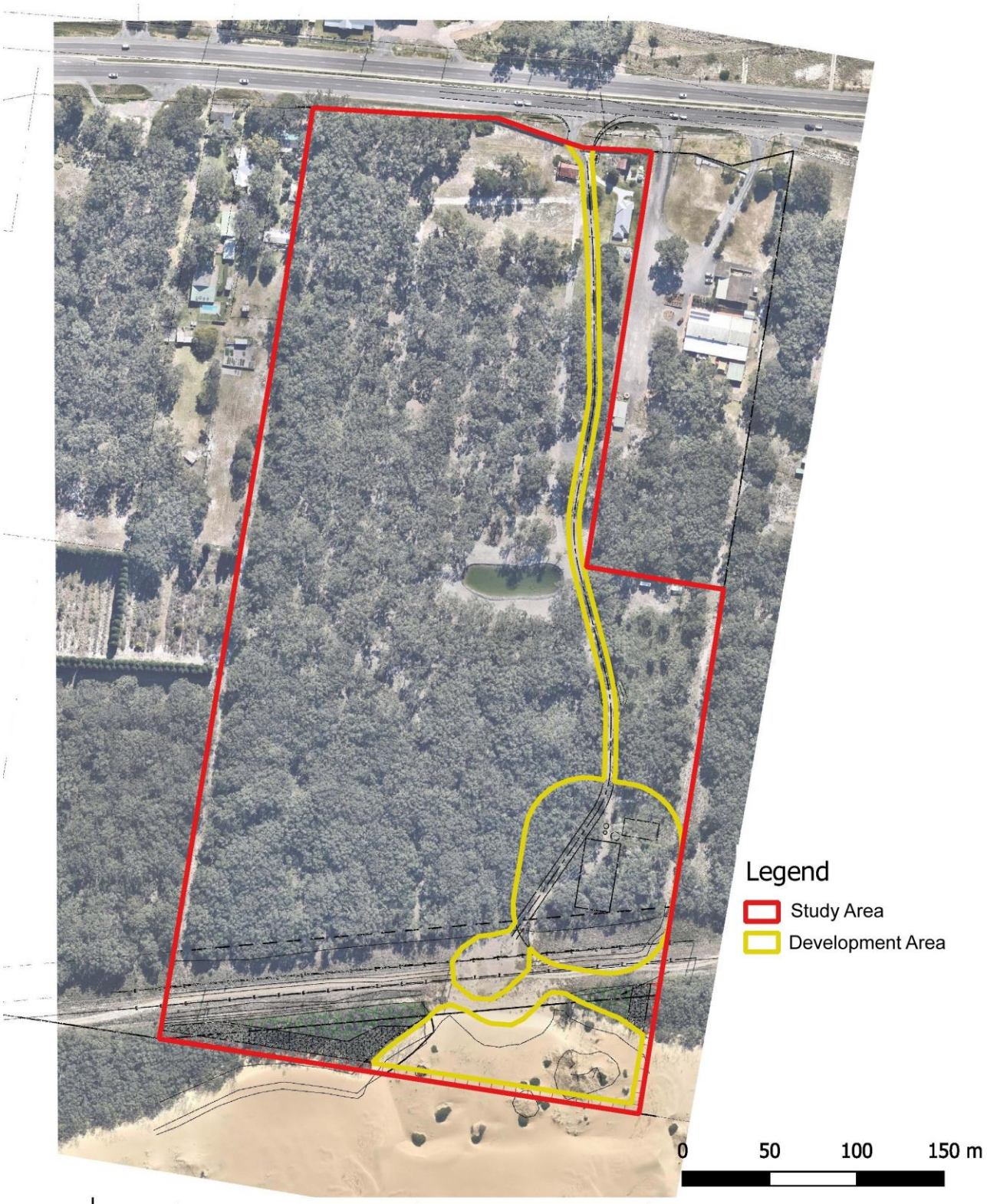
1.3 DEFINITION OF THE STUDY AREA

1.3.1 STUDY AREA

The 13.25 ha study area (Lot 591 DP 1191380) is located at Anna Bay, NSW, approximately 32km north-east of Newcastle and 9km south-west of Nelson Bay (Figure 1.2 & 1.3). The study area is situated on the southern side of Nelson Bay Road, bounded by the Stockton sand dunes to the south and predominantly bushland to the east and west.

The study area occurs on vegetated Aeolian Holocene transgressive dunes and the majority of the study area consisted of dry open sclerophyll forest dominated by the canopy species *Eucalyptus pilularis* (Blackbutt) and *Angophora costata* (Smooth-barked Apple). The southern portion of this community was in moderate condition; however, the northern portion of this community had been exposed to recent disturbance in the form of underscrubbing which has modified the mid-storey and understorey layers and removed a number of less mature canopy trees. A dwelling is located in the north eastern corner of the property with associated infrastructure. A pond has recently been constructed in the mid portion of the site and planted with a perimeter of Buffalo grass. A small area in the north west of the study area was composed of cleared grassland and a shed. A grassy electrical easement ran through the southern portion of the study area. Two access tracks ran north-south through the study area.


The entire view extent is within the:
-Port Stephens Local Government Area
-NSW North Coast IBRA7 Region
- Karuah Manning IBRA 7 Subregion
Legend
Study Area Boundary
BioNet Landscapes
Myall - Foster Barrier
Newcastle Coastal Ramp
Sydney - Newcastle Barriers and Beaches
WILDTHING
Environmental Consultants
(a Division of Tattersall Lander Pty Ltd)
ABN 41 003 509 215
Figure 1.1
Study Area Location Map
Lot 591 DP 1191380
Anna Bay, NSW
19 June 2018
0
2.5
5 km
Map Projection GDA94 MGA Zone 56
Author
BE
Reviewer
DH
Job Ref
12287
A4 Scale
1:125,000



A4 Scale	

Disclaimer: While all reasonable care has been taken to ensure the information contained on this map is up to date and accurate, no guarentee is given that the information protrayed is free from error or omission. In addition the spatial accuracy of the map is wholly dependant on source data. Please verify the accuracy of all information prior to use. Development footprint areas should be used for indicative areas only.

Aerial Photo: Nearmap

Figure 1.2

Development Area

Nelson Bay Road
Anna Bay

WILDTHING Environmental Consultants
(a Division of Tattersall Lander Pty Ltd)
ABN 41 003 509 215

Figure 1.3: Proposal

Zoning of the study area

The study area is zoned RU2 Rural Landscape under the Port Stephens LEP (Port Stephens Council 2013). The objectives of the RU2 Rural Landscape zone are:

- To encourage sustainable primary industry production by maintaining and enhancing the natural resource base;
- To maintain the rural landscape character of the land; and
- To provide for a range of compatible land uses, including extensive agriculture.

Land Tenure Information

The study area consists of a single parcel of land which is wholly owned by Ragusa Pty. Ltd.

1.4 INFORMATION SOURCES

A list of the resources used to inform this BDAR, the date they were accessed and the spatial extent captured, where relevant, is provided in Table 1.1.

Table 1.1: Desktop Resources

Resource	Date Reviewed	Spatial Extent
Previous Ecological Studies		
Wildthing Environmental Consultants (2017) Proposed Sand Extraction Quarry at Lot 591 DP 1191380 Nelson Bay Road, Anna Bay NSW Flora and Fauna Assessment Report. (Unpublished).	25-27 May 2018	-
ERM (2003). Environmental Impact Statement for the Electricity Supply Upgrade from Tomago to Tomaree. Energy Australia.	25-27 May 2018	-
Ecotone (2008) Vertebrate Fauna Survey Worimi Conservation Lands	25-27 May 2018	-
Department of Planning (2006) Lower Hunter Regional Strategy	25-27 May 2018	-
House (2003) Lower Hunter and Central Coast Regional Biodiversity Conservation Strategy	25-27 May 2018	-
Bell & Driscoll (2010) Vegetation of the Worimi Conservation Lands Port Stephens, New South Wales: Worimi NP, Worimi SCA & Worimi RP	25-27 May 2018	-
Zoning and Regulatory Maps		
Port Stephens Local Environmental Plan - Land Zoning Map (LZN-004) (Port Stephens Council 2013)	25-27 May 2018	Entire study area
Biodiversity Values and Landscape Maps		
NSW Biodiversity Values Map (OEH 2018a)	7 January 2020	Entire study area
SIX Maps -Base Map - LPI 1:25,000 digital topographic databases (DTDB) (LPI 2018) -Cadastral data LPI digital cadastral database (DCDB) (LPI 2018)	25-27 May 2018	Entire study area
Nearmap	13 January 2020	Entire study area
NSW SEED Mapping (NSW Gov 2018)	25-27 May 2018	Entire study area
BioNet NSW (Mitchell) Landscapes – Version 3.1 (OEH 2016a)	25-27 May 2018	Entire study area
NSW Interim Biogeographic Regions of Australia (IBRA region and sub-regions) – Version 7 (OEH 2016b)	25-27 May 2018	Entire study area
Atlas of Groundwater Dependent Ecosystems (BoM 2018)	25-27 May 2018	Entire study area

Soil Landscapes of the Port Stephens 1:100 000 Sheet Map. (Murphy 1995).	25-27 May 2018	Entire study area
Threatened Species, Vegetation and Landscape Databases		
BioNet Atlas of NSW Wildlife (BioNet) (OEH 2018b)	6 January 2020	10x10km radius of study area
Commonwealth Protected Matters Search Tool (PMST) (DoPE 2018a)	6 January 2020	10x10km radius of study area
Commonwealth species profiles and threats database (SPRAT) (DoPE 2018b)	May-June 2018 January 2020	-
OEH Profiles of threatened species, population, and ecological communities (OEH 2018c)	May-June 2018 January 2020	-
OEH BioNet Threatened Biodiversity Data Collection (TBDC) (OEH 2018d)	June 2018 January 2020	-
OEH BioNet vegetation classification database (OEH 2018e)	11 May 2018 January 2020	-
PlantNet NSW (The Royal Botanic Gardens and Domain Trust 2018).	May-June 2018	-
Directory of Important Wetlands in Australia (DIWA) (DoPE 2018c)	25-27 May 2018	-
Estuaries of NSW: Physical characteristics, tidal surveys and hydrographic surveys (OEH 2018e)	25-27 May 2018	-
Geological sites of NSW (Cartoscope 2018)	25-27 May 2018	-
OEH BioNet Vegetation Classification Database (VIS) (OEH 2018h)	25-27 May 2018 January 2020	-
Survey and Reporting Methodology		
Biodiversity Assessment Method (BAM) (OEH 2017)	May-June 2018 January 2020	-
Biodiversity Assessment Method Operational Manual – Stage 1 (OEH 2018f)	May-June 2018 January 2020	-
Threatened species survey and assessment guidelines: field survey methods for fauna – amphibians (OEH 2009)	May-June 2018 January 2020	-
NSW Guide to Surveying Threatened Plants (OEH 2016)	May-June 2018 January 2020	-
OEH Threatened Biodiversity Survey and Assessment Guidelines. Guidelines for Developments and Activities (OEH 2004)	May-June 2018 January 2020	-
Biodiversity Assessment Method Credit Calculator (BAM-CC) (OEH, 2018g)	May-June 2018 January 2020	-
Climatic Data		
061395 Tanilba Bay WWTP (BoM 2018)	25-27 May 2018	-
Development Footprint Design		
Anna Bay sand extraction facility and site office/managers residence design and location map (Tattersall Lander 2020).	January 2020	Entire development footprint
Rehabilitation Plan		
Rehabilitation Plan for a proposed Sand Extraction Facility at Lot 591 DP 1191380 Nelson Bay Road, Anna Bay NSW (Wildthing Environmental Consultants, 2020)	January 2020	

2.0 LEGISLATIVE CONTEXT

This chapter provides a brief outline of the key biodiversity legislation and government policy considered in this assessment.

2.1 NSW ENVIRONMENTAL PLANNING AND ASSESSMENT AMENDMENT ACT 2017

The Environmental Planning & Assessment Act 1979 (EP&A Act) was legislated to require the consideration and management of impacts of proposed development and land use change on the environment and the community.

- Part 1 Section 1.7 of the EP&A Act requires consideration of the proposed development under Part 7 of the Biodiversity Conservation Act 2016 (BC Act).
- The EP&A Act is also supported by other statutory environmental planning instruments, including State Environmental Planning Policies (SEPPs). The following SEPPs are relevant to this report:

2.1.1 NSW BIODIVERSITY CONSERVATION (BC) ACT 2016

The purpose of the BC Act is "to establish a pathway to avoid, minimise and offset the impacts of proposed development and land use change on biodiversity and to establish a scientific method for assessing the likely impacts on biodiversity values of proposed development and land use change, for calculating measures to offset those impacts and for assessing improvements in biodiversity values".

In accordance with the BC Act, the Biodiversity Assessment Method (BAM) (OEH 2017c) and entry into the Biodiversity Offsets Scheme (BOS) is applicable to certain development activities based on specific criteria. Preparation of a Biodiversity Development Assessment Report (BDAR) is required for a development application that meets any of the following criteria:

- Part 4 development activities deemed to be 'State Significant' under the NSW Environmental Planning and Assessment Act 1979 (NSW EP&A Act);
- Development activities that have the potential to impact Areas of Outstanding Biodiversity Value (AOBV) as listed under Part 3 of the BC Act;
- Development activities that have the potential to cause a significant impact on a threatened species, population or ecological community, listed under Schedules 1 and 2 of the BC Act, as determined by application of a five-part-test of significance in accordance with Section 7.3 of the BC Act;
- Development activities that have the potential to impact areas mapped as having 'high biodiversity value' as indicated by the NSW Biodiversity Values Map (BV Map); and
- Development activities that involve clearing of native vegetation that exceeds the Biodiversity Offset Scheme thresholds (BOS thresholds) as determined by the NSW BC regulation.

As the proposed development will require removal of 10.86ha of native vegetation which exceeds the BOS clearing threshold (1ha) detailed in Section 7.2 of the Biodiversity Conservation Regulation

2017, a BDAR is required to support a development application for the proposed development. This report has been prepared according to the methodology detailed within the BAM.

2.1.2 STATE ENVIRONMENTAL PLANNING POLICY (SEPP) 44 KOALA HABITAT PROTECTION

SEPP 44 aims to encourage the conservation and management of natural vegetation areas that provide habitat for koalas to ensure permanent free-living populations will be maintained over their present range and to reverse the current trend of koala-population decline. It applies to areas of native vegetation greater than one hectare and in Councils listed in Schedule 1 of SEPP 44. The study area is located in the Port Stephens LGA, as such the requirements of SEPP 44 are relevant to the assessment. Further information on Koala conservation within the study area has been provided in Appendix A of this report.

2.1.3 COASTAL MANAGEMENT SEPP

The State Environmental Planning Policy (Coastal Management) 2018 (CM SEPP) updates and consolidates into one integrated policy SEPP 14 (Coastal Wetlands), SEPP 26 (Littoral Rainforests) and SEPP 71 (Coastal Protection), including clause 5.5 of the Standard Instrument – Principal Local Environmental Plan. These policies are now repealed.

The aim of this Policy is to promote an integrated and co-ordinated approach to land use planning in the coastal zone in a manner consistent with the objects of the Coastal Management Act 2016, including the management objectives for each coastal management area, by:

- managing development in the coastal zone and protecting the environmental assets of the coast, and
- establishing a framework for land use planning to guide decision-making in the coastal zone, and
- mapping the 4 coastal management areas that comprise the NSW coastal zone for the purpose of the definitions in the Coastal Management Act 2016.

These coastal management areas are:

- the coastal wetlands and littoral rainforests area,
- the coastal vulnerability area,
- the coastal environment area, and
- the coastal use area.

The study area contained areas of Coastal wetlands, Coastal Environment Area and Coastal Use areas. Further information on this matter is provided in Appendix A of this report.

2.2 NSW BIOSECURITY ACT 2015

The NSW Biosecurity Act 2015 (BS Act), amongst other considerations, provides regulatory controls and powers to manage noxious weeds in NSW. For weed management, this Act divides NSW into

regions based on combined LGAs and priority weeds for a region are listed. Some weeds are managed at a state level as they form part of a broader containment strategy. The legislation compliments listed Weeds of National Significance (WoNS). Further information on this matter is provided in Appendix A of this report.

2.3 COMMONWEALTH ENVIRONMENT PROTECTION AND BIODIVERSITY CONSERVATION ACT 1999

The purpose of the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) is to ensure that actions likely to cause a significant impact on Matters of National Environmental Significance (MNES) undergo a process of assessment. Under the EPBC Act, an action includes a project, undertaking, development or activity that may impact MNES. An action that 'has, will have or is likely to have a significant impact on a MNES' is deemed to be a 'controlled action' and may not be undertaken without prior approval from the Commonwealth Minister for the Department of the Environment and Energy (DoEE). MNES categories listed under the EPBC Act are:

- world heritage properties;
- national heritage places;
- wetlands of international importance (Ramsar wetlands);
- threatened species and ecological communities (Section 18 and 18A);
- migratory species;
- commonwealth marine areas;
- nuclear actions (including uranium mining); and
- a water resource, in relation to coal seam gas development and large coal mining development.

Initially, MNES protected under the EPBC Act are assessed in accordance with the Significant Impact Guidelines 1.1 - Matters of National Environmental Significance (DoE 2013). This is performed to determine if there is likelihood for an action to have a significant impact on MNES. An action will require referral to, and may require the approval of, the Commonwealth Minister for the Environment (in addition to any local or state government consent or approval) if that action will have, or is likely to have, a significant impact on the environment or on a MNES.

The project is unlikely to have a significant impact on MNES and is, therefore, not required to be referred to DoEE for consideration. Further information on this matter is provided in Appendix A of this report. An extract of the Protected Matters Search Tool used for this assessment has been provided in Appendix G.

2.4 PORT STEPHENS COMPREHENSIVE KOALA PLAN OF MANAGMENT

The Port Stephens Council CKPoM has been prepared in accordance with State Environmental Planning Policy No. 44 - Koala Habitat Protection (SEPP 44). The principal aim of this CKPoM is identical to that of SEPP 44: "…to encourage the proper conservation and management of areas of natural vegetation that provide habitat for koalas, to ensure permanent free-living populations over

their present range and to reverse the current trend of population decline." The study area has been assessed to contain Supplementary Koala Habitat, as such an assessment of the proposal against the performance criteria set out in the CKPoM has been undertaken. Further information on this matter is provided in Appendix A of this report.

2.5 LICENCING

Fieldwork undertaken by Wildthing Environmental Consultants was carried out under the NPWS Scientific Investigation Licence SL 100345 and under Animal Care and Ethics Approval: Animal Research Authority Issue by the Director General of NSW Agriculture (File No. TRIM 13/251) for the Fauna Survey for Biodiversity and Impact Assessment.

3.0 STAGE 1 - BIODIVERSITY ASSESSMENT - LANDSCAPE CONTEXT

This Section of the report describes the landscape context, including the landscape features present within the study area and a 1500 metre buffer from the edge of the study area, as required by the BAM (OEH 2017).

3.1 IBRA BIOREGION & SUBREGION

Interim Biogeographic Regionalisation for Australia (IBRA) Bioregions are large, geographically distinct areas of land with common characteristics such as geology, landform patterns, climate, ecological features, and flora and fauna communities. The study area is located within the NSW North Coast (NNC) IBRA Bioregion and the Karuah Manning IBRA Subregion (OEH 2016b). Both IBRA and IBRA Subregional Boundaries do not occur near the study area and hence are not shown within Figure 3.1.

3.2 NSW LANDSCAPE REGION

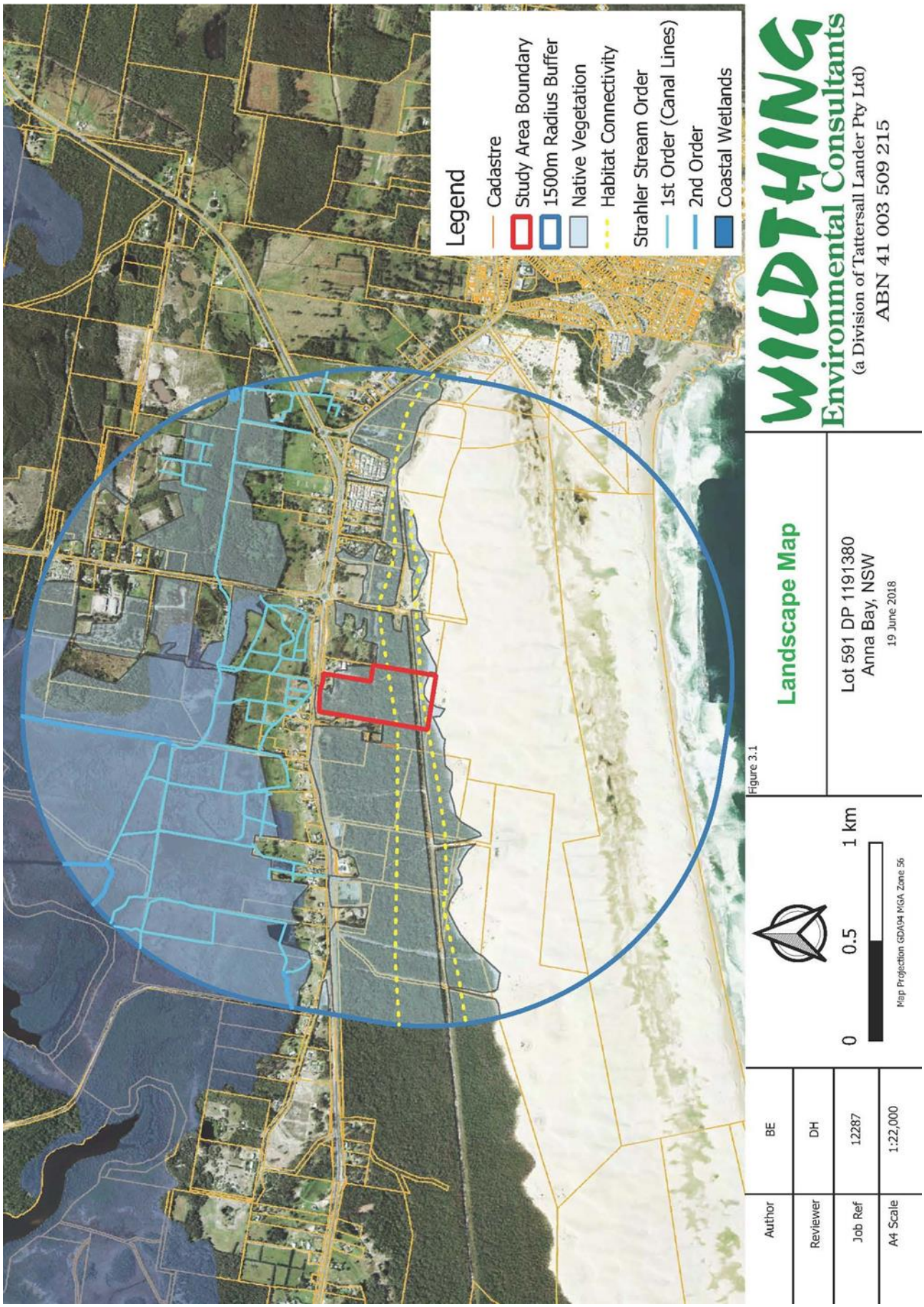
The study area falls entirely within the Sydney Newcastle Barriers and Beaches (SB Coastal Barriers) BioNet Landscape (formerly Mitchell Landscapes) (OEH 2016a). The Mitchell Landscapes within the vicinity of the study area are shown in Figure 3.1.

3.3 RIVERS AND STREAMS

The study area is located within the Hunter Central Rivers Catchment. According to the NSW Government SEED mapping, no rivers, streams and estuaries are present within the study area (NSW Gov 2018). This absence was confirmed during the field survey. A number of mapped minor canal lines were present to the north of the study area across Nelson Bay Road. In addition, there were a small number of 2nd order tributaries to Finnegans Island Creek approximately 2km north of the study area Rivers, streams, estuaries and mapped canal lines within the vicinity of the study area are displayed in Figure 3.1.

3.4 WETLANDS

No important wetlands as defined in the Biodiversity Assessment Method Operational Manual – Stage 1 (OEH 2018f) were found to be present within the study area or occur downstream/adjacent to the study area. A Coastal Wetland (Coastal Management SEPP) was present approximately 0.65km to the north west of the study area, this wetland was not a listed as a wetland of International Importance developed under the Ramsar Convention (NSW Gov 2018) nor a DIWA listed wetland (DoEE 2108). The location of the Coastal Wetland in relation to the study area is shown in Figure 3.1.


Legend
Cadastre
Study Area Boundary
1500m Radius Buffer
Native Vegetation
Habitat Connectivity
Strahler Stream Order
1st Order (Canal Lines)
2nd Order
Coastal Wetlands
WILDTHING
Environmental Consultants
(a Division of Tattersall Lander Pty Ltd)
ABN 41 003 509 215
Landscape Map
Lot 591 DP 1191380
Anna Bay, NSW
19 June 2018
Figure 3.1
0
0.5
1 km
Map Projection GDA94 MGA Zone 56
Author
BE
Reviewer
DH
Job Ref
12287
A4 Scale
1:22,000

3.5 CONNECTIVITY FEATURES

Habitat function within the study area is primarily associated with coastal sclerophyll forest. For mobile fauna species and seed/pollen dispersal of some flora species, habitat within the study area is connected to the vegetation of Worimi National Park to the west (Bell & Driscoll 2010). The Lower Hunter Regional Strategy (NSW Department of Planning 2006) identifies this area as part of a key green corridor linking large vegetated areas, allowing the movement and dispersal of biodiversity within the region. This corridor links the Watagan and Yengo National Parks with the coastal plains of the Tomago Sand beds, Stockton Bight and Port Stephens. The Lower Hunter and Central Coast Regional Biodiversity Conservation Strategy (House, 2003) also identifies the Coastal Sand Apple – Blackbutt Forest occurring along the Stockton Bight dune system as a regionally significant habitat linkage. Habitat connectivity in relation to the study area is shown in Figure 3.1.

3.6 GEOLOGY TOPOGRAPHY AND SOILS

The study area is located on the Port Stephens soil landscape, composed of Holocene sand sheets and beach ridges (Murphy, 1995). The soil consists of loamy sand throughout the majority of the study area. The topography is flat to undulating throughout the study area, with a sharp incline into sand dunes in the south of the study area. The southern portion of the study area borders Stockton Bight sand dunes and is characterised by transgressive sand dunes of marine and Aeolian Holocene sands. There are no karst, caves, cliffs or other areas of geological significance within the study area or within the surrounding assessment area.

3.7 HIGH AND OUTSTANDING BIODIVERSITY AREAS

There are currently no declared areas of Outstanding Biodiversity Value under the NSW Biodiversity Conservation Regulation 2017 associated with the study area.

The NSW Biodiversity Values Map was consulted on 7 January 2020, at this time it was observed that the study area does not fall within an area of high biodiversity value.

3.8 NATIVE VEGETATION EXTENT IN THE BUFFER AREA

The Biodiversity Assessment Method Operational Manual Stage 1 (OEH 2018f) defines 'Native Vegetation Cover' as:

The amount of native vegetation (woody and non-woody vegetation including regrowth and plantations comprised of plants native to New South Wales) that is estimated to remain in the landscape proximal to the assessment area. It is used:

- *as a filter by the Calculator to predict threatened species likely to occur or use habitat on a site; and*
- *to define the intrinsic rate of increase in species richness and plant cover as part of the assessment of future vegetation condition on a biodiversity stewardship site*

Native vegetation extent within a 1500m buffer from the edge of the study area was estimated from review of aerial imagery and regional vegetation mapping and via field inspection and professional judgement. It was determined that 39.91% of native vegetation was present within the 1500m buffer including the vegetation within the study area, this value was accordingly input into the BAM-CC. Native vegetation contained within a 1500m buffer of the study area is shown in Figure 3.1.

3.9 CLEARED AREAS

Cleared areas within the locality include roads, sand dunes, car parks, existing development, waterbodies and waterways (natural and man-made) and vacant land lots.

3.10 DIFFERENCES BETWEEN MAPPED VEGETATION EXTENT AND AERIAL IMAGERY

There were no significant differences between the mapped vegetation extent and that present within available aerial imagery.

4.0 SUBJECT SITE CONTEXT

This section describes the vegetation extent present within the subject site, as required by the BAM (OEH, 2019). The habitats and vegetation within the subject site are a small subset of the in the wider landscape. A full inventory of the flora and fauna species identified within the subject site has been provided in Appendix C and D respectively.

4.1 NATIVE VEGETATION EXTENT IN THE SUBJECT SITE

It was determined that the study area was composed of 84.75 % of native vegetation.

Area of study area: 13.25 ha
Native vegetation extent: 11.23 ha
Cleared areas: 1.74 ha
Dam and associated turf: 0.25 ha

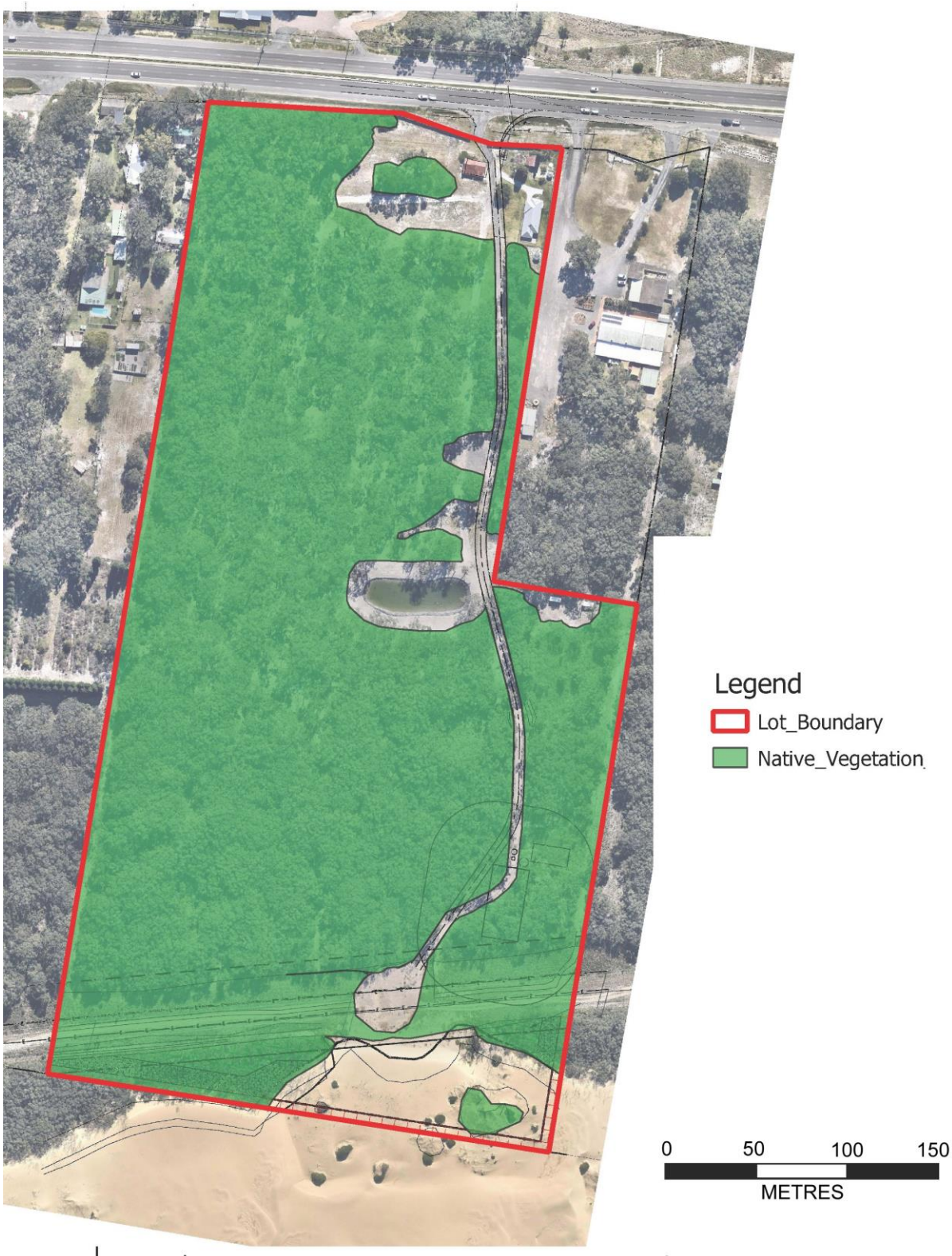
Figure 4.1 provides a map of the native vegetation extent recorded within the study area and proposed development impact area, as assessed during field investigations undertaken in May 2018. The figure includes all areas of native vegetation (native ground cover and areas with canopy). Areas not shown as native vegetation cover within Figure 4.1 are not included for further assessment in accordance with Section 5.1.1.5 of the BAM unless they are determined within Section 8 of this report to be consistent with habitat for candidate species credit species as detailed within Section 6.4.1.37 of the BAM.

4.2 CLEARED AREAS AND NATIVE VEGETATION

The study area has had a history of past disturbance and clearing. Disturbed areas consisted of the following

- A primary access track has been cleared running north to south to provide access to the sand dunes of Stockton Bight.
- An electricity transmission line easement runs east to west at the south of the site and a secondary access track is present within the east of the study area. The electricity transmission line easement has been cleared of all canopy vegetation and is maintained (slashed) as part of periodic maintenance conducted by Ausgrid. The understorey of this community is composed of derived native grassland (DNG) consistent with the adjacent intact native coastal forest.
- An area within the northern portion of the study area has been cleared in the past and is primarily composed of disturbed non-native grassland and exotic weed species. A residence has been recently constructed in the far north-east of this area;
- An area of native vegetation within the northern portion of the study area was observed to have been exposed to recent disturbance in the form of underscrubbing which has modified the mid-storey and understorey layers and removed a number of less mature canopy trees;

- A dam has also been constructed within the south-east of the underscrubbed area. The dam has an area of 0.11ha, Turf composed of introduced *Stenotaphrum secundatum* (Buffalo Grass) had been recently laid around the dam and covered an area of 0.14ha.



Author	
A4 Scale	1:10000

Disclaimer: While all reasonable care has been taken to ensure the information contained on this map is up to date and accurate, no guarentee is given that the information protrayed is free from error or omission. In addition the spatial accuracy of the map is wholly dependant on source data. Please verify the accuracy of all information prior to use. Development footprint areas should be used for indicative areas only.

Map Projection GDA94 MGA Zone 56

Figure 4.1

Native Vegetation

Nelson Bay Road
Anna Bay, NSW

XX Month Year

WILDTHING Environmental Consultants
(a Division of Tattersall Lander Pty Ltd)
ABN 41 003 509 215

4.2 DIFFERENCES BETWEEN MAPPED VEGETATION EXTENT AND AERIAL IMAGERY

Native vegetation extent and internal ecotone boundaries between communities were 'ground truthed' and mapped during fieldwork using a handheld Geographic Positioning System (GPS). During the survey period, there were not notable differences between vegetation extent displayed in recent aerial imagery. Within the south of the study area it was observed that the transgressive sand dunes of Stockton Bight have advanced north further into the study area and have reduced the extent of woodland present south of the transmission easement.

5.0 PLANT COMMUNITY TYPES

This Section describes the attribution of vegetation community profile descriptors to vegetation surveyed within the subject site in accordance the NSW Plant Community Types (PCTs) held within the NSW BioNet Vegetation Information System (BioNet VIS) database.

5.1 PLANT COMMUNITY TYPE (PCT) ASSESSMENT METHOD

Existing surveys conducted within the locality as well as database searches (See Section 1.3) were reviewed to inform the vegetation investigations. In addition, a search was undertaken of the BioNet VIS Database (OEH 2019h) and NSW SEED mapping to access existing vegetation mapping information within the subject site. It was determined that the mapping dataset, Lower Hunter Vegetation Mapping VIS_ID 4513 (Parsons Brinckerhoff Pty Ltd 2017), was the most appropriate to use for the context of the subject site as it was both fine scale, current and contains the broader context of vegetation types present in the locality. Accordingly, this mapping data (VIS_ID 4513) was adopted as a 'base map' to inform field studies of vegetation extent and type within the subject site and representation of the extent within the region. Based on the results of the background review and the requirements of the BAM with respect to this BDAR, appropriate surveys were designed for the subject site.

The vegetation base map was used to guide a floristic assessment of the subject site. Supplementary iterations and amendments were made to the base map throughout the fieldwork period, in accordance with Section 5.2 of the BAM, via hand-held GPS units and aerial photo interpretation. Iterations to the base map were based on observation of broad vegetation composition, landform, physiography and on quantitative data collection through identification of all plants encountered to the species level.

The vegetation types observed were compared to the base map and cross-referenced with the community profile descriptors (and diagnostic species tests) held within the BioNet VIS Database (OEH 2018h) with an assessment of consistency being conducted. Details of the most consistent PCTs selected are detailed in Section 5.2 below.

5.2 PCT'S IDENTIFIED WITHIN THE STUDY AREA

Two Plant Community Types (PCT) were determined to be present within the study area, being:

- PCT 1648 - Smooth-barked Apple - Blackbutt heathy open forest of the Tomaree Peninsula;
- PCT 1204 - Spinifex beach strand grassland, Sydney Basin Bioregion and South East Corner Bioregion

5.3 PCT'S IDENTIFIED WITHIN THE SUBJECT SITE

A comprehensive description of the two PCTs present within the subject site is provided within Table 5.1. A full list of the flora species recorded during the fieldwork is listed in Appendix C.

Table 5.1: Details of PCT 1648

Smooth-barked Apple Blackbutt heathy open Forest of the Tomaree Peninsula	
PCT No.	1648
PCT Name	Smooth-barked Apple Blackbutt heathy open Forest of the Tomaree Peninsula
Vegetation Formation	Dry Sclerophyll Forests (Shrubby sub-formation)
Vegetation Class	Coastal Dune Dry Sclerophyll Forests
Extent within study area	11.17 ha comprises all treed vegetation and derived native grassland within the study area
Associated Species* *The associated species which occurred within the subject site and informed assignment of this PCT have been made bold.	***Angophora costata**, Corymbia gummifera, **Eucalyptus pilularis** / **Banksia serrata**, Acacia terminalis, **Bossiaea rhombifolia**, **Dillwynia retorta**, Eriostemon australasius, **Acacia suaveolens**, **Ricinocarpus pinifolius**, **Acacia ulicifolia, Persoonia levis / Themeda australis**, Leucopogon ericoides, Tetratheca ericifolia, Hypolaena fastigiata, **Pteridium esculentum**, Epacris pulchella* *The associated species above which occurred within the study area and informed assignment of this PCT have been made bold
Justification of PCT	The PCT assigned to this forest assemblage was initially determined by entering dominant canopy species and the IBRA bioregion into the BioNet vegetation classification database, a shortlist of two PCTs was collected that were considered to have potential to occur within the locality, these were: • PCT 1646 - Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast; • PCT 1648 - Smooth-barked Apple - Blackbutt heathy open forest of the Tomaree Peninsula The short list of PCTs above were cross referenced with the floristic inventory collected for the study area. It was found that both PCTs were largely consistent with the flora inventory taken within the site. However, despite PCT 1648 not occurring on the Tomaree Peninsula it had diagnostic flora species within the middle and lower stratum such as *Eriostemon australasius* which were not diagnostic within PCT 1646. As such PCT 1648 was chosen as the most consistent PCT prescriptive of the study area.
TEC Status	This PCT can form part of the TEC River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions, which is listed as Endangered under Schedule 2 of the BC Act. No occurrence of this PCT within the study area was situated within a floodplain, thus this PCT was not found to be consistent with this TEC.
Estimate of % Cleared	57%

Table 5.2: Details of PCT 1204

Spinifex beach strand grassland, Sydney Basin Bioregion and South East Corner Bioregion (PCT 1204)	
PCT No.	1204
PCT Name	Spinifex beach strand grassland, Sydney Basin Bioregion and South East Corner Bioregion
Vegetation Formation	Grasslands
Vegetation Class	Maritime Grasslands
Extent within study area	0.06 ha
Typically, Associated Species	***Spinifex sericeus****; Austrofestuca littoralis; Carpobrotus glaucescens; Calystegia soldanella; Actites megalocarpa; Isolepis nodosa* *The associated species above which occurred within the study area and informed assignment of this PCT have been made bold.
Justification of PCT	The transgressive sand dunes within the south of the study area were predominately absent of vegetation. Discrete occurrences of *Chrysanthemoides monilifera* subsp. *monilifera* (Bitou bush) thickets and small patches of homogenous *Spinifex sericeus* (hairy spinifex) grassland were present on the top of the dune. The PCT assigned to the patches of homogenous hairy spinifex grassland was initially determined by entering this species and the IBRA bioregion into the BioNet vegetation classification database, a single PCTs within the North Coast IBRA bioregion was listed which contains hairy spinifex, this was: • PCT 1272 - *Themeda australis* sod tussock grassland of coastal areas of the NSW North Coast Bioregion As this PCT is not consistent with transgressive sand dunes it was discounted as being consistent with the vegetation present. A new search was conducted not applying a location setting within an IBRA Bioregion. This search produced a shortlist of six PCTs which had a vegetation class of maritime grasslands, these were • PCT 779 - Coastal dune swale wetland at Cape Howe, far southern South East Corner Bioregion • PCT 1204 - Spinifex beach strand grassland, Sydney Basin Bioregion and South East Corner Bioregion • PCT 897 - Kangaroo Grass sod tussock grassland of coastal areas of the Sydney Basin Bioregion • PCT 898 - Kangaroo Grass sod tussock grassland of coastal areas of the Sydney Basin Bioregion and South East Corner Bioregion • PCT 1697 - Kangaroo Grass - Coastal Rosemary grassland on coastal headlands The short list of PCTs above were cross referenced with typically associated landscapes, soil types and their distribution within NSW. Of the PCTs shortlisted, PCT 1648, was the most likely to occur on an underlying soil type of transgressive sand dunes. As such, it was selected as the most appropriate PCT.
TEC Status	This PCT is not likely to form part of a TEC
Estimate of % Cleared	38%

6.0 VEGETATION ZONES

This Section describes the attribution of vegetation zones to the PCT identified within Section 5.0 of this report. Designation of vegetation zones was undertaken accordance with the methodology for vegetation integrity assessment outlined within Section 5.3 of the BAM (OEH, 2017).

6.1 VEGETATION ZONES ASSESSMENT METHOD

Detailed floristic surveys were undertaken on 29 March and 23 and 25 May, 2018. This survey included the establishment of vegetation integrity plots across the study area. The survey effort (number of vegetation integrity plots established, per vegetation zone) was undertaken in accordance with Table 2 in the BAM (OEH, 2017). Data on the composition, structure and function of the vegetation was collected utilising the methodology presented in the (BAM, 2017) by persons trained in the BAM and under the direction of persons accredited under the BAM. The field data collected during the vegetation integrity assessment can be found in Appendix C.

Two PCTs were identified in the study area. Each PCT was considered in terms of if they should be further stratified into separate vegetation zones on the basis of current condition state / management or other environmental variables. The random meander, overview inspection and detailed floristic plots have been used to inform the stratification of PCTs into vegetation zones.

Updated random meander surveys were undertaken on 13, 15 and 21 January 2020 and the vegetation map were updated accordingly.

Only PCT 1648 was stratified, on the basis of the broad presence/absence of key strata over the study area, these vegetation zones were attributed with a vegetation zone ID, which are

- 1648_Intact
- 1648_Modified Understorey
- 1648_DNG

The other PCT present, PCT 1204, was considered to be homogenous within its occurrence on the study area and well represented by the plot data. As such this PCT was attributed with a single vegetation zone ID, which was

- 1204_Sparse

An aerial photo showing the extent of the four Vegetation Zones present within the study area, the intersection of vegetation zones with the proposed developments project components and the location of the vegetation integrity plots is shown in Figure 6.1. Polygons of vegetation zone extent and internal ecotone boundaries were mapped in accordance with Subsection 5.3.1 of the BAM, using a combination of field observations and aerial imagery interpretation at a minimum scale of 1:10,000. Table 6.1 provides details of the vegetation zones within the study area. The plot data from the vegetation integrity survey plots were entered into the BAM credit calculator (BAM-CC). The results from the vegetation integrity assessment are provided in Table 6.2.

A4 Scale	1:10000

Disclaimer: While all reasonable care has been taken to ensure the information contained on this map is up to date and accurate, no guarentee is given that the information protrayed is free from error or omission. In addition the spatial accuracy of the map is wholly dependant on source data. Please verify the accuracy of all information prior to use. Development footprint areas should be used for indicative areas only.

Map Projection GDA94 MGA Zone 56

Figure 6.1

Vegetation Zones

Nelson Bay Road
Anna Bay, NSW

January 2020

WILDTHING Environmental Consultants
(a Division of Tattersall Lander Pty Ltd)
ABN 41 003 509 215

6.2 PATCH SIZE

Patch size is defined in the BAM (OEH, 2017) as an area of intact native vegetation that:

- *occurs on the study area or biodiversity stewardship site, and*
- *includes native vegetation that has a gap of less than 100m from the next area of moderate to good condition vegetation (or ≤30m for non woody ecosystems). Patch size may extend into adjoining land that is not part of the study area or biodiversity stewardship site.*

The BAM (OEH, 2017) defines 'intact native vegetation' as:

- *Intact vegetation: vegetation where all tree, shrub, grass and/or forb structural growth form groups expected for a plant community type are present.*

As described in Section 6.1 above PCT 1648 was stratified broadly into three condition classes by the absence of key structural layers, which are:

- 1648_Intact
- 1648_Modified Understorey
- 1648_DNG

All of the above vegetation zones contained all growth form groups expected for the PCT 1648, even if severely reduced from disturbance in the case of 1648_Modified Understorey and 1648_DNG. As such all of the above vegetation zones would be considered intact native vegetation in accordance with the definitions provided in the BAM methodology.

The above-mentioned vegetation zones were connected to a large area of coastal forest running parallel to Stockton Bight, namely Woromi National Park extending across an area of approximately 2500 ha. Therefore, each of the Vegetation Zones above have been attributed with a patch size class of ≥100ha.

PCT 1204, was attributed with a single vegetation zone ID, which was

- 1204_Sparse

This vegetation zone was found to be comprised of sparse occurrences of a single native species, hairy spinifex. This vegetation zone does not meet the definition of intact native vegetation listed within the BAM as it was missing key structural growth form groups expected for this PCT. As such, this vegetation zone has been attributed with a patch size class of >100ha.

Table 6.1: Details of Vegetation Zones within the Study Area

PCT ID	PCT Name	Vegetation Zone ID/Condition	No. of Vegetation Integrity Plots Established	Area Total (ha)	Patch Size (ha)	Example of Vegetation Zone
1648	Smooth-barked Apple - Blackbutt heathy open forest of the Tomaree Peninsula	**1648_Intact** This vegetation zone was dominated by the canopy species *Eucalyptus pilularis* (Blackbutt) and *Angophora costata* (Smooth-barked Apple). The mid-storey was dominated by *Banksia serrata* (Old Man Banksia) as well as *Pittosporum undulatum* (Sweet Pittosporum) and *Glochidion ferdinandi* (Cheese Tree). The understorey of this community was moderately intact; however, it was evident that some areas had been underscrubbed in the past and this community was in a stage of recovery post-disturbance. This vegetation zone had an intact understorey.	2	6.11	>100	

PCT ID	PCT Name	Vegetation Zone ID/Condition	No. of Vegetation Integrity Plots Established	Area Total (ha)	Patch Size (ha)	Example of Vegetation Zone
1648	Smooth-barked Apple - Blackbutt heathy open forest of the Tomaree Peninsula	**1648_Modified Understorey** This zone had a species assemblage consistent with vegetation zone 1648_Intact. However, the midstorey and understorey for this community was severely reduced after recent disturbance in the form of under scrubbing and also had a far reduced abundance of less mature canopy trees, which are likely to have been removed during under scrubbing.	3	4.07	>100	

PCT ID	PCT Name	Vegetation Zone ID/Condition	No. of Vegetation Integrity Plots Established	Area Total (ha)	Patch Size (ha)	Example of Vegetation Zone
1648	Smooth-barked Apple - Blackbutt heathy open forest of the Tomaree Peninsula	**1648_DNG** This vegetation zone was located within the Ausgrid electrical easement in the south of the study area and along a maintained access track in the east of the study area. This easement area had been previously cleared of trees and shrubs and is maintained as a lower ground cover. Common ground cover species within this community were *Themeda triandra* (Kangaroo Grass), *Imperata cylindrica* var. *major* (Blady Grass), *Cymbopogon refractus* (Barbed Wire Grass) and *Pteridium esculentum* (Bracken Fern). Several native shrub species were present within this community including *Acacia suaveolens* (Sweet Wattle), *Pimelea linifolia* (Rice Flower) and *Bossiaea rhombifolia* as well as sapling *Eucalyptus pilularis* (Blackbutt), *Angophora costata* (Smooth-barked Apple) and *Banksia serrata* (Old Man Banksia).	2	0.99	>100	

PCT ID	PCT Name	Vegetation Zone ID/Condition	No. of Vegetation Integrity Plots Established	Area Total (ha)	Patch Size (ha)	Example of Vegetation Zone
1204	Spinifex beach strand grassland, Sydney Basin Bioregion and South East Corner Bioregion	**1204_Sparse** This vegetation zone was located on the sand dune incursion within the south of the study area. Vegetation within this area was very sparsely distributed, with only small patches containing *Spinifex sericeus* (Coastal Spinifex) as well as the introduced *Chrysanthemoides monilifera* subsp. *monilifera* (Bitou Bush), *Cakile edentula* (American Sea Rocket) and *Hydrocotyle bonariensis* (Kurnell Curse).	1	0.06	>100	

Table 6.2: Vegetation integrity Scores

Vegetation Integrity Plot ID	Vegetation Zone ID	Composition Score	Structure Score	Function Score	Vegetation Integrity Score
BPBE3	1648_Intact	**62.7**	**64**	**60.8**	**62.5**
BPBE5					
BPBH2					
BPBE1	1648_Modified Understorey	**63.9**	**34.7**	**79.5**	**56.1**
BPBE2					
BPDH1	1648_DNG	**52.5**	**25.3**	**22.8**	**31.2**
BPBE6					
BPBE4	1204_Sparse	**2**	**0.2**	**N/A[1]**	**0.6**
[1] Function scores are not assessable for Vegetation Zones which are consistent with a vegetation formation of grasslands					

6.3 EXCLUSION OF VEGETATION ZONES FROM FURTHER ASSESSMENT

As outlined in Section 3.1.1.3 of the BAM if a vegetation zone has a vegetation integrity score of:

- *<15 where the PCT is representative of an endangered or critically endangered ecological community, or*
- *<17 where the PCT is associated with threatened species habitat (as represented by ecosystem credits), or is representative of a vulnerable ecological community.*
- *<20 where the PCT is not representative of a TEC or associated with threatened species habitat.*

then for that vegetation zone

- *assessment of native vegetation is not required beyond Section 5.4* (determining vegetation integrity score), and
- *an assessment of threatened species habitat according to Section 6.2 and Paragraph 6.2.1.4* (Assessing habitat suitability for species that can be predicted by habitat surrogates (ecosystem credits)) *is not required.*

Vegetation zone 1204_Sparse is not a TEC, however it is associated with some threatened species habitat. As such, with a vegetation integrity score of 0.6 (i.e. ≤17), further assessment of habitat suitability for ecosystem credit species associated with this vegetation zone within Section 7.0 of this report is not required.

7.0 ECOSYSTEM CREDIT SPECIES

This Section identifies and assesses the suitability of habitat constraints within the subject site for ecosystem credit species. Ecosystem credit species are threatened species where the likelihood of occurrence of a species or elements of the species' habitat can be predicted by habitat surrogates and landscape features, or for which targeted survey has a low probability of detection. Targeted survey is not required for these species.

Ecosystem credit species are pre-determined by OEH in the BAM-CC (OEH, 2018g) based on the data collected and displayed in Section 3.6 of this report.

The BAM methodology defines a two-step process of habitat suitability assessment for ecosystem credit species, these are:

1) identify ecosystem credit species for assessment; and
2) assessment the habitat constraints and vagrant species on the subject land

These steps have been carried out in the following Sections.

7.1 ECOSYSTEM CREDIT SPECIES FOR ASSESSMENT (STEP 1)

A total of 32 ecosystem credit species have been generated from the BAM-CC (OEH 2018) as requiring assessment and are listed in Table 7.1. Relevant databases and literature were reviewed (See Table 1.1) for additional ecosystem credit species for assessment. Three additional ecosystem credit species were added for assessment, namely *Ephippiorhynchus asiaticus* (Black-necked Stork), *Tyto longimembris* (Eastern Grass Owl) and *Pseudomys novaehollandiae* (New Holland Mouse). Of the species in Table 7.1, 21 have been recorded within a 10km radius of the study area. Four ecosystem credit species for assessment have been recorded within the study area, namely *Haliaeetus leucogaster* (White-bellied Sea-Eagle), *Falsistrellus tasmaniensis* (Eastern False Pipistrelle, *Miniopterus australis* (Little Bentwing-bat) and *Scoteanax rueppellii* (Greater Broad-nosed Bat).

Table 7.1: Ecosystem Credit Species for Assessment

Scientific Name	Common Name	Conservation Status[1]		BAM-CC Vegetation Association or Recorded Database
		BC Act	EPBC Act	
Callocephalon fimbriatum	Gang-gang Cockatoo (Foraging)	V	E	PCT_1648
Calyptorhynchus lathami[2]	Glossy Black-Cockatoo (Foraging)	V		PCT_1648
Ephippiorhynchus asiaticus	Black-necked Stork	E		BioNet
Tyto longimembris	Eastern Grass Owl	V		BioNet
Pseudomys novaehollandiae	New Holland Mouse		V	BioNet
Daphoenositta chrysoptera	Varied Sittella	V		PCT_1648
Dasyurus maculatus	Spotted-tailed Quoll	V	E	PCT_1648

Scientific Name	Common Name	Conservation Status[1]		BAM-CC Vegetation Association or Recorded Database
		BC Act	EPBC Act	
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V		PCT_1648
Glossopsitta pusilla	Little Lorikeet	V		PCT_1648
Haliaeetus leucogaster	White-bellied Sea-Eagle (Foraging)	V		PCT_1648
Hieraaetus morphnoides	Little Eagle (Foraging)	V		PCT_1648
Kerivoula papuensis	Golden-tipped Bat	V		PCT_1648
Lathamus discolor	Swift Parrot (Foraging)	E	CE	PCT_1648
Lophoictinia isura	Square-tailed Kite (Foraging)	V		PCT_1648
Melithreptus gularis gularis	Black-chinned Honeyeater (eastern subspecies)	V		PCT_1648
Miniopterus australis	Little Bentwing-bat (Foraging)	V		PCT_1648
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat (Foraging)	V		PCT_1648
Mormopterus norfolkensis	Eastern Freetail-bat	V		PCT_1648
Neophema pulchella	Turquoise Parrot	V		PCT_1648
Ninox connivens	Barking Owl (Foraging)	V		PCT_1648
Ninox strenua	Powerful Owl (Foraging)	V		PCT_1648
Pandion cristatus	Eastern Osprey (Foraging)	V		PCT_1648
Petaurus australis	Yellow-bellied Glider	V		PCT_1648
Phascolarctos cinereus	Koala (Foraging)	V	V	PCT_1648
Pomatostomus temporalis temporalis	Grey-crowned Babbler (eastern subspecies)	V		PCT_1648
Pseudomys gracilicaudatus	Eastern Chestnut Mouse	V		PCT_1648
Pteropus poliocephalus	Grey-headed Flying-fox (Foraging)	V		PCT_1648
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V		PCT_1648
Scoteanax rueppellii	Greater Broad-nosed Bat	V		PCT_1648
Sternula albifrons	Little Tern (Foraging)	E		PCT_1648
Syconycteris australis	Common Blossom-bat	V		PCT_1648
Tyto novaehollandiae	Masked Owl (Foraging)	V		PCT_1648

Legend E=Endangered Species
V=Vulnerable Species
CE=Critically Endangered
* Cells highlighted blue indicate species has been previously recorded as occurring within a 10km radius of the study area within databases reviewed within Section 1.3 of this report.

7.2 ECOSYSTEM CREDIT SPECIES ASSESSMENT (STEP 2)

Under this step of the BAM the assessor may opt to undertake an additional assessment of the habitat constraints on the subject land for the ecosystem credit species predicted by the BAM-CC. All species that were associated with PCT_1648 were assumed to occur and generate ecosystem credits. As stated within Section 6.2 of this report, all ecosystem credit species associated with PCT 1204 were excluded assessment and credit generation as all consistent vegetation zones within the study area had a vegetation integrity score of <17.

8.0 SPECIES CREDIT SPECIES

This Section identifies and assesses the suitability of habitat present within the subject site for species credit species. Species credit species are threatened species where the likelihood of occurrence of a species or elements of suitable habitat for the species cannot be confidently predicted by vegetation surrogates and landscape features and can be reliably detected by survey. Targeted survey is required for these species which are not excluded from assessment in Section 8.2.

Species credit species are pre-determined by the BAM-CC based on the data collected and displayed in Section 3.6 of this report. The residual impact on the species' habitat from development, clearing is measured in biodiversity credits using the vegetation integrity score for each vegetation zone.

The BAM assessment defines a six-step process for identifying habitat suitability for species credit species, this is:

1) identify species credit species for assessment,
2) assess the habitat constraints for species credit species on the Subject land,
3) identify candidate species credit species for further assessment,
4) determine presence or absence of a candidate species credit species,
5) determine the area or count, and location of suitable habitat for a species credit species; and
6) determine the habitat condition within the species polygon for species assessed by area.

These steps have been carried out in Sections 8.1- 8.7 below.

8.1 SPECIES CREDIT SPECIES FOR ASSESSMENT (STEP 1)

A total of 50 species credit species have been generated from the BAM-CC (OEH, 2018) as requiring assessment and are listed in Table 8.1. Relevant databases and literature were reviewed (See Table 1.1) for additional species credit species for assessment, three additional species credit species were added for assessment, namely *Petalura gigantea* (Giant Dragonfly), *Haematopus fuliginosus* (Sooty Oystercatcher) and *Syzygium paniculatum* (Magenta Lilly Pilly).

Of the species in Table 8.1, 33 have been recorded within a 10km radius of the study area. Three species credit species for assessment have been recorded within the study area, namely *Diuris praecox* (Rough Doubletail), *Haliaeetus leucogaster* (White-bellied Sea-Eagle), *Miniopterus australis* (Little Bentwing-bat), accordingly these species were given a higher level of examination within steps 2-6 below.

Table 8.1: Species Credit Species for Assessment

Scientific Name	Common Name	Conservation Status[1]		Serious and Irreversible Impact Entity (SAII)
		BC Act	EPBC Act	
Angophora inopina	Charmhaven Apple	V	V	No
Burhinus grallarius	Bush Stone-curlew	E		No
Callistemon linearifolius	Netted Bottle Brush	V		No
Callocephalon fimbriatum	Gang-gang Cockatoo (Breeding)	V		No
Calyptorhynchus lathami	Glossy Black-Cockatoo (Breeding)	V		No
Petalura gigantea	Giant Dragonfly	E		Yes
Haematopus fuliginosus	Sooty Oystercatcher	V		No
Syzygium paniculatum	Magenta Lilly Pilly	E	V	No
Cercartetus nanus	Eastern Pygmy-possum	V		No
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	Yes
Chamaesyce psammogeton	Sand Spurge	E		No
Corybas dowlingii	Red Helmet Orchid	E		No
Crinia tinnula	Wallum Froglet	V		No
Cryptostylis hunteriana	Leafless Tongue Orchid	V	V	No
Diuris arenaria	Sand Doubletail	E		Yes
Diuris praecox	Rough Doubletail	V	V	No
Dromaius novaehollandiae - endangered population	Emu population in the New South Wales North Coast Bioregion and Port Stephens local government area	E1		No
Esacus magnirostris	Beach Stone-curlew (Breeding)	CE		Yes Mapped important areas - contact OEH for maps
Eucalyptus camfieldii	Camfield's Stringybark	V	V	No
Eucalyptus parramattensis subsp. decadens		V	V	No
Haematopus longirostris	Pied Oystercatcher	E		No
Haliaeetus leucogaster	White-bellied Sea-Eagle (Breeding)	V		No
Hieraaetus morphnoides	Little Eagle (Breeding)	V		No
Hoplocephalus bitorquatus	Pale-headed Snake	V		No
Lathamus discolor	Swift Parrot (Breeding)	E	CE	Yes Mapped important areas - contact OEH for maps
Litoria brevipalmata	Green-thighed Frog	V		No
Lophoictinia isura	Square-tailed Kite (Breeding)	V		No
Melaleuca groveana	Grove's Paperbark	V		No

Scientific Name	Common Name	Conservation Status[1]		Serious and Irreversible Impact Entity (SAII)
		BC Act	EPBC Act	
Miniopterus australis	Little Bentwing-bat (Breeding)	V		Yes No threshold or spatial data provided
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat (Breeding)	V		Yes No threshold or spatial data provided
Myotis macropus	Southern Myotis	V		No
Ninox connivens	Barking Owl (Breeding)	V		No
Ninox strenua	Powerful Owl (Breeding)	V		No
Pandion cristatus	Eastern Osprey (Breeding)	V		No
Petaurus norfolcensis	Squirrel Glider	V		No
Petrogale penicillata	Brush-tailed Rock-wallaby	E	V	Yes No threshold or spatial data provided
Phascogale tapoatafa	Brush-tailed Phascogale	V		No
Phascolarctos cinereus	Koala (Breeding)	V	V	No
Phascolarctos cinereus - endangered population	Koala, Hawks Nest and Tea Gardens population	E1		No
Planigale maculata	Common Planigale	V		No
Prostanthera densa	Villous Mint-bush	V	V	No
Pteropus poliocephalus	Grey-headed Flying-fox (Breeding)	V	V	No
Rhizanthella slateri	Eastern Australian Underground Orchid	V	E	Yes No threshold or spatial data provided
Sternula albifrons	Little Tern (Breeding)	E		No
Tetratheca juncea	Black-eyed Susan	V	V	No
Tyto novaehollandiae	Masked Owl (Breeding)	V		No
Uperoleia mahonyi	Mahony's Toadlet	E		No
Vespadelus troughtoni	Eastern Cave Bat	V		Yes No threshold or spatial data provided
Xenus cinereus	Terek Sandpiper (Breeding)	V		No

Legend E=Endangered Species
E1=Endangered Population
V=Vulnerable Species
CE=Critically Endangered

* Cells highlighted blue indicate species has been previously recorded as occurring within a 10km radius of the study area within databases reviewed within Section 1.3 of this report.

8.2 ASSESSMENT OF HABITAT CONSTRAINTS FOR SPECIES CREDIT SPECIES (STEP 2)

For the species credit species predicted to occur in Step 1, for which habitat constraints are listed, an assessment was undertaken for the presence of the habitat constraints within the study area. Habitat constraints for species credit species are identified in the BAM-CC and the Threatened Species Biodiversity Data Collection. The absence of habitat constraints for species credit species precludes the species from requiring further assessment in Steps 3-6. This assessment is not applicable to a species where no habitat constraints are listed in the BAM-CC and TBDC, e.g. threatened flora.

The methodology for the habitat constraints survey is provided below in Section 8.3. The results of the habitat constraints survey and an evaluation of species credit species for further assessment is provided in Table 8.2.

8.3 METHODOLOGY FOR DETERMINING HABITAT CONSTRAINTS

Significant Tree Inventory

A significant tree inventory was conducted by Wildthing Environmental Consultants over the entire study area. The survey identified the presence of any significant habitat attributes or characteristics within all trees present within the study area, this included the following:

- tree species, height, diameter at breast height (dbh) and location (taken on a handheld GPS),
- the size and number of any hollows, woodland bird nests or eyries present*,
- the presence or evidence of any breeding camps of megachiropteran bats,
- the presence of scansorial (climbing) mammal evidence in the form of scratches, scats on the trunks of trees and scats around the base; and
- the presence of any resting arboreal mammals, i.e. Koala

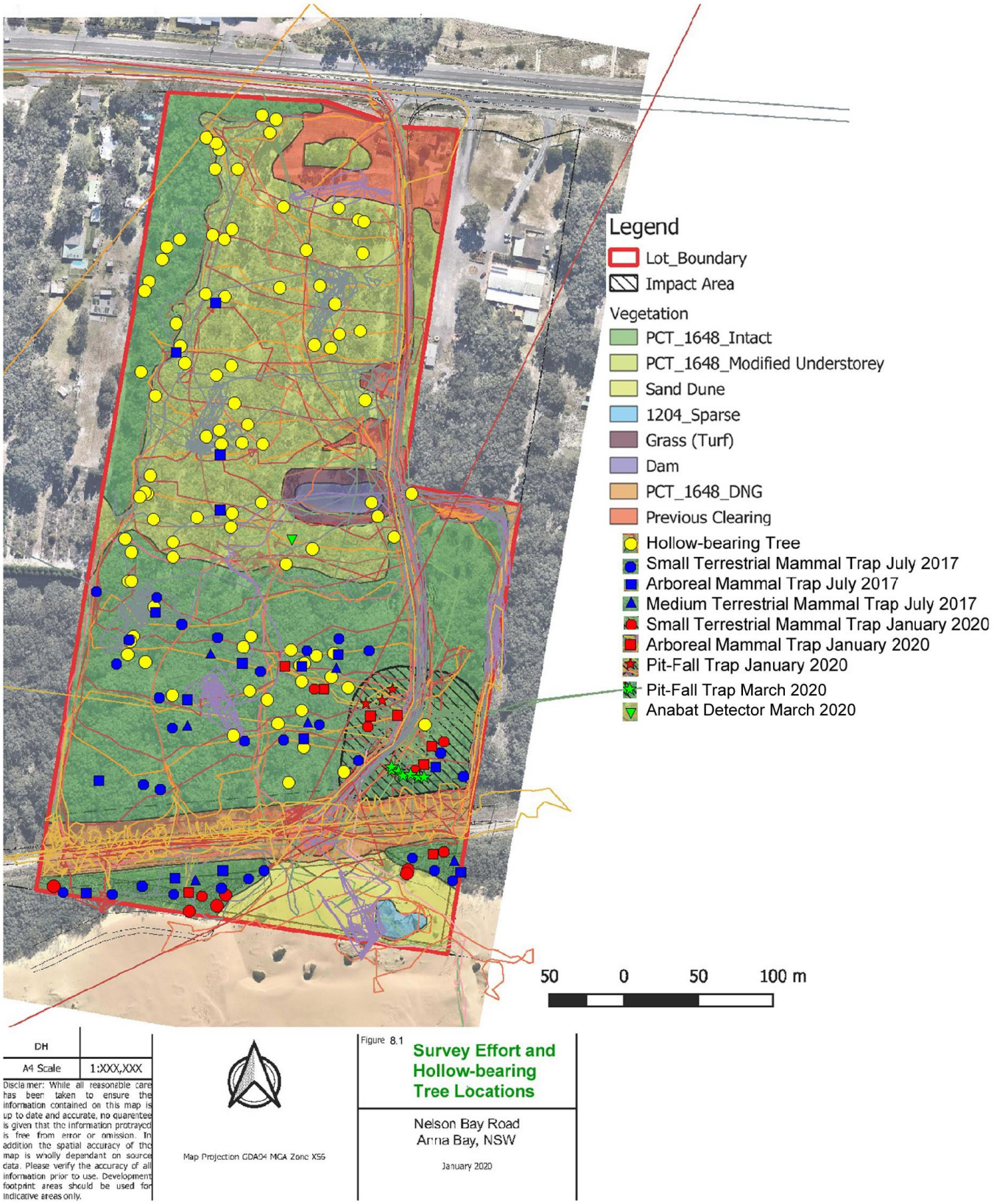
A map of recorded significant trees is provided in Figure 8.1.

Searches for Fallen/Standing Dead Timber

The presence of fallen and standing dead timber within each vegetation zone was qualitatively assessed for its potential to provide significant refuge resources to ground dwelling mammals, birds amphibians and reptiles.

Searches for Significant Geological Features and Suitable Artificial Structures

The presence of significant geological features and/or suitable artificial structures within each vegetation zone was qualitatively assessed for its potential to provide significant refuge resources to saxicolous (rock dwelling) and cave dwelling fauna such as microchiropteran bats, reptiles and some marsupials.


Legend
Lot_Boundary
Impact Area
Vegetation
PCT_1648_Intact
PCT_1648_Modified Understorey
Sand Dune
1204_Sparse
Grass (Turf)
Dam
PCT_1648_DNG
Previous Clearing
Hollow-bearing Tree
Small Terrestrial Mammal Trap July 2017
Arboreal Mammal Trap July 2017
Medium Terrestrial Mammal Trap July 2017
Small Terrestrial Mammal Trap January 2020
Arboreal Mammal Trap January 2020
Pit-Fall Trap January 2020
Pit-Fall Trap March 2020
Anabat Detector March 2020
50 0 50 100 m
DH
A4 Scale 1:XXX,XXX
Disclaimer: While all reasonable care has been taken to ensure the information contained on this map is up to date and accurate, no guarantee is given that the information protrayed is free from error or omission. In addition the spatial accuracy of the map is wholly dependant on source data. Please verify the accuracy of all information prior to use. Development footprint areas should be used for indicative areas only.
Map Projection GDA94 MGA Zone 56
Figure 8.1
Survey Effort and Hollow-bearing Tree Locations
Nelson Bay Road
Anna Bay, NSW
January 2020

Searches for Habitat Constraints within the Landscape

The occurrence of some species credit species can be defined by the presence of specific habitat constraints within the greater landscape outside of the confines of the study area. These species credit species are generally highly mobile species with a large range/territory i.e. Microchiropteran bats (microbats), woodland birds and some terrestrial mammals.

Information collected in Section 3.6 has been used to inform the likely presence/absence of habitat constraints within the landscape, with justification of the determination reached provided in Table 8.2. Where the presence/absence of habitat features within the locality could not be determined with a high level of confidence or justified from desktop assessment resources a conservative approach has been used and the habitat constraint has been assumed present within the landscape.

Mapped Breeding Habitat

For a small number of species, a habitat constraint may refer to a mapped location. Mapped locations identify areas that are considered important for the species (e.g. breeding areas or sites where multiple records have been located over multiple years). As defined in Section 6.4 of the BAM, if the study area is in a mapped location for a species, no targeted survey or further assessment is required (unless otherwise indicated in the TBDC); the species is considered to be present and the area of the subject land within the mapped location forms the species polygon used to generate species credits. Any remaining habitat on the subject land (e.g. foraging, unmapped locations) used by these species is assessed for ecosystem credits.

At the time of preparing this report, mapped breeding habitat for Little Tern and Terek Sandpiper had not been made publicly available by OEH. As such, provision of appropriate local knowledge in accordance with Section 2.2.2.1 of the BAM was undertaken. It was determined that “the Little Tern has never been recorded breeding north of the Sygna Shipwreck (Geographic Coordinates, Latitude - 32.858833 Longitude - 151.84394) and that the Terek Sandpiper has never been known to breed on or near to Stockton Sand Dunes” (*Pers. comm* Warren Mayers, National Parks and Wildlife Service, Nelson Bay, 06 June, 2018).

Table 8.2: Assessment of Habitat Constraints for Species Credit Species

Scientific Name	Common Name	Habitat Constraint Category	Habitat Constraint Description	Habitat Constraint or geographic limitation represented within the study area	Justification
Angophora inopina	Charmhaven Apple	Geographic	- South of Wootton (OEH 2018d)	Yes	The study area falls within the geographic restriction for this species.
Burhinus grallarius	Bush Stone-curlew	Other	- Fallen/standing dead timber including logs (OEH, 2018d)	Yes	The study area contains this feature.
Callistemon linearifolius	Netted Bottle Brush	N/A	N/A	N/A	This species has no defined habitat constraint and thus requires further assessment.
Callocephalon fimbriatum	Gang-gang Cockatoo (Breeding)	Hollow bearing trees	Eucalypt tree species with hollows greater than 9 cm diameter (OEH, 2018g)	Yes	The study area contains this habitat constraint.
Petalura gigantea	Giant Dragonfly	Other	Within 500 m of swamps (OEH, 2018g)	No	The study area is not within 500m of this habitat constraint.
Haematopus fuliginosus	Sooty Oystercatcher	Other	Within 100m of estuarine areas and the ocean (OEH, 2018g)	No	The study area is not within 100m of this habitat constraint.
Syzygium paniculatum	Magenta Lilly Pilly	N/A	N/A	N/A	This species has no defined habitat constraint and thus requires further assessment.
Calyptorhynchus lathami	Glossy Black-Cockatoo (Breeding)	Hollow bearing trees	Living or dead tree with hollows greater than 15cm diameter and greater than 5m above ground. (OEH, 2018g)	Yes	The study area contains this habitat constraint.
Cercartetus nanus	Eastern Pygmy-possum	N/A	N/A	N/A	This species has no defined habitat constraint and thus requires further assessment.
Chalinolobus dwyeri	Large-eared Pied Bat	Cliffs	Within two kilometres of rocky areas containing caves, overhangs, escarpments, outcrops, or crevices, or within two kilometres of old mines or tunnels (OEH, 2018d)	No	A desktop evaluation of the landscape and geological mapping for the region indicates that the geology within 2km of the study area would not be support the formation of significant caves, overhangs, escarpments, outcrops, or crevices nor likely to have been historically mined.

Scientific Name	Common Name	Habitat Constraint Category	Habitat Constraint Description	Habitat Constraint or geographic limitation represented within the study area	Justification
Chamaesyce psammogeton	Sand Spurge	Dunes	Fore-dunes or exposed headlands (OEH, 2018d)	Yes	The study area contains this feature.
Corybas dowlingii	Red Helmet Orchid	N/A	N/A	N/A	This species has no defined habitat constraint and thus requires further assessment.
Crinia tinnula	Wallum Froglet	N/A	N/A	N/A	This species has no defined habitat constraint and thus requires further assessment.
Cryptostylis hunteriana	Leafless Tongue Orchid	N/A	N/A	N/A	This species has no defined habitat constraint and thus requires further assessment.
Diuris arenaria	Sand Doubletail	Geographic	South of Soldiers Point (OEH, 2018d)	Yes	The study area falls within the geographic restriction for this species.
Diuris praecox	Rough Doubletail	N/A	N/A	N/A	This species has no defined habitat constraint and thus requires further assessment.
Dromaius novaehollandiae - endangered population	Emu population in the New South Wales North Coast Bioregion and Port Stephens local government area	N/A	N/A	N/A	This species has no defined habitat constraint and thus requires further assessment.
Esacus magnirostris	Beach Stone-curlew (Breeding)	N/A	N/A	N/A	This species has no defined habitat constraint and thus requires further assessment.
Eucalyptus camfieldii	Camfield's Stringybark	N/A	N/A	N/A	This species has no defined habitat constraint and thus requires further assessment.
Eucalyptus parramattensis subsp. decadens		N/A	N/A	N/A	This species has no defined habitat constraint and thus requires further assessment.
Haematopus longirostris	Pied Oystercatcher	Other	Within 100m of estuarine areas and the ocean (OEH, 2018d)	No	The study area is not within 100m of this habitat constraint.
Haliaeetus leucogaster	White-bellied Sea-Eagle (Breeding)	Other	Living or dead mature trees within suitable vegetation within 1km of a rivers, lakes, large dams or creeks, wetlands and coastlines (OEH,	Yes	The study area contains this habitat constraint.

Scientific Name	Common Name	Habitat Constraint Category	Habitat Constraint Description	Habitat Constraint or geographic limitation represented within the study area	Justification
			2018g)		
Hieraaetus morphnoides	Little Eagle (Breeding)	Other	Nest trees live (occasionally dead) large old trees within vegetation. (OEH, 2018fd)	No	The study area did not contain any eyrie bearing trees.
Hoplocephalus bitorquatus	Pale-headed Snake	N/A	N/A	N/A	This species has no defined habitat constraint and thus requires further assessment.
Lathamus discolor	Swift Parrot (Breeding)	Other	As per mapped areas (OEH, 2018g)	No	All mapped breeding areas for this species are located in Tasmania.
Litoria brevipalmata	Green-thighed Frog	N/A	N/A	N/A	This species has no defined habitat constraint and thus requires further assessment.
Lophoictinia isura	Square-tailed Kite (Breeding)	Other	Nest trees (OEH, 2018g)	No	The study area did not contain any eyrie bearing trees.
Melaleuca groveana	Grove's Paperbark	N/A	N/A	N/A	This species has no defined habitat constraint and thus requires further assessment.
Miniopterus australis	Little Bentwing-bat (Breeding)	Caves	Cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding (OEH, 2018g)	No	This species has previously been recorded within the study area and was recorded within the study area during current surveys. The study area did not contain caves or any other structure which was likely to provide breeding habitat. As this species is a duel ecosystem/species credit species and as relevant habitat constraints are not present within the study area this species has been assessed as an ecosystem credit species only.

Scientific Name	Common Name	Habitat Constraint Category	Habitat Constraint Description	Habitat Constraint or geographic limitation represented within the study area	Justification
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat (Breeding)	Caves	Cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding (OEH, 2018g)	No	The study area did not contain caves or any other structure which was likely to provide breeding habitat.
Myotis macropus	Southern Myotis	Hollow bearing trees	Within 200 m of riparian zone/other Bridges, caves or artificial structures within 200 m of riparian zone (OEH, 2018g)	Yes	Appropriate hollow-bearing trees (within 200m of a riparian zone) were not present within the study area. A number of hollow bearing trees within the north of the study area were within 200m of mapped canal lines. A dam is also present within the site.
Ninox connivens	Barking Owl (Breeding)	Hollow bearing trees	Living or dead trees with hollows greater than 20 cm diameter and greater than 4m above the ground. (OEH, 2018g)	Yes	The study area contains this habitat constraint.
Ninox strenua	Powerful Owl (Breeding)	Hollow bearing trees	Living or dead trees with hollow greater than 20cm diameter (OEH, 2018g)	Yes	The study area contains this habitat constraint.
Pandion cristatus	Eastern Osprey (Breeding)	Other	Living and dead trees (>15m) or artificial structures within 100m of a floodplain for nesting. (OEH, 2018g)	Yes	The north of the study area contained trees greater than 15m in height and within 100m of a floodplain.
Petaurus norfolcensis	Squirrel Glider	N/A	N/A	N/A	This species has no defined habitat constraint and thus requires further assessment.
Petrogale penicillata	Brush-tailed Rock-wallaby	Other	Land within 1 km of rocky escarpments, gorges, steep slopes, boulder piles, rock outcrops or cliff lines (OEH, 2018d)	No	A desktop evaluation of the landscape and geological mapping for the region indicates that the geology within 1km of the study area would not be conducive to the formation of rocky escarpments, gorges, steep slopes, boulder piles, rock outcrops or cliff lines
Phascogale tapoatafa	Brush-tailed Phascogale	Hollow bearing trees	N/A	Yes	The study area contains this habitat constraint.

Scientific Name	Common Name	Habitat Constraint Category	Habitat Constraint Description	Habitat Constraint or geographic limitation represented within the study area	Justification
Phascolarctos cinereus	Koala (Breeding)	Other	Areas identified via survey as important habitat (see comments) Important' habitat is defined by the density of koalas and quality of habitat determined by on-study area survey - contact OEH for more information. (OEH, 2018g)	No	Clarification of what constitutes 'important Koala breeding habitat' had not been made publicly available by OEH at the time of writing this report. Due to the high amount of previous records for Koala within the Atlas BioNet database, a conservative approach was taken and this habitat constraint was assumed present.
Phascolarctos cinereus - endangered population	Koala, Hawks Nest and Tea Gardens population	Other	Areas identified via survey as important habitat (see comments) (OEH, 2018g) Important' habitat is defined by the density of koalas and quality of habitat determined by on-study area survey - contact OEH for more information. (OEH, 2018g)	No	Clarification of what constitutes 'important Koala breeding habitat' had not been made publicly available by OEH at the time of writing this report. Due to the high amount of records for Koala (including Koalas within this endangered population) within the Atlas BioNet database, a conservative approach was taken and this habitat constraint was assumed present.
Planigale maculata	Common Planigale	N/A	N/A	N/A	This species has no defined habitat constraint and thus requires further assessment.
Prostanthera densa	Villous Mint-bush	N/A	N/A	N/A	This species has no defined habitat constraint and thus requires further assessment.
Pteropus poliocephalus	Grey-headed Flying-fox (Breeding)	Other	Breeding camps (OEH, 2018g)	N/A	The study area did not contain any breeding camps of this species.
Rhizanthella slateri	Eastern Australian Underground Orchid	N/A	N/A	N/A	This species has no defined habitat constraint and thus requires further assessment.
Sternula albifrons	Little Tern (Breeding)	Other	As per mapped areas (OEH, 2018g)	No	At the time of preparing this report mapped breeding habitat for Little Tern has not been made publicly available by OEH. This habitat constraint was determined to be absent via provision of appropriate local knowledge.

Scientific Name	Common Name	Habitat Constraint Category	Habitat Constraint Description	Habitat Constraint or geographic limitation represented within the study area	Justification
Tetratheca juncea	Black-eyed Susan	N/A	N/A	N/A	This species has no defined habitat constraint and thus requires further assessment.
Tyto novaehollandiae	Masked Owl (Breeding)	Hollow bearing trees	Living or dead trees with hollows greater than 20cm diameter. (OEH ,2018g)	Yes	The study area contains this habitat constraint.
Uperoleia mahonyi	Mahony's Toadlet	N/A	N/A	N/A	This species has no defined habitat constraint and thus requires further assessment.
Vespadelus troughtoni	Eastern Cave Bat	Caves	- Within two kilometres of rocky areas containing caves, overhangs, escarpments, outcrops, crevices or boulder piles, or within two kilometres of old mines, tunnels, old buildings or sheds. (OEH, 2018d)	No	A desktop evaluation of the landscape and geological mapping for the region indicates that the geology within 2km of the study area would not be conducive to the formation of significant caves, overhangs, escarpments, outcrops, or crevices or likely to have been historically mined.
Xenus cinereus	Terek Sandpiper (Breeding)	Other	As per mapped areas (contact OEH for maps) (OEH, 2018d)	No	At the time of preparing this report mapped breeding habitat for Terek Sandpiper has not been made publicly available by OEH. This habitat constraint was determined to be absent via provision of appropriate local knowledge.

8.4 IDENTIFY CANDIDATE SPECIES CREDIT SPECIES FOR FURTHER ASSESSMENT (STEP 3)

After the habitat constraints assessment within Step 2 a list of candidate species credit species has been refined for further assessment. These candidate species credit species required targeted survey to confirm their presence/absence within the study area. Candidate species for further assessment are listed in Table 8.2.

Table 8.3: Candidate Species Credit Species

Scientific Name	Common Name	Biodiversity Risk Weighting	Survey Period	Assumed to occur/survey/expert report	Present on study area	Species polygon Area or Count
Angophora inopina	Charmhaven Apple	1	Any	Surveyed	No	N/A
Burhinus grallarius	Bush Stone-curlew	2	Any	Surveyed	No	Area Polygon
Callistemon linearifolius	Netted Bottle Brush	2	Oct -Jan	Surveyed	No	N/A
Callocephalon fimbriatum	Gang-gang Cockatoo (Breeding)	2	Oct-Jan	Surveyed	No	N/A
Syzygium paniculatum	Magenta Lilly Pilly	2	Any	Surveyed	No	N/A
Calyptorhynchus lathami	Glossy Black-Cockatoo (Breeding)	2	Mar-Aug	Surveyed	No	N/A
Cercartetus nanus	Eastern Pygmy-possum	2	Oct-Mar	Surveyed	No	N/A
Chamaesyce psammogeton	Sand Spurge	2	Any	Surveyed	No	N/A
Corybas dowlingii	Red Helmet Orchid	2	June-July	Surveyed	No	N/A
Crinia tinnula	Wallum Froglet	1.5	Any	Surveyed	No	N/A
Cryptostylis hunteriana	Leafless Tongue Orchid	2	Nov-Jan	Surveyed	No	N/A
Diuris arenaria	Sand Doubletail	3	Sept	Surveyed	No	N/A
Diuris praecox	Rough Doubletail	1.5	Aug	Surveyed	Yes	Area Polygon
Dromaius novaehollandiae - endangered population	Emu population in the New South Wales North Coast	2	Any	Surveyed	No	N/A

Scientific Name	Common Name	Biodiversity Risk Weighting	Survey Period	Assumed to occur/survey/expert report	Present on study area	Species polygon Area or Count
	Bioregion and Port Stephens local government area					
Esacus magnirostris	Beach Stone-curlew (Breeding)	2	Any	Surveyed	No	N/A
Eucalyptus camfieldii	Camfield's Stringybark	2	Any	Surveyed	No	N/A
Eucalyptus parramattensis subsp. decadens		2	Any	Surveyed	No	N/A
Haliaeetus leucogaster	White-bellied Sea-Eagle (Breeding)	2	Jul-Dec	Surveyed	No	N/A
Hieraaetus morphnoides	Little Eagle	1.5	Aug-Oct	Surveyed	No	N/A
Hoplocephalus bitorquatus	Pale-headed Snake	2	Nov-March	Surveyed	No	N/A
Litoria brevipalmata	Green-thighed Frog	1.5	Oct-Mar	Surveyed	No	N/A
Melaleuca groveana	Grove's Paperbark	2	Any	Surveyed	No	N/A
Myotis macropus	Southern Myotis	2	Oct-Mar	Surveyed	No	N/A
Ninox connivens	Barking Owl (Breeding)	2	May-Dec	Surveyed	No	N/A
Ninox strenua	Powerful Owl (Breeding)	2	May-Aug	Surveyed	No	N/A
Pandion cristatus	Eastern Osprey (Breeding)	1.5	April-Nov	Surveyed	No	N/A

Scientific Name	Common Name	Biodiversity Risk Weighting	Survey Period	Assumed to occur/survey/expert report	Present on study area	Species polygon Area or Count
Petaurus norfolcensis	Squirrel Glider	2	Any	Surveyed	No	N/A
Phascogale tapoatafa	Brush-tailed Phascogale	2	Any	Surveyed	No	N/A
Planigale maculata	Common Planigale	2	Any	Surveyed	No	N/A
Prostanthera densa	Villous Mint-bush	2	Any	Surveyed	No	N/A
Rhizanthella slateri	Eastern Australian Underground Orchid	3	Sept-Nov	Surveyed	No	N/A
Sternula albifrons	Little Tern	2	Sep-Mar	Surveyed	No	N/A
Tetratheca juncea	Black-eyed Susan	2	Sep-Oct	Surveyed	No	N/A
Tyto novaehollandiae	Masked Owl (Breeding)	2	May-August	Surveyed	No	N/A
Uperoleia mahonyi	Mahony's Toadlet	2	Oct-March	Surveyed	No	N/A

8.5 DETERMINE PRESENCE OR ABSENCE OF A CANDIDATE SPECIES CREDIT SPECIES (STEP 4)

Targeted surveys were undertaken over the period of March 2017 to March 2020 for the candidate species credit species above to determine their presence or absence within the study area. Surveys were conducted as per the optimum survey months defined within the BAM-CC (OEH, 2018g). Where relevant guidelines were available, targeted surveys were conducted according to taxa-specific guidelines. For all other species, targeted survey was conducted in accordance with OEH Threatened Species Survey and Assessment Guidelines.

Targeted survey effort is located in Table 8.4. The survey effort, timing and prevailing weather conditions are summarised in Appendix G. A figure detailing the survey effort conducted within the study area is provided in Figure 8.1. Details of the survey methodology used and results for each surveyed species are provided below. Survey methodologies for candidate species credit species have been grouped where survey effort has captured multiple species.

Table 8.4: Targeted Survey Effort

Scientific Name	Common Name	Biodiversity Risk Weighting	Survey Period	Targeted Surveys within Development Footprint	Survey method	Present on study area
Angophora inopina	Charmhaven Apple	1	Any	21 June 2017 3 July 2017 23 January 2018 15 January 2020	14 person hours of identifying trees present within the site 3 person hours of targeted survey	No
Burhinus grallarius	Bush Stone-curlew	2	Any	26 May 2017 21 June 2017 3 July 2017 20 July 2017 21 July 2017 22 September 2017 12 December 2019 13 January 2020 15 January 2020 17 January 2020	13 person hours of targeted survey, which involved a combination of spotlighting and walking transects.	No
Callistemon linearifolius	Netted Bottle Brush	2	Oct -Jan	23 January 2018 15 January 2020	3 person hours of targeted survey	No
Callocephalon fimbriatum	Gang-gang Cockatoo (Breeding)	2	Oct-Jan	23 January 2018 12 December 2019 13 January 2020 15 January 2020 17 January 2020	9.5 person hours of targeted diurnal surveys	No
Calyptorhynchus lathami	Glossy Black-Cockatoo (Breeding)	2	Mar-Aug	26 May 2017 21 June 2017 3 July 2017	5.25 person hours of targeted surveys including a combination of diurnal and nocturnal census methods.	No
Cercartetus nanus	Eastern Pygmy-possum	2	Oct-Mar	27 March 2018 13 January 2020 14 January 2020 15 January 2020 16 January 2020	9 person hours of targeted spotlighting survey 32 targeted trap nights, 9 pit-fall trap nights and 24 additional consecutive pit-fall trap nights	No

Scientific Name	Common Name	Biodiversity Risk Weighting	Survey Period	Targeted Surveys within Development Footprint	Survey method	Present on study area
				17 January 2020 21 January 2020 2 March 2020 3 March 2020 4 March 2020 5 March 2020 6 March 2020		
Chamaesyce psammogeton	Sand Spurge	2	Any	19 July 2017 23 January 2018	7.5 person hours walking 10m interval parallel transects across potential habitat	No
Corybas dowlingii	Red Helmet Orchid	2	June-July	3 July 2017 19 July 2017	7.5 person hours involved walking parallel transects which were spaced at approximately 10m intervals across all potential habitat	No
Crinia tinnula	Wallum Froglet	1.5	Any	21 June 2017 20 July 2017 27 March 2018 12 December 2019 13 January 2020 15 January 2020 21 January 2020	10.25 person hours of targeted surveys including a combination of diurnal and nocturnal census methods.	No
Cryptostylis hunteriana	Leafless Tongue Orchid	2	Nov-Jan	21 December 2017 11 January 2018 12 December 2019	8 person hours involved walking parallel transects which were spaced at approximately 10m intervals across all potential habitat	No
Diuris arenaria	Sand Doubletail	3	Sept	22 September 2017	2 person hours involved walking parallel transects which were spaced at approximately 10m intervals across all potential habitat. Known flowering specimens at Bobs Farm were observed prior to survey	No
Diuris praecox	Rough Doubletail	1.5	Aug	30 August 2017	4 person hours involved walking parallel transects which were spaced at approximately 10m intervals across all potential habitat	Yes
Dromaius novaehollandiae -	Emu population in the New	2	Any	26 May 2017 21 June 2017	7.75 person hours of diurnal avifauna surveys involving transects targeting potential habitat	No

Scientific Name	Common Name	Biodiversity Risk Weighting	Survey Period	Targeted Surveys within Development Footprint	Survey method	Present on study area
endangered population	South Wales North Coast Bioregion and Port Stephens local government area			3 July 2017 23 January 2018	within the study areas of likely activity.	
Esacus magnirostris	Beach Stone-curlew (Breeding)	2	Any	26 May 2017 21 June 2017 3 July 2017 20 July 2017 21 July 2017 22 September 2017 12 December 2019 13 January 2020 15 January 2020 17 January 2020	13 person hours of targeted survey, which involved a combination of spotlighting and walking transects.	No
Eucalyptus camfieldii	Camfield's Stringybark	2	Any	21 June 2017 3 July 2017 23 January 2018 15 January 2020	14 person hours of identifying trees present within the site 3 person hours of targeted survey	No
Eucalyptus parramattensis subsp. decadens		2	Any	21 June 2017 3 July 2017 23 January 2018 15 January 2020	14 person hours of identifying trees present within the site 3 person hours of targeted survey	No
Haliaeetus leucogaster	White-bellied Sea-Eagle (Breeding)	2	Jul-Dec	3 July 2017 12 December 2018	4.5 person hours of diurnal avifauna surveys involving transects targeting potential habitat within the study areas of likely activity.	No
Hieraaetus morphnoides	Little Eagle	1.5	Aug-Oct	30 August 2017 22 September 2017 27 October 2017	7 person hours of diurnal avifauna surveys involving transects targeting potential habitat within the study areas of likely activity.	No
Hoplocephalus	Pale-headed	2	Nov-March	27 March 2018	A combination of 4 hours spotlighting, 1 hour	No

Scientific Name	Common Name	Biodiversity Risk Weighting	Survey Period	Targeted Surveys within Development Footprint	Survey method	Present on study area
bitorquatus	Snake			13 January 2020 14 January 2020 15 January 2020 16 January 2020 21 January 2020 2 March 2020 3 March 2020 4 March 2020 5 March 2020 6 March 2020	targeted reptile survey, 9 pit-fall trap nights and an additional 24 consecutive pit-fall trap nights.	
Litoria brevipalmata	Green-thighed Frog	1.5	Oct-Mar	27 March 2018 13 January 2020 14 January 2020 15 January 2020 16 January 2020 21 January 2020 2 March 2020 3 March 2020 4 March 2020 5 March 2020 6 March 2020	2 hours of targeted survey 9 pit-fall trap nights Additional 24 consecutive pit-fall trap nights 2 hours of targeted spotlighting	No
Melaleuca groveana	Grove's Paperbark	2	Any	21 June 2017 3 July 2017 23 January 2018 15 January 2020	14 person hours of identifying trees present within the site 3 person hours of targeted survey	No
Myotis macropus	Southern Myotis	2	Oct-Mar	2 March 2020 3 March 2020 4 March 2020 5 March 2020 6 March 2020	48 hours of targeted survey, which involved leaving an Anabat Detector recording adjacent to the dam from 2-6 March 2020.	
Ninox connivens	Barking Owl (Breeding)	2	May-Dec	21 June 2017 14 June 2018	4.5 person hours of targeted survey, which involved a combination of stag watching,	No

Scientific Name	Common Name	Biodiversity Risk Weighting	Survey Period	Targeted Surveys within Development Footprint	Survey method	Present on study area
					spotlighting and call play-back.	
Ninox strenua	Powerful Owl (Breeding)	2	May-Aug	21 June 2017 14 June 2018	4.5 person hours of targeted survey, which involved a combination of stag watching, spotlighting and call play-back.	No
Pandion cristatus	Eastern Osprey (Breeding)	1.5	April-Nov	26 May 2017 21 June 2017 3 July 2017	4 person hours of diurnal avifauna surveys involving transects targeting potential habitat within the study areas of likely activity.	No
Petaurus norfolcensis	Squirrel Glider	2	Any	17 July 2017 18 July 2017 19 July 2017 20 July 2017 21 July 2017 27 March 2018 14 June 2018 13 January 2020 14 January 2020 15 January 2020 16 January 2020 17 January 2020 21 January 2020	8 person hours of spotlighting 96 arboreal trap nights	No
Phascogale tapoatafa	Brush-tailed Phascogale	2	Any	17 July 2017 18 July 2017 19 July 2017 20 July 2017 21 July 2017 27 March 2018 14 June 2018 13 January 2020 14 January 2020 15 January 2020 16 January 2020 17 January 2020	8 person hours of spotlighting 96 arboreal trap nights 144 small terrestrial trap nights	No

Scientific Name	Common Name	Biodiversity Risk Weighting	Survey Period	Targeted Surveys within Development Footprint	Survey method	Present on study area
				21 January 2020		
Planigale maculata	Common Planigale	2	Any	17 July 2017 18 July 2017 19 July 2017 20 July 2017 21 July 2017 27 March 2018 14 June 2018 13 January 2020 14 January 2020 15 January 2020 16 January 2020 17 January 2020 21 January 2020 2 March 2020 3 March 2020 4 March 2020 5 March 2020 6 March 2020	8 person hours of spotlighting 144 small terrestrial trap nights 9 pit-fall trap nights 24 additional consecutive pit-fall trap nights	No
Prostanthera densa	Villous Mint-bush	2	Any	19 July 2017 23 January 2018	7.5 person hours walking 10m interval parallel transects across potential habitat	No
Rhizanthella slateri	Eastern Australian Underground Orchid	3	Sept-Nov	22 September 2017 27 October 2017 30 October 2017	3 person hours involved walking parallel transects which were spaced at approximately 10m intervals across all potential habitat	No
Sternula albifrons	Little Tern	2	Sep-Mar	22 September 2017 12 December 2019 13 January 2020 15 January 2020 17 January 2020 2 March 2020	22 person hours of targeted survey, which involved a combination of diurnal searches and walking transects.	No

Scientific Name	Common Name	Biodiversity Risk Weighting	Survey Period	Targeted Surveys within Development Footprint	Survey method	Present on study area
Syzygium paniculatum	Magenta Lilly Pilly	2	Any	21 June 2017 3 July 2017 23 January 2018 15 January 2020	14 person hours of identifying trees present within the site 3 person hours of targeted survey	No
Tetratheca juncea	Black-eyed Susan	2	Sep-Oct	22 September 2017 27 October 2017 30 October 2017	4 person hours walking 10m interval parallel transects across potential habitat	No
Tyto novaehollandiae	Masked Owl (Breeding)	2	May-August	21 June 2017 14 June 2018	4.5 person hours of targeted survey, which involved a combination of stag watching, spotlighting and call play-back.	No
Uperoleia mahonyi	Mahony's Toadlet	2	Oct-March	27 March 2018 13 January 2020 14 January 2020 15 January 2020 16 January 2020 21 January 2020	2 hours of targeted survey 9 pit-fall trap nights 2 hours of targeted spotlighting	No

Targeted Survey for Threatened Trees

Species Captured by Survey

- *Angophora inopina* Charmhaven Apple
- *Eucalyptus parramattensis* subsp. *decadens*
- *Eucalyptus camfieldii* Camfield's Stringybark
- *Melaleuca groveana* Grove's Paperbark
- *Syzygium paniculatum* Magenta Lilly Pilly

A full significant tree inventory was undertaken for the site on 21 June, 03 July 2017 over a period of approximately 14 person hours. This survey involved searching all individual trees within the study area for significant features including hollows, nests and arboreal termite mounds, this survey also required identification of all trees to the species level by a suitably qualified ecologist. Targeted searches were also conducted on 23 January 2018 and 15 January 2020 for a total of 3 person hours. It is considered very unlikely that any threatened tree species would have been overlooked if present.

Survey Results

No threatened trees were detected during the significant tree inventory within the study area. As such, the candidate species credit species were not considered to occur within the study area.

Targeted Survey for Threatened Forbs and Shrubs

Species Captured by Survey

- 23 January 2018 and 15 January 2020 for *Callistemon linearifolius* Netted Bottle Brush for a targeted survey effort of 3 person hours
- 19 July 2017 and 23 January 2018 for *Chamaesyce psammogeton* Sand Spurge and *Prostanthera densa* Villous Mint-bush for a total of 7.5 targeted survey hours
- 22 September 2017 27 October 2017 30 October 2017for *Tetratheca juncea* Black-eyed Susan for a targeted survey effort of 4 hours

Survey Effort

Suitable habitat for the threatened forbs and shrubs would be restricted to the vegetation zones with intact understorey and/or shrub layers within the study area. Targeted surveys were undertaken in accordance with the Guide to Surveying Threatened Plants (OEH, 2016) and involved walking parallel transects which were spaced at approximately 10m intervals across all potential habitat for the species above.

Survey Results

No threatened forbs and shrubs were detected during the targeted survey for the species above. As such these candidate species credit species were not considered to occur within the study area.

Targeted Survey for Threatened Orchids

Species Captured by Survey

- *Corybas dowlingii* Red Helmet Orchid
- *Cryptostylis hunteriana* Leafless Tongue Orchid
- *Diuris arenaria* Sand Doubletail
- *Diuris praecox* Rough Doubletail
- *Rhizanthella slateri* Eastern Australian Underground Orchid

Survey Effort

A targeted survey for threatened orchids was undertaken or the site on:

- 3 July and 19 July 2017 for *Corybas dowlingii* over a period of approximately 7.5 person hours
- 30 August 2017 for *Diuris praecox* Rough Doubletail Red Helmet Orchid over a period of 4 person hours
- 21 December 2017, 11 January 2018 and 12 December 2019 for *Cryptostylis hunteriana* Leafless Tongue Orchid over a period of approximately 8 person hours
- 22 September 2017 for *Diuris arenaria* Sand Doubletail over a period of approximately 2 person hours. A targeted survey was also undertaken on 30 August 2017 for a period of 4 person hours after observing this species flowering at a nearby location at Bobs Farm, however August has been removed from the BAM survey period as of 2020.
- 22 September 2017, 27 October 2017 and 30 October 2017 for *Rhizanthella slateri* Eastern Australian Underground Orchid over a period of approximately 3 person hours

Targeted surveys were undertaken in accordance with the Guide to Surveying Threatened Plants (OEH, 2016) and involved walking parallel transects which were spaced at approximately 10m intervals across all potential habitat for the species above.

Survey Results

252 individuals of Rough Doubletail were recorded within the study area, 234 individuals were recorded within the transmission line easement (vegetation zone 1648_DNG) and 18 individuals were recorded within the coastal forest (vegetation zone 1648_Intact). This species has been assessed further within Step 5.

No other threatened orchids were detected during the targeted survey for the remainder of the species above. As such these candidate species credit species were not considered to occur within the study area.

Targeted Survey for Threatened Amphibians

Species Captured by Survey

- *Uperoleia mahonyi* Mahony's Toadlet
- *Litoria brevipalmata* Green-thighed Frog
- *Crinia tinnula* Wallum Froglet

Survey Effort

- 27 March 2018 13 January 2020 14 January 2020 15 January 2020 21 January 2020 for *Uperoleia mahonyi* Mahony's Toadlet *Litoria brevipalmata* Green-thighed Frog over a period of 2 hours targeted survey, 2 hours of spotlighting survey, 9 pit-fall trap nights and an additional 24 consecutive pit-fall trap nights.
- 21 June 2017 20 July 2017 27 March 2018 12 December 2019, 13 January 2020, 15 January 2020 21 January 2020 for *Crinia tinnula* Wallum Froglet for 8.25 person hours of targeted surveys.

Targeted threatened amphibian surveys were completed on the night of 20 July 2017, 27 March 2018, 13 January 2020, 15 January 2020 and 21 January 2020 and during the day of 21 June 2017 and 20 July 2017 for a combined total of approximately 10.25 person hours.

Until late 2019 no specific areas of likely amphibian habitat in the form of natural waterbodies or drainage lines were present within or adjacent to the study area. The waterbody present on site in late 2019 was surveyed on 12 December 2019, 15 January 2020 and 21 January 2020. The entire study area and waterbody located on site was considered potential habitat.

The targeted surveys included a combination of diurnal and nocturnal census methods. Diurnal searches involved searches of the study area for basking or sheltering individuals. Any appropriate cover such as logs or leaf litter gathered within shallow depressions were turned over/uncovered for resting individuals.

Pit-fall traps were installed between 13 January and 16 January 2020 (17 January was closed off due to rain) giving a total of 9 trap nights. Pit-fall traps involved using 3 large buckets embedded in the ground approximately 3 meters apart with a plastic barrier for the animal to walk along and guide into the pit-fall trap. Leaf litter was placed at the bottom of the bucket to provide shelter for the animal. Lids were placed on the buckets to shut the traps off when rain was forecast.

Additional pit-fall traps using 6 large buckets embedded in the ground approximately 3 meters apart with a plastic barrier were installed between 2 March and 6 March 2020 giving a total of an additional 24 consecutive pit-fall trap nights.

Survey Results

No threatened amphibians were seen or heard during the survey. The only species recorded during the surveys were *Limnodynastes tasmaniensis* (Spotted Marsh Frog) and *Platyplectrum ornatum* (Ornate Burrowing Frog). As such these candidate species credit species were not considered to occur within the study area.

Targeted Survey for Threatened Nocturnal Reptiles

Species Captured by Survey

- *Hoplocephalus bitorquatus* Pale-headed Snake

Survey Effort

Targeted surveys were undertaken on 27 March 2018 13 January 2020 14 January 2020 15 January 2020 16 January 2020 21 January 2020 for a combined total of 4 hours spotlighting, 1 hour targeted reptile survey, and 9 pit fall trap nights.

Targeted nocturnal searches were focused on vegetation zones with intact understorey and/or shrub layers and dense canopy layer which would provide a greater habitat value for prey (frogs, lizards and small mammals).

Spotlighting was undertaken on foot using 100watt hand-held spotlights. The spotlighting undertaken involved walking at a slow pace conducting visual searches of undergrowth and canopy for hunting reptiles and stopping every 2 minutes, allowing the observer to hear fauna movement.

Pit-fall traps were installed between 13 January and 16 January 2020 (17 January was closed off due to rain) giving a total of 9 trap nights. Pit-fall traps involved using 3 large buckets embedded in the ground approximately 3 meters apart with a plastic barrier for the animal to walk along and guide into the pit-fall trap. Leaf litter was placed at the bottom of the bucket to provide shelter for the animal. Lids were placed on the buckets to shut the traps off when rain was forecast.

Additional pit-fall traps using 6 large buckets embedded in the ground approximately 3 meters apart with a plastic barrier were installed between 2 March and 6 March 2020 giving a total of an additional 24 consecutive pit-fall trap nights.

Survey Results

No Pale Headed Snakes were detected during the survey. As such this candidate species credit species were not considered to occur within the study area.

Targeted Survey for Threatened Nocturnal Birds

Species Captured by Survey

- 21 June 2017 and 14 June 2018 for *Tyto novaehollandiae* Masked Owl (Breeding), *Ninox strenua* Powerful Owl (Breeding) and *Ninox connivens* Barking Owl (Breeding) for a total of 4.5 person hours of targeted survey, which involved a combination of stag watching, spotlighting and call play-back.
- 26 May 2017 21 June 2017 3 July 2017 20 July 2017 21 July 2017 22 September 2017 12 December 2019 13 January 2020 15 January 2020 17 January 2020 for *Burhinus grallarius* Bush Stone-curlew and *Esacus magnirostris* Beach Stone-curlew (Breeding) with a total of 13 person hours of targeted survey, which involved a combination of spotlighting and walking transects.

Survey Effort

The entire site was considered to provide potential habitat for hunting owls. Vegetation zones with intact understorey and/or shrub layers and a significant amount of coarse woody debris was considered to provide potential refuge for beach-stone and bush-stone curlews, with areas closer to the sand dunes in the south of the study area being more preferred for the beach-stone curlew.

Targeted survey for nocturnal birds involved a combination of stag watching, spotlighting and call play-back. The stag watching survey for threatened owls involved watching significant hollow-bearing trees, 20 minutes prior to sunset and continuing until 20 minutes after sunset.

Spotlighting was undertaken on foot using 100watt hand-held spotlights. The spotlighting undertaken involved walking at a slow pace conducting visual searches of undergrowth and canopy for resting nocturnal birds and stopping every 2 minutes, allowing the observer to hear fauna movement.

Pre-recorded calls of Barking Owl, Powerful Owl, Masked Owl, Beach Stone-curlew and Bush Stone-curlew were broadcast through a megaphone designed to project the sound for at least 1km under still night conditions. An initial listening period of 10 minutes was undertaken, followed by 5 minutes of calls (repeated in four different directions). A period of two minutes of quiet listening was then employed after each 5-minute bracket of calls. At the conclusion of the call playback survey, spotlighting was carried out in the vicinity of the call playback site.

Survey Results

No threatened nocturnal birds were seen or heard during the surveys. An egg located by Port Stephens Council staff within the modified vegetation to the south-west of the site (vegetation zone 1648_Modified Understorey) on 31 October 2019 was confirmed to belong to Bush-stone Curlew by Mick Roderick (NSW Woodland Bird Program Manager, Birdlife Australia) and by the Biodiversity and Conservation Division. This species is therefore considered to occur within the study area. This species has been assessed further within Step 5.

No other threatened nocturnal birds were detected during the targeted surveys for the remainder of the species above. As such these candidate species credit species were not considered to occur within the study area.

Targeted Survey for Threatened Diurnal Birds

Species Captured by Survey

- 3 July 2017 and 12 December 2018 for *Haliaeetus leucogaster* White-bellied Sea-Eagle (Breeding) for a total of 4.5 person hours of diurnal avifauna surveys involving transects targeting potential habitat within the study areas of likely activity.
- 26 May 2017 21 June 2017 3 July 2017 for *Calyptorhynchus lathami* Glossy Black-Cockatoo (Breeding) for a total of 5.25 person hours of targeted surveys including a combination of diurnal and nocturnal census methods.
- 26 May 2017 21 June 2017 3 July 2017 and 23 January 2018 for *Dromaius novaehollandiae* - Emu population in the New South Wales North Coast Bioregion and Port Stephens local government area for a total of 7.75 person hours of diurnal avifauna surveys involving transects targeting potential habitat within the study areas of likely activity.
- 23 January 2018 12 December 2019 13 January 2020 15 January 2020 17 January 2020 for *Callocephalon fimbriatum* Gang-gang Cockatoo (Breeding) for a total of 9.5 person hours of targeted survey.
- 26 May 2017 21 June 2017 3 July 2017 for *Pandion cristatus Eastern* Osprey (Breeding) for a total of 4 person hours of diurnal avifauna surveys involving transects targeting potential habitat within the study areas of likely activity.
- 30 August 2017, 22 September 2017 and 27 October 2017 for *Hieraaetus morphnoides* Little Eagle for a total of 7 person hours of diurnal avifauna surveys involving transects targeting potential habitat within the study areas of likely activity.
- 22 September 2017 12 December 2019 13 January 2020 15 January 2020 17 January 2020 2 March 2020 for *Sternula albifrons* Little Tern for a total of 22 person hours of targeted survey, which involved a combination of diurnal searches and walking transects.

Survey Effort

Vegetation zones with an intact canopy layer which also contained large and hollow bearing remnant trees was considered to provide potential breeding habitat for hollow dependant cockatoos and eyrie building raptors. The entire study area was considered to provide potential habitat for the Emu.

The diurnal avifauna survey involved transects targeting potential habitat within the study areas of likely activity i.e. profusely flowering Eucalypts for nectivorous birds and tall canopy trees with a perspective of the ocean and other waterbodies for fishing raptors. Surveys were conducted at peak activity periods for most avifauna species (i.e. dawn and dusk). Surveys involved listening for characteristic call of targeted species and scanning potential habitat with a pair of binoculars. Incidental observations of secondary indications of presence (i.e. chewed cones and distinctive feathers) were also recorded.

In addition, full significant tree inventory was undertaken for the study area on 21 June and 03 July 2017 over a period of approximately 14 person hours. This survey would have likely identified any threatened diurnal bird species displaying notable breeding behaviour (i.e. entering and exiting hollows repeatedly or building/roosting within stick nests and eyries).

Survey Results

One individual of White-bellied Sea- eagle was identified during the targeted survey for threatened diurnal birds. This species was seen close to the ground within the easement in the south of the study area. Despite dedicated time spent observing this individual it did not displaying any behaviour to indicate that the study area may form part of this species breeding habitat (building stick nests, calling to mates or carrying prey to an eyrie) and was likely utilising the study area as a foraging resource at the time. As such, this duel ecosystem (foraging)/ species (breeding) credit species has been assessed as an ecosystem (foraging) credit species only and was not assessed further within Step 5. No other threatened diurnal birds were observed during the surveys.

Targeted Survey for Small & Medium Nocturnal Mammals

Species Captured by Survey

- 17 July 2017 18 July 2017 19 July 2017 20 July 2017 21 July 2017 27 March 2018 14 June 2018 13 January 2020 14 January 2020 15 January 2020 16 January 2020 17 January 2020 21 January 2020 2 March 2020 3 March 2020 4 March 2020 5 March 2020 6 March 2020 for *Planigale maculata* Common Planigale for a total of 8 person hours of spotlighting, 144 small terrestrial trap nights, 9 pit-fall trap nights and an additional 24 consecutive trap nights.
- 17 July 2017 18 July 2017 19 July 2017 20 July 2017 21 July 2017 27 March 2018 14 June 2018 13 January 2020 14 January 2020 15 January 2020 16 January 2020 17

January 2020 and 21 January 2020 for *Petaurus norfolcensis* Squirrel Glider and *Phascogale tapoatafa* Brush-tailed Phascogale for a total of 8 person hours of spotlighting, 96 arboreal trap nights and 144 small terrestrial trap nights of Brush-tailed Phascogale.

- 27 March 2018 13 January 2020 14 January 2020 15 January 2020 16 January 2020 17 January 2020 and 21 January 2020 2 March 2020 3 March 2020 4 March 2020 5 March 2020 6 March 2020 for *Cercartetus nanus* Eastern Pygmy-possum for a total of 9 person hours of targeted spotlighting survey, 32 targeted trap nights, 9 pit-fall trap nights and an additional 24 consecutive trap nights.

Survey Effort

The targeted survey for the species above involved a combination of spotlighting and small - medium mammal trapping and pit-fall trapping.

Vegetation zones with an intact canopy layer which also contained large and hollow bearing remnant trees over a relatively dense strata of shrub and understorey species were considered to provide more likely habitat for the species above.

Spotlighting was undertaken on foot using 100watt hand-held spotlights. The spotlighting undertaken involved walking at a slow pace conducting visual searches of undergrowth and canopy for foraging nocturnal mammals and stopping every 2 minutes, allowing the observer to hear fauna movement.

Small terrestrial mammal trapping was undertaken using 30 Elliott Type A traps (8x10x33cm) within the study area in July 2017. The traps were left in place for four consecutive nights giving a total of 120 small terrestrial trap nights. Additional trapping using 6 Elliott Type A traps (8x10x33cm) was conducted within the study area in January 2020. The traps were left in place for four consecutive nights giving a total of 24 small terrestrial trap nights. The traps were hidden in thick grass, under shrubs or near fallen logs and were camouflaged with vegetation where the ground cover was sparse. The northern portion of the study area was excluded from the small terrestrial mammal survey due to the absence of understorey vegetation from recent underscrubbing, which would have resulted in any fauna caught being left exposed overnight. The baits used for the traps were a mixture of rolled oats and honey, Good-O's (dry dog food) and peanut butter. The traps were checked early each morning and, where necessary, reset and rebaited.

Medium terrestrial mammal trapping was undertaken using 6 cage traps (60×35×40cm) within the study area in July 2017. The traps were left in place for four consecutive nights giving a total of 24 medium terrestrial trap nights. The traps were hidden in thick grass, under shrubs or near fallen logs and were camouflaged with vegetation where the ground cover was sparse. The bait used for the

traps were raw chicken necks. The traps were checked early each morning and, where necessary, reset and rebaited.

Arboreal mammal trapping was undertaken using 12 Elliott Type B traps (15 × 15 × 46cm) and 4 PVC Pipe traps within the study area in July 2017 to determine the presence of arboreal mammals, particularly *Petaurus norfolcensis* (Squirrel Glider) which is known to occur in similar habitats in the local area (OEH, 2017). The traps were left in place for four consecutive nights giving a total of 64 trap nights. Additional arboreal mammal trapping was undertaken using 4 Elliott Type B traps (15 × 15 × 46cm) and 4 PVC Pipe traps within the study area in January 2020. The traps were left in place for four consecutive nights giving a total of 32 trap nights. The traps were placed around 3 - 4 metres above the ground on platforms mounted on tree trunks. The targeted trees contained hollows, were flowering or had scratches present on the boles. The baits used consisted of a rolled oats and honey mixture, peanut butter and liquorice pieces. The traps were sprayed with honey mixed in water before being placed in the trees to attract fauna and mask the smell of humans. The tree trunks were also sprayed with this mixture each day. In all cases the traps were checked early each morning and, where necessary, reset and rebaited.

Pit-fall traps were installed between 13 January and 16 January 2020 (17 January was closed off due to rain) giving a total of 9 trap nights. Pit-fall traps involved using 3 large buckets embedded in the ground approximately 3 meters apart with a plastic barrier for the animal to walk along and guide into the pit-fall trap. Leaf litter was placed at the bottom of the bucket to provide shelter for the animal. Lids were placed on the buckets to shut the traps off when rain was forecast.

Additional pit-fall traps using 6 large buckets embedded in the ground approximately 3 meters apart with a plastic barrier were installed between 2 March and 6 March 2020 giving a total of an additional 24 consecutive pit-fall trap nights.

Survey Results

The results of the small terrestrial mammal survey are shown in Table 8.5. Trap locations are displayed in Figure 8.1

Table 8.5: Trapping Results.

Date	Trap No	Species	Sex
Small Terrestrial Mammal Trapping			
Tuesday 18/07/17	T1	*Antechinus stuartii* (Brown Antechinus)	Male
	T7	*A. stuartii*	Male
	T11	*A. stuartii*	Male
	T12	*A. stuartii*	Male
	T19	*A. stuartii*	Male
	T29	*A. stuartii*	Male
Wednesday 19/07/17	T1	*A. stuartii*	Male
	T7	*A. stuartii*	Male

Date	Trap No	Species	Sex
	T10	*A. stuartii*	Male
	T12	*A. stuartii*	Male
	T14	*A. stuartii*	Male
	T17	*A. stuartii*	Female
	T18	*A. stuartii*	Male
	T20	*A. stuartii*	Male
	T22	*A. stuartii*	Female
	T27	*A. stuartii*	Female
	T29	*A. stuartii*	Male
	T30	*A. stuartii*	Male
Thursday 20/07/17	T1	*A. stuartii*	Male
	T4	*A. stuartii*	Male
	T10	*A. stuartii*	Male
	T15	*A. stuartii*	Female
	T18	*A. stuartii*	Male
	T21	*A. stuartii*	Male
	T25	*A. stuartii*	Female
	T30	*A. stuartii*	Male
Friday 21/07/17	T1	*A. stuartii*	Male
	T5	*A. stuartii*	Male
	T10	*Rattus rattus* (Black Rat)	Female
	T12	*A. stuartii*	Male
	T14	*A. stuartii*	Male
	T15	*A. stuartii*	Male
	T19	*A. stuartii*	Male
	T27	*A. stuartii*	Female
	T29	*A. stuartii*	Male
	T30	*A. stuartii*	Female
Tuesday 14/01/2020	N/A	No captures	N/A
Wednesday 15/01/20	N/A	No captures	N/A
Thursday 16/01/20	N/A	No captures	N/A
Friday 17/01/20	N/A	No captures	N/A
Medium Terrestrial Mammal Trapping			
Tuesday 18/07/17	N/A	No captures	N/A
Wednesday 19/07/17	N/A	No captures	N/A
Thursday 20/07/17	N/A	No captures	N/A
Friday 21/07/17	C1	*Isoodon macrourus* (Northern Brown Bandicoot)	Undetermined
Arboreal Mammal Trapping			
Tuesday 18/07/17	A15	*Antechinus stuartii* (Brown Antechinus)	Female
Wednesday 19/07/17	A1	*A. stuartii*	Male
	A7	*A. stuartii*	Male
	A15	*A. stuartii*	Male
Thursday 20/07/17	A15	*A. stuartii*	Male
Friday 21/07/17	A7	*A. stuartii*	Female
Tuesday 14/01/2020	N/A	No captures	N/A
Wednesday 15/01/20	N/A	No captures	N/A
Thursday 16/01/20	N/A	No captures	N/A

Date	Trap No	Species	Sex
Friday 17/01/20	A4	*Rattus fuscipes* (Bush Rat)	Female
Pit-fall Trapping			
Tuesday 14/01/2020	N/A	No captures	N/A
Wednesday 15/01/20	N/A	No captures	N/A
Thursday 16/01/20	N/A	No captures	N/A
Friday 17/01/20	N/A	Closed off due to rain	N/A
Tuesday 03/03/2020		1 x *Saiphos equalis* (Three Toed Skink)	N/A
Wednesday 04/03/2020		1 x *S. equalis*	N/A
Thursday 05/03/2020		2 x *S. equalis*	N/A
Friday 06/03/2020		No captures	N/A

Survey Results

No threatened small or medium nocturnal mammals were observed or trapped during the survey. As such these candidate species credit species were not considered to occur within the study area.

Targeted Survey for Koala Breeding Habitat

Survey Effort

A targeted Koala survey was completed on the night of 20 July 2017, 21 July 2017, 27 March 2018, 14 June 2018, 13 January 2020 and 21 January 2020 during the day of 21 June 2017 and 03 July 2017 for a combined total of approximately 25 person hours. The Spot Assessment Technique (SAT) was conducted on 15 January 2020 for a total of 5 person hours.

No preferred Koala feed trees were present within the study area, thus all areas within the study area containing an intact canopy layer was considered potential habitat

Surveys for the Koala involved both direct observation during spotlighting and call-playback surveys and indirect observation methods during diurnal significant tree inventory consistent with the EPBC Act Referral Guidelines for the Vulnerable Koala (Department of the Environment, 2014). Two spot assessments using the Sport Assessment Technique (SAT) (Phillips and Callaghan 2011) was undertaken on 15 January 2020.

Direct observation involved spotlighting using 100-watt hand-held spotlights. The spotlighting undertaken involved walking at a slow pace conducting visual searches of undergrowth and canopy

for foraging nocturnal mammals and stopping every 2 minutes, allowing the observer to hear fauna movement. Pre-recorded calls of the Koala were broadcast through a megaphone, within the centre of the study area, to project the sound for at least 1km under still night conditions. An initial listening period of 10 minutes was undertaken, followed by 5 minutes of calls (repeated in four different directions). A period of two minutes of quiet listening was then employed after each 5-minute bracket of calls. At the conclusion of the call playback survey, spotlighting was carried out in the vicinity of the call playback study area.

Indirect survey techniques involved searches for scratches on tree trunks and also searches for scats, this was undertaken concurrently with a full significant tree inventory across the study area, checking all trees present for significant attributes and habitat features. It is considered very unlikely that any evidence of Koala would have been overlooked if present.

Survey Results

No Koalas were detected during the surveys. As such this candidate species credit species were not considered to occur within the study area

Targeted Survey for Threatened Microchiropteran Bats

Survey Effort

A targeted microchiropteran bat survey was completed on the nights of 21 June 2017, 20 July 2017, 21 July 2019, 14 June 2018, 21 January 2020, 2 March 2020, 3 March 2020, 4 March 2020, 5 March 2020 and 6 March 2020 for a combined total of 61.25 hours. Surveys conducted between 2 March 2020 and 6 March 2020 were conducted to target Southern Myotis by placing the Anabat Bat echo-location device adjacent to the dam located within the site.

All vegetation zones within the study area were considered to provide potential hunting habitat for microchiropteran bats.

Surveys for microchiropteran bats involved using a handheld Anabat Bat echo-location device to survey for species specific hunting pulses created by microbats. Echolocation surveys used a combination of stationary and hand held mobile surveys. Mobile surveys within the study area targeted microhabitats of potentially increased bat activity including flyways, clearings and ecotones and were conducted over two nights. Stationary call activated microchiropteran bat detection was undertaken from dusk to dawn for five nights.

Survey Results

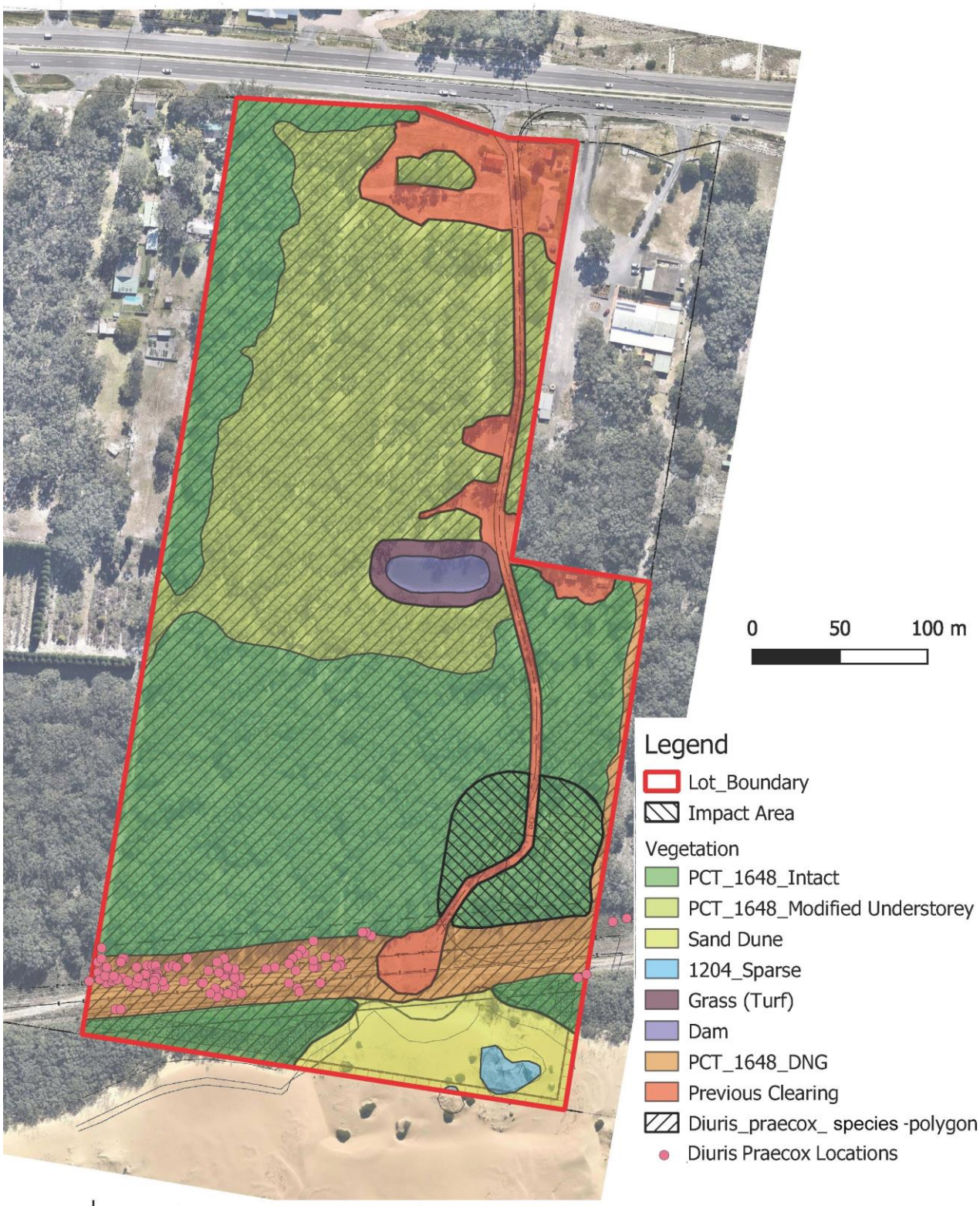
Six microchiropteran bat species were recorded during the survey; *Chalinolobus gouldii* (Gould's Wattled Bat), *Falsistrellus tasmaniensis* (Eastern-False Pipistrelle), *Miniopterus australis* (Little

Bentwing Bat), *Nyctophilus* sp., *Scoteanax rueppellii* (Greater Broad-nosed Bat) and *Vespadelus* sp. Two species, *Nyctophilus* sp. and *Vespadelus* sp. could only be identified to the genus level. One species of threatened microbat within the genus *Vespadelus*, *Vespadelus troughtoni* was generated by the BAM-CC as having potential to occur within the study area, thus a conservative approach was adopted and this species was given consideration as occurring within the study area.

The species credit species above have habitat constraints of caves or other significant refuge/breeding features both on a landscape and study area level. In addition, both of these species credit species have large foraging ranges and it is likely that the study area could be within a foraging area for these species yet not contain significant habitat constraints. As such the occurrence of this species was not considered to trigger the requirement for species credit generation and was not assessed further within Step 5. No other microbat species were recorded during the surveys.

8.6 DETERMINE THE AREA OR COUNT, AND LOCATION OF SUITABLE HABITAT FOR A SPECIES CREDIT SPECIES (STEP 5)

Two Species Credit Species were confirmed on site. One threatened orchid, Rough Doubletail, was confirmed through survey as present within the study area and one threatened nocturnal bird, Bush-stone Curlew was confirmed through the identification of an egg located on site. A description of the ecology of these species, their defined habitat constraint and the approach used to estimate a species polygon for these species has been provided in Table 8.6 below. The species polygon for Rough Doubletail is mapped in Figure 8.2 and the species polygon for Bush-stone Curlew is mapped in Figure 8.3.



DH	
A4 Scale	1:XXX,XXX

Disclaimer: While all reasonable care has been taken to ensure the information contained on this map is up to date and accurate, no guarentee is given that the information protrayed is free from error or omission. In addition the spatial accuracy of the map is wholly dependant on source data. Please verify the accuracy of all information prior to use. Development footprint areas should be used for indicative areas only.

Map Projection GDA94 MGA Zone 56

Figure 8.2

Diuris praecox Species Polygon

Nelson Bay
Site Suburb, NSW

January 2020

WILDTHING Environmental Consultants
(a Division of Tattersall Lander Pty Ltd)
ABN 41 003 509 215

	XX
A4 Scale	1:2700

Disclaimer: While all reasonable care has been taken to ensure the information contained on this map is up to date and accurate, no guarentee is given that the information protrayed is free from error or omission. In addition the spatial accuracy of the map is wholly dependant on source data. Please verify the accuracy of all information prior to use. Development footprint areas should be used for indicative areas only.

Map Projection GDA94 MGA Zone 56

Figure 8.3

Bush Stone-curlew Species Polygon

Nelson Bay Road
Anna Bay, NSW

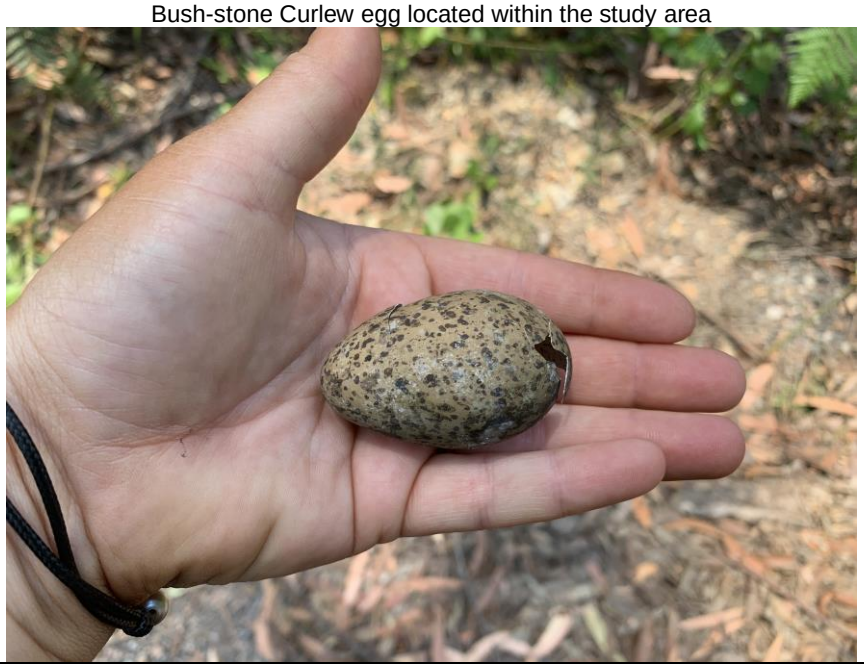
WILDTHING Environmental Consultants
(a Division of Tattersall Lander Pty Ltd)
ABN 41 003 509 215

Table 8.6: Species Credit Species located on site Ecology and Polygon within the site.

***Diuris praecox* (Rough Doubletail)** **BC Act - Vulnerable** **EPBC Act - Vulnerable**	
Description	Terrestrial orchid with two or three linear leaves, flowers nodding, yellow with a few dark brown markings at the base of the dorsal sepal and labellum. Petals obliquely erect, widely divergent, curved backwards; lamina narrow-elliptic to ovate.
Habitat and Distribution	This species is known from between Bateau Bay and Smiths Lake. Grows on hills and slopes of near-coastal districts in open forests which have a grassy to fairly dense understorey. Exists as subterranean tubers most of the year. It produces leaves and flowering stems in winter.
Biodiversity Concern/risk Weighting	Moderate Biodiversity Concern Risk weighting - 1.50
Method used to Confirm Presence	Targeted Survey
Number and location of individuals recorded	234 individuals within Vegetation Zone 1648_DNG 18 individuals within Vegetation Zone 1648_Intact
Defined Habitat Constraints	N/A
Species Polygon Unit of Measure	Area
SAII Entity	No
Approach used to define species polygon boundary	In accordance with Section 6.4.1.28 of the BAM the species polygon for fauna species, and flora species where the unit of measure is area, according to the TBDC, the species polygon is used to measure the area and location of suitable habitat. Although this species was only identified within a two vegetation zones comprised of derived native grassland and intact coastal forest its habitat as defined within the TSBDC includes open forests which have a grassy to fairly dense understorey which would be inclusive of all vegetation zones containing native vegetation within the study area. Thus, the species polygon for Rough Doubletail has been extended to include the entirety of Vegetation Zones: • 1648_Intact • 1648_Modified Understorey • 1648_DNG Which encompasses a total area of 11.23 ha.
Example of Rough Doubletail within the study area 	

***Burhinus grallarius* (Bush-stone Curlew)** **BC Act - Endangered** **EPBC Act - Not listed**	
Description	The Bush Stone-curlew is a large, long-legged ground dwelling bird. It has a rounded head, large yellow eyes, a black eye-stripe and a short dark bill.
Habitat and Distribution	The Bush Stone-curlew inhabits dry open forest and woodland with an open grassy understorey that has not been overgrazed. It prefers woodland with many fallen branches where it roosts during the day. It has also been known to utilise coastal scrub, mangrove fringes, golf courses and plantations. Within N.S.W. this species has been recorded mainly in pastoral areas of the western slopes and plains. It is rare east of the Great Divide; however, isolated populations have been recorded from Western Sydney, Gosford, Port Macquarie and Northern Rivers around Grafton and Brunswick Heads.
Biodiversity Concern/risk Weighting	High Biodiversity Concern Risk weighting - 2
Method used to Confirm Presence	Targeted Survey Egg identification
Number and location of individuals recorded	1 egg located at -23.771523, 152.059387 within Vegetation Zone 1648_Modified Understorey
Defined Habitat Constraints	N/A
Species Polygon Unit of Measure	Area
SAII Entity	No
Approach used to define species polygon boundary	In accordance with Section 6.4.1.28 of the BAM the species polygon for fauna species, and flora species where the unit of measure is area, according to the TBDC, the species polygon is used to measure the area and location of suitable habitat. The egg positively identified as belonging to a Bush-stone Curlew was located within the 1648_Modified understory vegetation zone. Habitat for this species is considered to be inclusive of all vegetation zones within the study area, with the exclusion of Spinifex. Thus, the species polygon for Bush-stone Curlew has been extended to include the entirety of Vegetation Zones: • 1648_Intact • 1648_Modified Understorey • 1648_DNG Which encompasses a total area of 11.23 ha

Bush-stone Curlew egg located within the study area



8.7 DETERMINE THE HABITAT CONDITION WITHIN THE SPECIES POLYGON FOR SPECIES ASSESSED BY AREA (STEP 6)

In accordance with Section 6.4.1.35 of the BAM the following table details the habitat condition of each species polygon by using the vegetation integrity score for each vegetation zone that is within the species polygon (Table 8.7).

Table 8.7: Habitat Condition for Species Polygon

Species	Vegetation Zones within Species Polygon			
	1648_Intact Vegetation Integrity Score	1648_Modified Understorey Vegetation Integrity Score	1648_DNG Vegetation Integrity Score	1204_Sparse Vegetation Integrity Score
Diuris praecox (Rough Doubletail)	62.5	56.1	31.2	Vegetation zone not within Species polygon
Burhinus grallarius (Bush-stone Curlew)	62.5	56.1	31.2	Vegetation zone not within Species polygon

9.0 ACTIONS TO AVOID/MINIMISE PROJECT IMPACTS

Although the proposed development is primarily associated with the extraction of sand from the dunes it is anticipated that direct impacts to biodiversity values within the study area will be primarily restricted to the vegetation removal required for the development of ancillary structures and civil works, as detailed within Section 1.2.

The principal means to reduce impacts on biodiversity within the study area has been to avoid and minimise removal of native vegetation and fauna habitat and to avoid the direct loss of significant biodiversity values and threatened matters. An options assessment for the consideration of alternative locations for the site shed and manager's residence was initially performed (Section 9.1). Subsequently, the potential impacts resulting from the proposed development have been broken down into three phases of activity: site selection and planning, construction and operation. Section 10.4 details measures to maintain or improve the habitat for Species Credit Species that are known to occur on site. Measures taken to date to avoid and minimise impacts have been summarised and recommendations to assist the proponent to design a development that further avoids and minimises are provided.

9.1 OPTIONS ASSESSMENT

An options assessment was conducted for the consideration of alternative locations for the site shed and manager's residence in accordance with Section 6.12 of the *Biodiversity Conservation Act 2016* and the BAM Operations Manual - Stage 2. Relocation of the site shed and manager's residence to the northern extent of the property along Nelson Bay Road, within the area that contains modified vegetation was deemed not viable by the proponent and land owner. Efficient operation of the proposal requires that the manager has visual access to the site of operations and is within close proximity to the sand extraction facility to effectively facilitate scheduling and operational procedures. The land owner also expressed that locating the site shed and manager's residence further north within the site was not a possibility.

Several locations within close proximity to the point of operations were considered during the planning of the mine in consultation with Wildthing and with consideration given to the constraints of location detailed by the proponent and land owner. Option 1 was situated parallel to proposed extraction operations just north of the Ausgrid easement (Figure 9.1) and was deemed inappropriate. The footprint contained 4 hollow-bearing trees and a large portion of the population of *Diuris praecox*. Through discussions, Option 2 was positioned to the east of the study area where impact on these biodiversity values and indirect impacts to native flora and fauna were minimised. It was also considered that Option 2 (proposed site office/manager's residence development site) out of the two possible options reduced the amount of vegetated corridor requiring removal. As a worst-case scenario, within the study area, the width of the vegetated corridor will be reduced, as a result of the proposed development, from approximately 550m to 450m wide. This is not considered likely to result

in substantial or significant adverse impedance to mobile fauna species and some flora species that may use the vegetation within the study area corridor for dispersal.

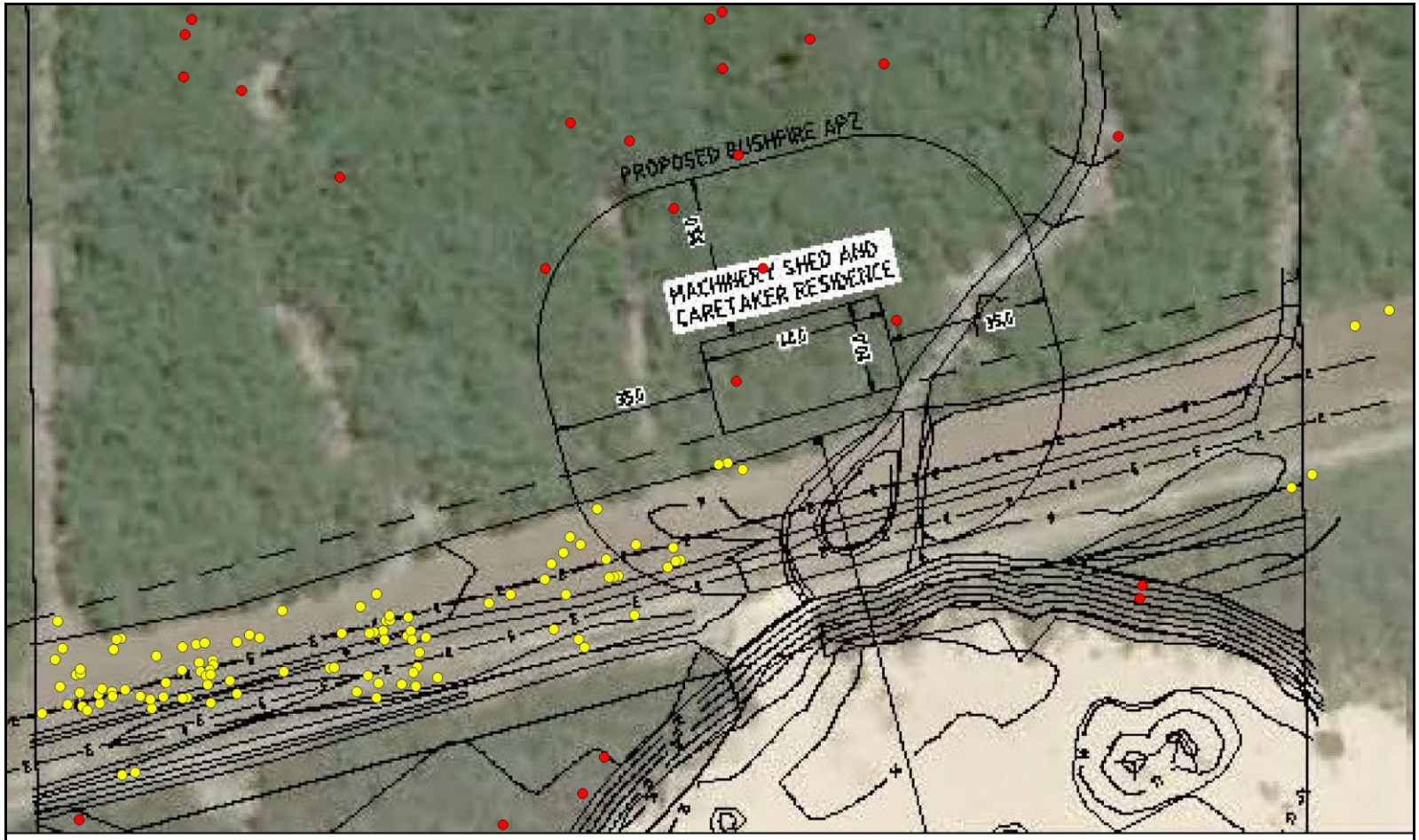


Figure 9.1: Options assessment, Option 1 preliminary plans.

9.2 PLANNING AND DETAILED DESIGN

The proponent has considered biodiversity values present within the study area and sought advice from Wildthing in the planning and detailed design stages of the development layout to avoid, where possible, direct impacts to identified biodiversity values. The current development layout has been selected, in part, to minimise impacts to significant biodiversity values, threatened matters and flora and fauna habitats present within the broader study area.

The presence of the threatened flora species, Rough Doubletail within the study area has affected the final detailed design of the ancillary facilities within the study area (site managers shed and associated APZ). During the conceptual design phase for the proposed development, the ancillary facilities were planned to be located closer to the sand extraction operations area directly adjacent to the north of the Ausgrid easement. A preliminary ecological constraints analysis was conducted by Wildthing during initial scoping of fieldwork, it was determined that a large population of Rough Doubletail was present within the easement. Accordingly, the final development layout was revised, the site manager's shed and associated APZ is now proposed for location within the east of the study area, its revised location contains fewer biodiversity values. A portion of the APZ contains the Vegetation Community DNG, which will not require modification/removal for the establishment of an APZ.

All direct impacts to the area containing the Rough Doubletail have been avoided as has the loss of a significant concentration of hollow-bearing trees present within the southern section of the study area. The final layout and location of the ancillary structure has not been able to completely avoid all biodiversity values, one hollow bearing tree within the shed footprint will require removal and, in addition, one hollow-bearing tree may require removal for the establishment of an APZ.

Access to the sand dunes within the south of the study area will be required for heavy reticulated vehicles and plant machinery to export sand from the study area. Minimisation of the clearance of native vegetation required for vehicle access was considered during the detailed design phase of the development and use of the pre-existing dirt access track running north-south through the study area has been maximised, where feasible, to facilitate vehicle movement. A small section of realignment will be required to allow for the turning circle required for reticulated vehicles and also to allow the space necessary for the relocation of the ancillary facilities within the east of the study area. No further recommendations of avoidance/minimisation were relevant to this phase of the development. Assessment of the residual impact from the layout has been assessed within Section 10.

9.3 CONSTRUCTION

Construction for the proposed development will require removal of native vegetation in support of the installation of ancillary facilities including the managers shed within the east of the study area. Construction of the site managers shed will also require the establishment of an associated asset

protection zone with a radius of approximately 35m from the edge of the building footprint (See Figure 1.2). It is proposed that additional ancillary infrastructure associated with the proposed development, including on-site pump-out septic system, water storage tank and stormwater discharge to a level spreader or infiltration trench will be located within the APZ to avoid removal of additional vegetation. Further road widening to access the proposed development and clearing for connections to electricity will not be required.

During the detailed design phase of the proposed development a final quantitative measure of vegetation removal for the APZ could not be confirmed due to uncertainties regarding the final canopy cover to be retained. Although it is likely that a significant amount of the canopy within this area will be retained, a conservative approach has been adopted and all trees within the APZ have been considered likely to be removed and have been included within the residual impact assessment in Section 10. A portion of the APZ contains the Vegetation Community DNG, which will not require modification/removal for the establishment of an APZ.

A table defining recommendations for further avoidance and minimisation strategies during the construction phase have been detailed below (Table 9.1). The residual impact predicted to occur after considering the avoidance and minimisation strategy above has been detailed within Section 10.

Table 9.1: Further avoidance and minimisation strategies for the construction phase

Nature of Potential Impact	Avoidance/minimisation Strategy Proposed	Timing	Responsibility
Clearing of native vegetation	Where possible, construction works should avoid any impact to mature trees. Where unavoidable, works should minimise impacts to mature trees as follows: • clearing limits will be clearly marked to prevent unnecessary clearing beyond the extent of the development footprint. Tree clearing and disturbance will be limited to the development site; • where a tree must be disturbed the priority should be given to pruning rather than clearing; and • the clearing of any trees should be undertaken in a manner that avoids damaging adjacent vegetation i.e. all trees should be felled into disturbed areas when feasible.	Prior to and during vegetation clearing	Construction site manager
Inadvertent impact to biodiversity values	Priority will be given during construction to avoid any inadvertent impact to significant biodiversity values within the study area. Avoidance measure should include the following: • appropriate signage, such as 'No Go Zone' or 'Environmental Protection Area', and exclusion fencing where relevant, should be installed where construction and operation is near significant biodiversity values i.e. location of Rough Doubletail population; • the location and significance of all ecological	Prior to and during vegetation clearing	Construction site manager

Nature of Potential Impact	Avoidance/minimisation Strategy Proposed	Timing	Responsibility
	constraints within the study area should be made known to all contractors and staff. Annotated site plans should be displayed in lunch room / site offices. Specific management measures required near constraints areas should be discussed in tool box talks and as part of all induction; • all material stockpiles, vehicle parking and machinery storage will be located within cleared areas proposed for clearing, and not in areas of native vegetation that are to be retained; • establishment of wet down areas to reduce dust generation during construction; • implementation of temporary stormwater controls during construction and to ensure that discharges to the drainage channels are consistent with existing conditions; and • temporary erosion and sediment controls (e.g. silt fences, sediment traps) should be installed prior to construction to avoid disturbance and degradation of soils and nearby features (e.g. water ways, adjacent habitat and vegetation). These should conform to the specifications in Soils and Construction 'Blue Book' (Landcom, 2004) and should be maintained throughout the construction process until soil is successfully stabilised.		
Clearing of fauna habitat, resulting in fauna injury and/or mortality	A suitably qualified and experienced ecologist should be engaged to supervise removal of all significant habitat features as displayed in Figure 8.1 and maintain a vegetation clearance register which should include the location, type, size of felled habitat trees and any contact with resident fauna. The supervising ecologist will work co-operatively with the plant operator to develop an adaptive clearance methodology that should minimise impacts to potential resident fauna whilst being conducted according to safe work methods. The adaptive clearance methodology should include the following key aspects: • seeking consultation with a suitably qualified ecologist to determine the best time to schedule clearance works to avoid nesting and breeding times for resident fauna; • preclearance surveys completed on the morning of any clearance works to determine if any nesting birds or canopy dwelling mammals are within the clearance footprint; • clearing utilising a 'soft felling' technique in which trees are 'nudged' by machinery and fauna given time to leave (overnight), and nudging of habitat trees on the	Prior to and during vegetation clearing	Construction site manager and suitably trained fauna handler

Nature of Potential Impact	Avoidance/minimisation Strategy Proposed	Timing	Responsibility
	day of clearing before slowly felling the tree; • if fauna is identified within the proposed clearing area prior to clearing, or after 'nudging' the tree, operations will cease until the fauna has moved to a safe location or has been relocated. If fauna flee into a habitat tree demarcated for removal this tree should also be nudged and left to fell until the following day. This tree should then be nudged again on the day of clearing; • any captured displaced fauna relocated to the nearest area of appropriate habitat. If arboreal, the fauna to be placed inside an artificial nest box and relocated. If the displaced fauna is nocturnal relocation to occur during dusk; and • all hollow logs and felled trees would be inspected by the ecologist before relocation into areas of similar adjacent habitat All habitat tree felling activities and results to be summarised in a tree clearance report by the supervising ecologist, including fauna injuries. Any animals injured during construction should be taken immediately to the Salamander Bay Veterinary Clinic (Open 9am-6pm weekdays) for treatment. Any animals suspected to require rehabilitation would be delivered post-veterinary care to an appropriate animal rehabilitator associated with Wildlife in Need of Care (phone # 1300 946 295). All fauna sightings/captures would be recorded and uploaded to the NSW Wildlife Atlas.		
Salvage of significant habitat features	Habitat salvage within the development footprint should be undertaken during clearance activities, with the salvage methodology including the following key aspect: • Tree limbs containing natural hollows should be relocated and restored for use by fauna in the nearest adjacent area of similar habitat by a suitably qualified ecologist. Where natural hollows cannot be relocated, an artificial nest box should be installed onto a tree in the nearest adjacent area of similar habitat by a suitably qualified ecologist. Installation of nest boxes should be undertaken in accordance with Part B1 of Port Stephens Councils Development Control Plan (Port Stephens Council 2014). Where removal of woody debris is required: • dead trees and woody debris that are removed (diameter >10 cm) to be placed in the nearest adjacent area of similar habitat by a suitably qualified ecologist.	Prior to and during vegetation clearing	Construction site manager and suitably trained fauna handler

9.4 OPERATION

The operational effects of the proposed development will primarily be restricted to the sand extraction process within the south of the study area and the associated entry/egress of reticulated vehicles and plant machinery via Nelson Bay Road. Initially, the extraction of sand will be restricted to the area of Stockton Sand Dunes that has encroached into the study area (approximately 1 ha), as displayed in Figure 1.2. This area is primarily composed of bare Aeolian sand with a small amount of native vegetation which has a low structure, function and composition score (see Table 6.2).

The sand material to be mined is transgressive by nature and its extent is constantly changing according to prevailing winds buffeting the study area from the south. It is expected, based upon previous observations made by the proponent that the dunes to the east and west of the current sand incursion area will advance over time eventually encompassing all native vegetation present to the south of the Ausgrid easement. If this is to occur the proponent will extend sand extraction operations to include this area and create a barrier to protect the remaining vegetation as per the Rehabilitation Plan (Wildthing Environmental Consultants, 2020). Before this occurs, the proponent should contract a BAM accredited assessor to re-evaluate the current coastal forest areas south of the Ausgrid easement to determine if sand incursion has occurred to a degree where the coastal forest does not support significant function, composition and structure scores.

A table defining recommendations for further avoidance and minimisation strategies during the operation phase has been detailed below (Table 9.2). The residual impact predicted to occur after considering the avoidance and minimisation strategy above has been detailed within Section 10.

Table 9.2: Further avoidance and minimisation strategies for the operation phase

Nature of Potential Impact	Avoidance/minimisation Strategy Proposed	Timing	Responsibility
Avoiding operational impacts on flora and fauna	Measures to reduce impact to resident fauna and flora within the study area during the operations phase should be implemented including: • vehicle movement within the study area to be restricted to operational hours of 9am-5pm Monday-Friday; • vehicle speed within the study area to be limited according to adjacent habitat value and road condition (e.g. 10km/hr); • no workers to be permitted to bring dogs onto the site; • all food waste to be disposed of in covered waste bins; and • a register of all disturbances to fauna caused during site operations to be kept and updated by the site manager, In addition, measures to supply further protection from operation impacts to the Rough Doubletail population within	For life of operational phase	Site Manager

	the Ausgrid easement should be considered, this could be inclusive of permanent exclusion fencing, sedimentation barriers and spill management controls. All measures to further protect this population would be sought in consultation with Ausgrid who maintain ownership and responsibility for the easement and require periodic access for maintenance works.		
Assisting injured fauna	Any animals injured during operations should be taken immediately to the Salamander Bay Veterinary Clinic (Open 9am-6pm weekdays) for treatment. Any animals suspected to require rehabilitation would be delivered post-veterinary care to an appropriate animal rehabilitator associated with Wildlife in Need of Care Phone 1300 946 295).	For life of operational phase	Site Manager
Minimise weed infestations	The following measures should be implemented to prevent exotic plant material from entering/exiting the study area: • no imported/exported material to be permitted unless it has been inspected and confirmed to be free of dirt and mud which may contain weed seeds and vegetative material such as bulbs, root fragment, tubers or rhizomes; and vehicles and machinery to be clean of soils, vegetation and seeds that have been brushed off or washed down prior to entering the study area A clean down register to be maintained at the entry of the study area	For life of operational phase	Site Manager
Treat existing weed infestations	All employees and sub-contractors working within the study area should be educated on the identification of noxious weed species known to occur or with potential to occur during site specific induction. A protocol of reporting and mapping any sightings of these species would be developed by the site manager. As a part of maintenance within the study area any high threat weeds known to occur will be controlled in accordance with appropriate DPI guidelines. Guidelines for the treatment of high threat weeds can be sourced within the DPI website (DPI, 2018).	For life of operational phase	Site Manager
Prevention of excessive dust	Unsealed access roads and operational areas should be regularly watered to limit dust generation, particularly in windy conditions.	For life of operational phase	Site Manager
Reduce impacts of artificial lighting	Any artificial lighting used for security at night should be angled/directed downwards to avoid excessive light pollution affecting adjacent habitat.	For life of operational phase	Site Manager

9.5 MEASURES TO MAINTAIN OR IMPROVE HABITAT OF SPECIES CREDIT SPECIES THAT OCCUR ON SITE

It is recommended that a Biodiversity Management Plan (BMP) be conditioned upon approval of the proposed development. The following measures should be considered in the BMP to maintain or improve the habitat for the two Species Credit Species recorded within the site.

Table 9.3: Measures to be considered in the BMP to maintain or improve habitat for Species Credit Species recorded within the site.

Species Credit Species Recorded on Site	Measures to maintain or improve habitat	Timing	Responsibility to implement measures
Diuris praecox Rough Doubletail	• Specialised weed control and understorey management within areas adjacent to the Ausgrid easement to enhance habitat of *Diuris praecox* and promote expansion of the current population • All specimens of *Diuris praecox* within the subject site are to be protected from unintended removal/disturbance during construction and other associated activities. This will require the erection of a barrier fence to create a 15m wide vegetated buffer zone between the development and *Diuris praecox* to protect the threatened species. • As Ausgrid are responsible for the easement it will also be important to liaise with Ausgrid regarding maintenance of the easements and erection of the barrier fence to minimise impacts and support the protection of *D. arenaria*. • Signage should be erected detailing no-go areas to prevent trampling or removal of *D. praecox* individuals. • The removal of grazing livestock (notably goats and sheep observed grazing within the site) from *D. praecox* habitat to prevent the compaction of soil and consumption of plants.	During the construction phase and for life of operational phase	Site Manager
Burhinus grallarius (Bush-stone Curlew)	• Placement of fallen timber (piled logs) into areas of managed understorey to provide essential habitat for foraging and camouflage for day time roosts for the Bush Stone-Curlew • Undertake Fox control activities annually • Prior to any development works during the breeding season additional surveys for the Bush Stone-curlew will need to be undertaken to ensure any breeding on site is not impacted. It would be favourable if works are undertaken outside the breeding season • The removal of grazing livestock (notably goats and sheep observed grazing within the site) from known Bush Stone-Curlew habitat to mitigate the potential for nests, eggs and hatchlings being trampled	During the construction phase and for life of operational phase	Site Manager

	• Ensuring that maintenance slashing of the APZ occurs outside the spring-summer breeding/nesting period for the Bush Stone-curlew (slashing to occur in the months of April-July) • Any Bush Stone-Curlew nest observed within the site are to be immediately signposted to warn people not to enter the nesting area.		

10.0 ASSESSMENT OF RESIDUAL IMPACTS

In accordance with Section 9 of the BAM this section provides assessment of the extent of the residual impacts unable to be feasibly avoided and an assessment of the likelihood of residual indirect impacts which may occur after considering the feasibility of avoidance and minimisation strategies proposed within Section 9. A Rehabilitation Plan has also been prepared for the proposed development (Wildthing Environmental Consultants, 2020)

10.1 DIRECT RESIDUAL IMPACTS

The construction phases of the proposal have the potential to directly impact biodiversity values. This would occur through impacts such as vegetation clearance in support of the installation of ancillary facilities and the loss of individual habitat trees. These impacts will be permanent and will occur from the outset of the development works. Mitigation measures outlined in Section 9 above will help to minimise the potential impacts to biodiversity values that remain present within the study area. A portion of the proposed APZ contains the Vegetation Community DNG, which will not require modification/removal for the establishment of an APZ.

The direct impacts arising from the project include:

- the removal of 0.62 ha of Vegetation Zone 1648_Intact
- the removal of 0.02ha of Vegetation Zone 1648_Intact for haul road widening below the area of the dam. No additional widening is required for the haul road above the area of the dam;
- the removal of 0.06 ha of Vegetation Zone 1204_Sparse
- the potential removal of 2 hollow-bearing trees within Vegetation Zone 1648_Intact
- the removal of threatened species habitat, including the removal of 0.64 ha of suitable habitat for the species credit species Rough Doubletail

10.2 INDIRECT RESIDUAL IMPACTS

Indirect impacts occur when the proposal or activities relating to the construction or operation of the proposal affect native vegetation, threatened ecological communities and threatened species habitat beyond the study area. Impacts may also result from changes to land-use patterns. Table 10.1 provides an assessment of the potential indirect residual impacts on the study area and adjacent vegetation in accordance with Section 9.1.4.2 of the BAM.

Table 10.1: Indirect Impact Assessment

Indirect Impact	Assessment/ Likelihood of Occurrence
Inadvertent impacts on adjacent habitat or vegetation	The proposed development has the potential to result in inadvertent impacts on adjacent retained habitat or vegetation. However, the mitigation measures described above will minimise the likelihood of

	occurrence of this indirect impact during the construction phase of the project.
Reduced viability of adjacent habitat due to edge effects	The proposed development will not result in a significant increase in edge effects impacting upon the retained vegetation. The majority of the site has been historically disturbed and as such edge effects have been an ongoing impact to the retained vegetation within the study area. The proposed development will increase edge effects to a small portion of the vegetation present in the southern and eastern corners of the study area. This vegetation is currently disturbed and will remain connected to other areas of higher condition vegetation and as such any increased edge effects are expected only to result in negligible impacts.
Reduced viability of adjacent habitat due to noise, dust or light spill	The proposed development has the potential to result in impact to fauna habitat due to noise, dust and light spill. However, the mitigation measures described above will minimise the likelihood of occurrence of this indirect impact during the construction and operational phase of the project. An air quality impact assessment has been conducted to assess the cumulative impacts of the sand extraction activity during the operations phase (Advitech 2018).
Transport of weeds and pathogens from the site to adjacent vegetation	The proposed development has the potential to result in an increase of weed spread within the study area and adjacent vegetation. However, the mitigation measures described above will minimise the likelihood of occurrence of this indirect impact during the construction and operation phase of the project.
Increased risk of starvation, exposure and loss of shade or shelter	This is unlikely to occur as the proposed development will not substantially modify vegetation within the study area or surrounding habitat such that a significant loss in foraging, hunting and shelter resources would occur.
Loss of breeding habitats	Two hollow-bearing trees were recorded within the development footprint and both could potentially require removal as a result of the proposed development. However, the mitigation measures described above will ensure that no net loss of hollows will result from the proposed development.
Trampling of threatened flora species	The proposed development has the potential to result in inadvertent impacts to a population of Rough Doubletail within the study area via inadvertent trampling. A method for ensuring the protection of this population i.e. appropriate signage and exclusion fencing, should be sought by the client in consultation with Ausgrid.
Inhibition of nitrogen fixation and increased soil salinity	The proposed development will not result in the removal of a substantial area of native vegetation, there are also large patches of vegetation, both within and adjacent to the study area, that will not be impacted. As such it is not considered likely that nitrogen fixation or soil salinity will be impacted.
Fertiliser drift	No fertiliser is proposed to be used.
Rubbish dumping	Mitigation measures outlined above and standard construction environmental controls will ensure potential impact from rubbish dumping is minimised.
Wood collection	The proposed development is industrial in nature and it is considered unlikely those persons who will work at the site will collect wood from the retained vegetation.

Bush rock removal and disturbance	The sandy soil present within the study area does not support bush rock.
Increase in predatory species populations	There is no proposed change to land use that will likely lead to an increase in predatory species populations
Increase in pest animal populations	There is no proposed change to land use that will likely lead to an increase in pest animal populations.
Increased risk of fire	There is no proposed change to land use that will likely lead to an increased risk of fire.
Disturbance to specialist breeding and foraging habitat, e.g. Beach nesting for shorebirds	No specialist breeding habitat occurs within the study area. A number of shorebirds are likely to utilise Stockton Sand Dunes for both foraging and nesting; however, no shorebird species have been recorded within the sand dunes likely to be affected both directly and indirectly by the operational phase of the proposed development.
Fragmentation of movement corridor.	As outlined in Figure 3.1 and Section 3.5 of this report, vegetation to be removed within the study area comprises the eastern extent of a key green corridor and regionally significant habitat linkage, linking habitats surrounding the study area and across the greater landscape from the Watagans and Yengo National Parks to the coastal plains of the Tomago Sand beds, Stockton Bight and Port Stephens. As a worst-case scenario, within the study area, the width of the vegetated corridor will be reduced, as a result of the proposed development, from approximately 550m to 450m wide. This is not considered likely to result in substantial or significant adverse impedance to mobile fauna species and some flora species that may use the vegetation within the study area corridor for dispersal. Large areas of vegetation, present in similar ecological condition, will be retained maintaining the corridor at, or just below, its current functionality. Direct impacts to this movement corridor (removal of 0.62 hectares of vegetation at the southern boundary of the corridor) are considered incremental and minor when being considered at the landscape scale. Indirect impact to this corridor from the proposed development would be primarily restricted to a potential increase in vehicle strikes of fauna arising from increased heavy vehicle movement within the study area. However, the mitigation measures described above will minimise the likelihood of occurrence of this indirect impact during the construction phase of the project

10.3 PRESCRIBED IMPACTS

Prescribed impacts are the impacts on biodiversity values which are not related to, or are in addition to, native vegetation clearing and habitat loss (Section 6.7 of the BAM). In general, these types of impacts identify habitat or features of the environment that are irreplaceable. Assessment of prescribed biodiversity impacts are outlined and addressed in Table 10.3 below.

Table 10.2 Prescribed Impacts Assessment

Prescribed impact	Assessment / likelihood of occurrence
Impacts of development on the habitat of threatened species or ecological communities associated with karst, caves, crevices, cliffs and other features of geological significance.	No karst, caves, crevices, cliffs and other features of geological significance will be impacted by the proposed works.
Impacts of development on the habitat of threatened species or ecological communities associated with rocks.	No significant clusters of rocks were present within the study area.
Impacts of development on the habitat of threatened species or ecological communities associated with human made structures.	No human made structures will be impacted by the proposed works.
Impacts of development on the habitat of threatened species or ecological communities associated with non-native vegetation.	An area of non-native vegetation was recorded within the north of study area in the form of maintained introduced grass and a small number of exotic trees and shrubs. No threatened species that rely on this non-native vegetation as a habitat resources were recorded or predicted to occur within the study area during the assessment.
Impacts of development on the connectivity of different areas of habitat of threatened species that facilitates the movement of those species across their range.	As outlined in Table 10.1, vegetation to be removed within the study area comprises the eastern extent of a key green corridor and regionally significant habitat linkage, linking habitats surrounding the study. In line with the assessment within Table 10.1, the small amount of vegetation removal proposed is not considered likely to result in substantial or significant adverse impedance to mobile fauna species and some flora species that may use the vegetation within the study area corridor for dispersal.
Impacts of the development on movement of threatened species that maintains their life cycle	A number of threatened species are likely to utilize the vegetation within the study area however the movement of threatened species throughout the study area is not expected to be adversely affected given the recommendations of avoidance and minimisation of impacts within Section 9.
Impacts of development on water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities (including subsidence or upsidence resulting from underground mining or other development)	No waterbodies or waterways were present within the study area. In addition, no aquifers or ground water dependant ecosystems were mapped within the study area (BoM 2018) nor would the operational effects of the proposed development require penetration of an aquifer.
Impacts of wind turbine strikes on protected animals	N/A
Impacts of vehicle strikes on threatened species of animals or on animals that are part of a TEC	Vehicle strikes on threatened species have the potential to occur within the construction and operational phase of the development. Methods to avoid potential occurrences of vehicle strike on threatened species have been detailed within Section 9.

10.4 IMPACTS TO GROUNDWATER DEPENDENT ECOSYSTEMS

The study area is not mapped as being a ground water dependant ecosystem (BoM 2018) or associated with a known aquifer.

The NSW DPI step by step guide for assessing a proposal against the NSW Aquifer Interference Policy states: *If an activity is not defined as an aquifer inference activity, then assessment is not required under the Aquifer Interference Policy.*

The Water Management Act defines an aquifer interference activity as an activity involving any of the following:

- The penetration of an aquifer.
- The interference with water in an aquifer.
- The obstruction of the flow of water in an aquifer.
- The taking of water from an aquifer in the course of carrying out mining, or any other activity prescribed by the regulations., and/or the disposal of that water.

The proposed development is not associated with any mapped Groundwater Dependent Ecosystems (GDEs), nor will it require significant subsurface penetration or aquifer interference activity and as such, will not impact upon GDEs.

10.5 SERIOUS AND IRREVERSIBLE IMPACTS (SAII)

The principles used to determine if a development will have serious and irreversible impacts, include impacts that:

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

No threatened matter consistent with a SAII candidate species identified as likely to occur or to contain significant habitat within the study area is likely to be impacted by the proposed development

10.6 ADAPTIVE MANAGEMENT STRATEGY

No adaptive management strategy is proposed for the development.

11.0 BIODIVERSITY CREDITS

This section outlines the thresholds for assessment and offsetting in accordance with Section 10 of the BAM.

11.1 IMPACTS ON VEGETATION ZONES NOT REQUIRING OFFSETS

A 0.11ha area of maritime grassland associated with vegetation zone 1204_Sparse (Vegetation Integrity Score - 0.6) was present within the sand dune incursion within the south of the study area and will require complete removal during sand extraction operations. As outlined in Section 10.3.1 of the BAM, offset credit value under the BOS is required to be determined for all impacts of development on vegetation zones that have a vegetation integrity score of:

- *≥15 where the PCT is representative of an endangered or critically endangered ecological community, or*
- *≥17 where the PCT is associated with threatened species habitat (as represented by ecosystem credits), or is representative of a vulnerable ecological community, or*
- *≥20 where the PCT is not representative of a TEC or associated with threatened species habitat.*

Vegetation zone 1204_Sparse is not a TEC, however it could potentially provide habitat for threatened species. As such, with a vegetation integrity score of 0.6 (i.e. ≤17), offsets are not required for impact to this vegetation zone.

11.2 IMPACTS REQUIRING OFFSETS UNDER THE BIODIVERSITY OFFSETS SCHEME

The following Sections provide a breakdown of the credit requirement for the proposed development in accordance with Section 10 of the BAM.

11.2.1 ECOSYSTEM CREDITS

The PCTs and vegetation zones requiring offset credits and the ecosystem credits required are documented in Table 11.1. A copy of the BAM Credit Summary Report is contained in Appendix G.

Table 11.1: Summary of ecosystem credits required.

Vegetation Zone	Total Area	Area Proposed for Removal	Current Vegetation Integrity Score	Change in Vegetation Integrity Score	Loss of Hollow Bearing Trees	Ecosystem Credits Required
1648 - Smooth-barked Apple - Blackbutt heathy open forest of the Tomaree Peninsula						
1648_Intact	6.11	0.64	62.5	0.1	2	17
				Total	2	17
1204 - Spinifex beach strand grassland, Sydney Basin Bioregion and South East Corner Bioregion						
1204_Sparse	0.06	0.06	0.6	-0.6	0	0
				Total	0	0

Species credits

An offset is required for the threatened species impacted by the development that require species credits. These species and the species credits required are documented in Table 11.2.

Table 11.2 Species credit species that require offsets

Species credit Species	Biodiversity Risk Weighting	Area of habitat or count of individuals lost	Species credits required
Diuris praecox (Rough Doubletail)	1.5	0.64 ha	15
Burhinus grallarius (Bush-stone Curlew)	2	0.64 ha	20

A total of the offset credits required to be retired, as generated by the BAM-CC, has been provided in Appendix D of this report.

11.3 OFFSETTING OF BIODIVERSITY CREDITS

As the client does not own the subject land, they have indicated the credits will be offset by payment into the Biodiversity Conservation Fund (BCF) to satisfy an offset obligation.

11.4 OFFSETS REQUIRED UNDER THE EPBC ACT

Offsetting requirements for potential impacts to suitable habitat for the nationally listed species *Diuris praecox* (Rough Doubletail) have been addressed under state legislation and thus are not considered to be warranted under federal legislative frameworks. No other species listed under the EPBC Act has been identified as having the potential to be significantly impacted by the development. As such, the proposal is not considered to require offsets in accordance with the EPBC Offsets Policy.

12.0 CONCLUSION

Wildthing Environmental Consultants have prepared this BDAR on behalf of the proponent for a proposed sand extraction facility and site office/manager's residence in Anna Bay, NSW. The purpose of this BDAR was to address the requirements of the BAM and to address the biodiversity matters raised in the SEARs.

In this BDAR, biodiversity impacts have been assessed through:

- Comprehensive mapping and assessment completed in accordance with the BAM
- The identification of a threatened species of flora within the development site, the impacts to which have been adequately assessed
- Mitigation measures which have been outlined to reduce the impacts to biodiversity
- The generation of 17 Ecosystem Credit within the development site for impacts to native vegetation and the generation of 15 Species Credit for impacts to the Rough Doubletail and 20 Species Credit for the impact to Bush-stone Curlew.

The retirement of these credits can be carried out in accordance with the NSW Biodiversity Offsets Policy for Major Proposals, and will be achieved by either:
(a) retiring credits under the Biodiversity Offsets Scheme
(b) making payments into the Biodiversity Conservation Fund
(c) funding a biodiversity action

As the client does not own the subject land, they have indicated the credits will be offset by payment into the Biodiversity Conservation Fund (BCF) to satisfy an offset obligation.

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APPENDIX A
ASSESSMENT AGAINST BIODIVERSITY LEGISLATION

This appendices gives consideration to supporting biodiversity legislation relevant to the study area and the proposed development. The following legislative frameworks have been addressed in this Appendix:

- Environment Protection and Biodiversity Conservation Act 1999
- Coastal Management SEPP
- The Port Stephens Comprehensive Koala Plan of Management
- Biosecurity Act 2015

A.1 ENVIRONMENT PROTECTION AND BIODIVERSITY CONSERVATION ACT 1999

An assessment of the impacts of the proposed development on Matters of National Environmental Significance, against heads of consideration outlined in Commonwealth of Australia (2013) was prepared to determine whether referral of the project to the Commonwealth Minister for the Environment is required. MNES relevant to the project are summarised in Table A.1.

Table A1: MNES relevant to the study area

MNES	Project Specifics	Potential For Significant Impact
Threatened species	One nationally listed flora species Sand Doubletail was recorded to occur within the study area. No loss of individuals of this species will be required as a result of the proposed development, it is expected that approximately 0.81 ha of suitable habitat will require removal as a result of the proposal. The loss of suitable habitat for this species has been addressed in Section 9-10 of this report and compensatory offsetting for this species under the BC Act have been defined in Section 11. Provided that the recommendations for offsetting the impact to this species and the recommendation for the protection of individuals within the study area are undertaken it is unlikely that the proposed development will result in a significant impact to this species. No other nationally significant flora or fauna species are likely to be impacted from the proposal.	Significant impact unlikely to result from the proposed development.
Threatened Ecological Communities	A review of the most relevant mapping dataset for the study area (see Section 5.1) and the locality showed that no nationally listed threatened ecological communities were present within the study area, this was verified via detailed floristic and vegetation surveys conducted within the study area to inform the body of this report.	Significant impact unlikely to result from the proposed development.
Migratory species	52 migratory bird species have been recorded or are predicted to occur in the locality. The study area does not provide nationally important habitat for any of these species.	Significant impact unlikely to result from the proposed development.
World Heritage properties	The proposed development is not considered to affect any World Heritage properties.	Significant impact unlikely to result from the proposed development.
Wetlands of international	The Myall Lakes Ramsar site is with 10km of the site. There is no hydrological connection between the study area and the Myall Lakes Wetland,	Significant impact unlikely to result from the proposed development.

MNES	Project Specifics	Potential For Significant Impact
importance (Ramsar)	hence the proposal is unlikely to a significant impact on these wetlands.	
Nuclear activities	The proposal does not involve any type of nuclear activity.	Significant impact unlikely to result from the proposed development.
Commonwealth marine environment	The proposal does not involve the modification of the Commonwealth marine environment.	Significant impact unlikely to result from the proposed development.

On this basis, no significant impacts are predicted to result from the proposed development and referral of the Project to the Australian Government Minister for the Environment will not be required.

A.2 COASTAL MANAGEMENT SEPP

A key aim of the Coastal Management SEPP (CM SEPP) is to promote an integrated and co-ordinated approach to land use planning in the coastal zone in a manner consistent with the objects of the Coastal Management Act 2016, including the management objectives for each coastal management area, by:

- managing development in the coastal zone and protecting the environmental assets of the coast, and
- establishing a framework for land use planning to guide decision-making in the coastal zone, and
- mapping the 4 coastal management areas that comprise the NSW coastal zone for the purpose of the definitions in the Coastal Management Act 2016.

The Coastal Management SEPP identifies four coastal management areas that comprise the coastal zone. These are:

- the coastal wetlands and littoral rainforests area,
- the coastal vulnerability area,
- the coastal environment area, and
- the coastal use area.

The CM SEPP imposes targeted development controls for these areas to guide appropriate development within the coastal zone.

The study area is located within a mapped area of "Coastal Environment Area", the development controls for this area, as listed within Division 4 of the CM SEPP have been addressed below.

(1) Development consent must not be granted to development on land that is within the coastal environment area unless the consent authority has considered whether the proposed development is likely to cause an adverse impact on the following:

- *the integrity and resilience of the biophysical, hydrological (surface and groundwater) and ecological environment,*
- *coastal environmental values and natural coastal processes,*
- *the water quality of the marine estate (within the meaning of the Marine Estate Management Act 2014), in particular, the cumulative impacts of the proposed development on any of the sensitive coastal lakes identified in Schedule 1,*
- *marine vegetation, native vegetation and fauna and their habitats, undeveloped headlands and rock platforms,*
- *existing public open space and safe access to and along the foreshore, beach, headland or rock platform for members of the public, including persons with a disability,*
- *Aboriginal cultural heritage, practices and places; and*
- *the use of the surf zone.*

The potential impacts of the proposed development are primarily restricted to the removal of approximately 0.92 ha of coastal vegetation and associated biodiversity values. Methods of avoidance, minimisation and compensatory offsetting have been detailed within this report. Given the mitigation

methods detailed within this report, impacts to coastal vegetation and associated biodiversity values are expected to be of an incremental nature.

A.3 CONSIDERATIONS UNDER THE PORT STEPHENS COMPREHENSIVE KOALA PLAN OF MANAGEMENT

The Port Stephens Comprehensive Koala Plan of Management (CKPoM) has been prepared for the Port Stephens LGA in accordance with SEPP 44 – 'Koala Habitat Protection'. The principal aim of the Port Stephens CKPoM is to encourage the proper conservation and management of areas of natural vegetation that provide habitat for Koalas to ensure a permanent free-living population over their present range and to reverse the current trend of Koala population decline.

Koala Habitat Assessments under the Port Stephens CKPoM involve four stages: preliminary assessment, vegetation mapping, Koala habitat identification and assessment of the proposal. A Koala habitat assessment has been completed below specifically for the development of this site.

A.3.1 PRELIMENARY ASSESSMENT

The preliminary assessment for the study area involves reviewing the Koala Habitat Planning Map for the area as contained in the CKPoM and undertaking a site inspection to determine whether the study area contains individuals of Koala trees outside areas marked as 'Preferred Koala Habitat'. Review of the Koala Habitat Planning Map showed the site to contain two Koala habitat categories:

- 'Supplementary Koala Habitat';
- 'Mainly Cleared'

The majority of the site has been designated as 'Supplementary Koala Habitat' with a small patch in the north of the site designated as 'Mainly Cleared' (Figure A.1).

Within the CKPoM there are three species of Eucalypt identified as Koala food trees, being *Eucalyptus robusta* (Swamp Mahogany), *Eucalyptus parramattensis* subsp. *decadens* (Drooping Red Gum) and *Eucalyptus tereticornis* (Forest Red Gum). No feed tree species were present in the study area.

A.3.2 VEGETATION MAPPING

The next step in the Koala Habitat Assessment is to provide a description of the vegetation assemblages present within the study area and to compare the results of the vegetation survey conducted for this report with the LGA wide vegetation map.

As detailed in Section 5.0, two PCTs were found to be present on the study area:

- PCT-1648 - Smooth-barked apple - blackbutt heathy open forest of the Tomaree Peninsula
- PCT-1204 - Spinifex beach strand grassland, Sydney Basin Bioregion and South East Corner Bioregion

Review of the relevant LGA vegetation map (Figure 2.5 in Part 2: CKPoM Resource Document) showed vegetation on the site as being composed of two vegetation assemblages:

- 3. – Blackbutt and Smooth-barked Apple Open Forest
- 25 – Mainly cleared

Blackbutt and Smooth-barked Apple Open Forest was mapped over the majority of the study area. A small area of Mainly Cleared vegetation were present in the north-east of the site. The field investigation results were found to be consistent with the LGA vegetation map except for a small area in the south of the site composed of PCT-1204, which would be consistent with the LGA mapping as Mainly Cleared.

A.3.3 KOALA HABITAT IDENTIFICATION

Koala Habitat Identification involves:

- the application of the definitions of Preferred and Supplementary Koala Habitat detailed by Lunney *et al*. (1998) to the study area;
- the application of Habitat Buffers to all areas of Preferred Koala Habitat; and
- approximation of Habitat Linking Areas between all patches of Preferred Koala Habitat that occur within 800m of each other.

Under the definitions provided by Lunney *et al.* (1998):

- Preferred Koala Habitat is defined as a combination of the all field survey Primary, Secondary and Community Survey category A/B (regardless of whether or not they overlap);
- Supplementary Habitat – where field survey Marginal and Community Survey Category C/D overlap;
- Marginal Koala Habitat – where field survey Marginal and Community Survey Category E overlap.

<u>Field Survey</u>

The area of PCT-1648 was found to be most consistent with the Community Survey Category C - Tall Open Blackbutt and Sydney Red Gum Forest. The description of the map-based habitat category based on field work is most likely to be Marginal Koala Habitat – Vegetation associations containing low densities of species known to be preferred by Koalas. Where field survey Marginal and Community Survey Category C/D overlap Supplementary Habitat is obtained. The north-east and south-east portions of the site are consistent with the Community Survey category Cleared - Mainly Cleared Land (some trees). Hence Mainly Cleared is obtained for these areas.

No Koala Feed Tree Species were present nor were any areas of Preferred Koala Habitat present within the site.

A.3.4 ASSESSMENT OF THE PROPOSAL

There are eight performance criteria applied to developments proposed on sites that contain or are adjacent to 'Preferred Koala Habitat', Supplementary Koala Habitat', 'Habitat Buffers', 'Habitat Linking Areas' or areas that contain preferred Koala feed tree species. Each criterion is displayed in italics followed by the site-specific answer.

The proposed development must:

a) *Minimise the removal or degradation of native vegetation within Preferred Koala Habitat or Habitat Buffers*.

No areas of Preferred Koala Habitat or Habitat Buffers were present within the site hence the proposal will not result in the removal or degradation of any of these areas.

b) *Maximise retention and minimise degradation of native vegetation within Supplementary Koala Habitat and Habitat Linking Areas;*

Approximately 0.59ha of Supplementary Koala Habitat will be required to be removed for the proposed development. No Habitat Linking Areas are required to be removed. Approximately 9.64ha of Supplementary Koala Habitat will be retained within the site.

c) *Minimise the removal of any individuals of preferred Koala food trees, wherever they occur on a study area. In the Port Stephens LGA these tree species are Eucalyptus robusta (Swamp Mahogany), Eucalyptus parramattensis (Parramatta Red Gum) and Eucalyptus tereticornis (Forest Red Gum);*

No species of recognised preferred Koala food trees were found to be present within the study area, hence the proposal will not result in the removal of any individual feed trees.

d) *Make provisions, where appropriate, for restoration or rehabilitation of areas identified as Koala Habitat including Habitat Buffers and Habitat Linking Areas over Mainly Cleared Land;*

Approximately 4.56ha in the north of the site identified as Supplementary Koala Habitat has been subject to recent disturbance in the form of underscrubbing. Weeds should be controlled within this area to prevent further degradation and allow native species to regenerate.

e) *Make provisions for long term management and protection of Koala habitat including both existing and restored habitat;*

Native vegetation existing north of the easement should be protected and enhanced. Areas which have been subject to recent vegetation should be allowed to regenerate to their original state.

f) *Not compromise the potential for safe movement of Koalas across the site. This should include maximising tree retention generally and minimising the likelihood that the proposal would result in the creation of barriers to Koala movement, such as would be imposed by certain types of fencing;*

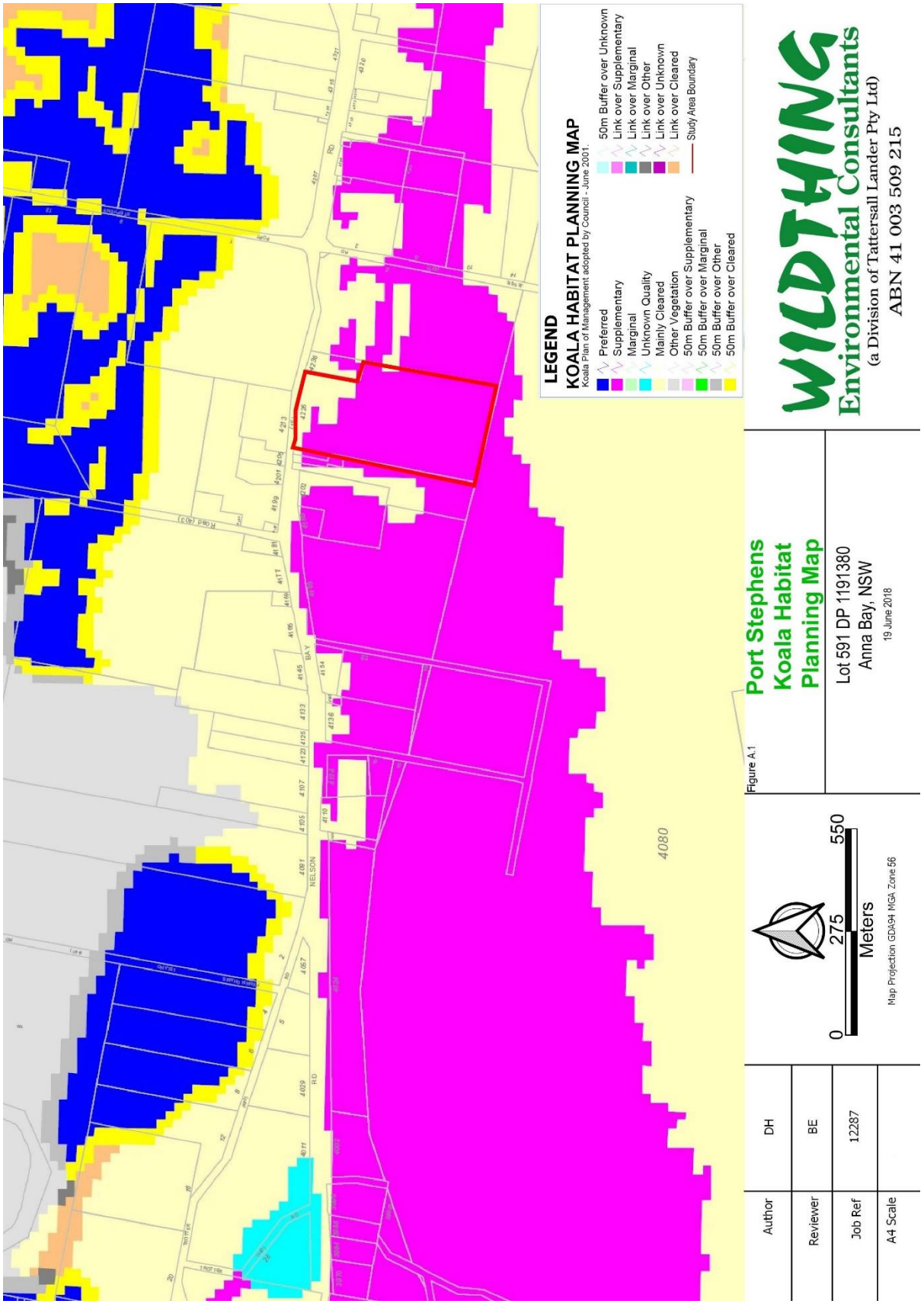
Methods of mitigation of impacts to resident fauna and to allow the safe movement of fauna across the study area have been proposed in Section 9.3.

g) *Be restricted to identified envelopes which contain all buildings and infrastructure and fire fuel reduction zone;*

The development footprint has been defined in this report. Provisions to prevent inadvertent impact to adjacent habitat and biodiversity values have been made in Section 9.2.

h) *Include measures to effectively minimise the threat posed by Koalas by dogs, motor vehicles and swimming pools.*

Methods of mitigation of impacts to resident fauna and to allow the safe movement of fauna across the study area have been proposed in Section 9.3.


LEGEND
KOALA HABITAT PLANNING MAP
Koala Plan of Management adopted by Council - June 2001.
Preferred
Supplementary
Marginal
Unknown Quality
Mainly Cleared
Other Vegetation
50m Buffer over Supplementary
50m Buffer over Marginal
50m Buffer over Other
50m Buffer over Cleared
50m Buffer over Unknown
Link over Supplementary
Link over Marginal
Link over Other
Link over Unknown
Link over Cleared
Study Area Boundary
4080
NELSON
BAY
RD
WILDTHING
Environmental Consultants
(a Division of Tattersall Lander Pty Ltd)
ABN 41 003 509 215
Figure A.1
Port Stephens
Koala Habitat
Planning Map
Lot 591 DP 1191380
Anna Bay, NSW
19 June 2018
0
275
550
Meters
Map Projection GDA94 MGA Zone 56
Author
DH
Reviewer
BE
Job Ref
12287
A4 Scale

A.4 BIOSECURITY ACT 2015

The Biosecurity Act was enacted to provide for the identification, classification and control of Priority Weeds with the purpose of determining if a biosecurity risk is likely to occur, i.e.:

- The introduction, presence, spread or increase of a pest into or within the State or any part of the State.
- A pest plant has the potential to; harm or reduce biodiversity or out-compete other organisms for resources, including food, water, nutrients, habitat and sunlight.

Ten Priority Weeds for NSW North Coast which includes the Port Stephens Council LGA that have been recorded in the study area are listed in Table A.2 along with their associated Duty.

Table A.2: Priority Weed species found within the study area.

Weed Species	Biosecurity Duty	Additional Significance
Senecio madagascariensis (Fireweed)	• General Biosecurity Duty • Prohibition on dealings	N
Nephrolepis cordifolia (Fishbone Fern)	• General Biosecurity Duty • Prohibition on dealings	
Arundo donax (Giant Reed)	• General Biosecurity Duty • Prohibition on dealings • **Regional Recommended Measure** Land managers should mitigate the risk of new weeds being introduced to their land. The plant should not be bought, sold, grown, carried or released into the environment.	
Eragrostis curvula (African lovegrass)	• General Biosecurity Duty • Prohibition on dealings	
Schinus sp (Peppercorn)	• General Biosecurity Duty • Prohibition on dealings	
Conyza species (Fleabane)	• General Biosecurity Duty • Prohibition on dealings	
Chrysanthemoides monilifera subsp. Rotundata (Bitou bush)	• General Biosecurity Duty • Prohibition on dealings • **Biosecurity Zone** Within the Biosecurity Zone (all of NSW) this weed must be eradicated where practicable, or as much of the weed destroyed as practicable, and any remaining weed suppressed. The local control authority must be notified of any new infestations of this weed within the Biosecurity Zone	T N
Ricinus communis (Castor oil plant)	• General Biosecurity Duty • Prohibition on dealings	
Lantana camara (Lantana)	• General Biosecurity Duty • Prohibition on dealings	T N
Lilium formosanum (Taiwan lily)	• General Biosecurity Duty • Prohibition on dealings	

T – Listed as a Threatening Process under the NSW BC Act 2016.
N –Weed of National Significance.

***Priorities under the Biosecurity Act 2015**
General Biosecurity Duty - any person dealing with plant matter must take measures to prevent, minimise or eliminate the biosecurity risk (as far as is reasonably practicable).
Prohibition on dealings - Must not be imported into the State or sold

APPENDIX B
EPBC Protected Matters Search Tool

Australian Government
Department of the Environment and Energy

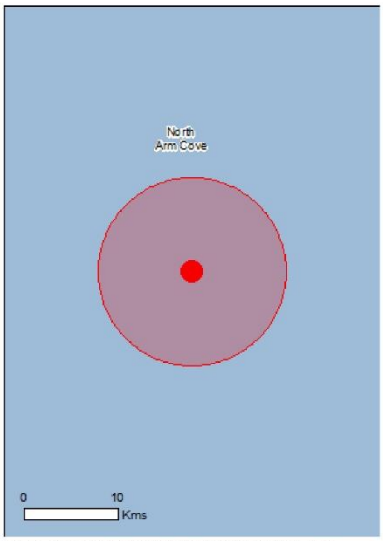
EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 06/01/20 16:14:36



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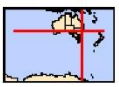

Details

Matters of National Environmental Significance

Wetlands of International Importance (Ramsar) [Resource Information]

Name	Proximity
Myall lakes	Within Ramsar site

Commonwealth Marine Area [Resource Information]

Approval is required for a proposed activity that is located within the Commonwealth Marine Area which has, will have, or is likely to have a significant impact on the environment. Approval may be required for a proposed action taken outside the Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area. Generally the Commonwealth Marine Area stretches from three nautical miles to two hundred nautical miles from the coast.

Name
EEZ and Territorial Sea

Marine Regions [Resource Information]

If you are planning to undertake action in an area in or close to the Commonwealth Marine Area, and a marine bioregional plan has been prepared for the Commonwealth Marine Area in that area, the marine bioregional plan may inform your decision as to whether to refer your proposed action under the EPBC Act.

Name
Temperate East

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland ecological community	Endangered	Community likely to occur within area
Lowland Rainforest of Subtropical Australia	Critically Endangered	Community may occur within area
Posidonia australis seagrass meadows of the Manning-Hawkesbury ecoregion	Endangered	Community likely to occur within area
Subtropical and Temperate Coastal Saltmarsh	Vulnerable	Community likely to occur within area

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Anthochaera phrygia Regent Honeyeater [82338]	Critically Endangered	Foraging, feeding or related behaviour likely to occur within area
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Roosting known to occur

Name	Status	Type of Presence within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area
Dasyornis brachypterus Eastern Bristlebird [533]	Endangered	Species or species habitat likely to occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea antipodensis gibsoni Gibson's Albatross [82270]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Erythrotriorchis radiatus Red Goshawk [942]	Vulnerable	Species or species habitat likely to occur within area
Fregetta grallaria grallaria White-bellied Storm-Petrel (Tasman Sea), White-bellied Storm-Petrel (Australasian) [64438]	Vulnerable	Species or species habitat likely to occur within area
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat may occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat known to occur within area
Limosa lapponica baueri Bar-tailed Godwit (baueri), Western Alaskan Bar-tailed Godwit [86380]	Vulnerable	Species or species habitat known to occur within area
Limosa lapponica menzbieri Northern Siberian Bar-tailed Godwit, Bar-tailed Godwit (menzbieri) [86432]	Critically Endangered	Species or species habitat may occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Pachyptila turtur subantarctica Fairy Prion (southern) [64445]	Vulnerable	Species or species habitat known to occur within area

Name	Status	Type of Presence
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat may occur within area
Pterodroma leucoptera leucoptera Gould's Petrel, Australian Gould's Petrel [26033]	Endangered	Species or species habitat may occur within area
Pterodroma neglecta neglecta Kermadec Petrel (western) [64450]	Vulnerable	Foraging, feeding or related behaviour may occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Species or species habitat may occur within area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Species or species habitat may occur within area
Thalassarche bulleri platei Northern Buller's Albatross, Pacific Albatross [82273]	Vulnerable	Species or species habitat may occur within area
Thalassarche cauta cauta Shy Albatross [82345]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche cauta steadi White-capped Albatross [82344]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche eremita Chatham Albatross [64457]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thinornis rubricollis rubricollis Hooded Plover (eastern) [66726]	Vulnerable	Species or species habitat known to occur within area
Fish		
Epinephelus daemelii Black Rockcod, Black Cod, Saddled Rockcod [68449]	Vulnerable	Species or species habitat likely to occur within area
Frogs		
Heleioporus australiacus Giant Burrowing Frog [1973]	Vulnerable	Species or species habitat may occur within area
Litoria aurea Green and Golden Bell Frog [1870]	Vulnerable	Species or species habitat likely to occur within area
Mixophyes balbus Stuttering Frog, Southern Barred Frog (in Victoria) [1942]	Vulnerable	Species or species habitat likely to occur

Name	Status	Type of Presence within area
Insects		
Synemon plana Golden Sun Moth [25234]	Critically Endangered	Species or species habitat may occur within area
Mammals		
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat may occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Chalinolobus dwyeri Large-eared Pied Bat, Large Pied Bat [183]	Vulnerable	Species or species habitat known to occur within area
Dasyurus maculatus maculatus (SE mainland population) Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat known to occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat likely to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Petauroides volans Greater Glider [254]	Vulnerable	Species or species habitat known to occur within area
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT) Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Vulnerable	Species or species habitat known to occur within area
Potorous tridactylus tridactylus Long-nosed Potoroo (SE Mainland) [66645]	Vulnerable	Species or species habitat likely to occur within area
Pseudomys novaehollandiae New Holland Mouse, Pookila [96]	Vulnerable	Species or species habitat known to occur within area
Pteropus poliocephalus Grey-headed Flying-fox [186]	Vulnerable	Roosting known to occur within area
Plants		
Angophora inopina Charmhaven Apple [64832]	Vulnerable	Species or species habitat known to occur within area
Asperula asthenes Trailing Woodruff [14004]	Vulnerable	Species or species habitat may occur within area
Cryptostylis hunteriana Leafless Tongue-orchid [19533]	Vulnerable	Species or species habitat known to occur within area
Cynanchum elegans White-flowered Wax Plant [12533]	Endangered	Species or species habitat may occur within area

Name	Status	Type of Presence
Diuris praecox		
Newcastle Doubletail [55086]	Vulnerable	Species or species habitat known to occur within area
Eucalyptus parramattensis subsp. decadens		
Earp's Gum, Earp's Dirty Gum [56148]	Vulnerable	Species or species habitat known to occur within area
Grevillea parviflora subsp. parviflora		
Small-flower Grevillea [64910]	Vulnerable	Species or species habitat known to occur within area
Melaleuca biconvexa		
Biconvex Paperbark [5583]	Vulnerable	Species or species habitat may occur within area
Persicaria elatior		
Knotweed, Tall Knotweed [5831]	Vulnerable	Species or species habitat may occur within area
Phaius australis		
Lesser Swamp-orchid [5872]	Endangered	Species or species habitat may occur within area
Prostanthera densa		
Villous Mintbush [12233]	Vulnerable	Species or species habitat likely to occur within area
Syzygium paniculatum		
Magenta Lilly Pilly, Magenta Cherry, Daguba, Scrub Cherry, Creek Lilly Pilly, Brush Cherry [20307]	Vulnerable	Species or species habitat known to occur within area
Tetratheca juncea		
Black-eyed Susan [21407]	Vulnerable	Species or species habitat likely to occur within area
Reptiles		
Caretta caretta		
Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas		
Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dermochelys coriacea		
Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Breeding likely to occur within area
Eretmochelys imbricata		
Hawksbill Turtle [1766]	Vulnerable	Species or species habitat known to occur within area
Natator depressus		
Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Sharks		
Carcharias taurus (east coast population)		
Grey Nurse Shark (east coast population) [68751]	Critically Endangered	Species or species habitat likely to occur within area
Carcharodon carcharias		
White Shark, Great White Shark [64470]	Vulnerable	Breeding known to occur within area
Rhincodon typus		
Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area

Listed Migratory Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence

Name	Threatened	Type of Presence
Migratory Marine Birds		
Anous stolidus Common Noddy [825]		Species or species habitat likely to occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardenna carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Foraging, feeding or related behaviour likely to occur within area
Ardenna grisea Sooty Shearwater [82651]		Species or species habitat likely to occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat known to occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat likely to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat likely to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat may occur within area
Sternula albifrons Little Tern [82849]		Breeding likely to occur within area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Species or species habitat may occur within area
Thalassarche cauta Shy Albatross [89224]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Thalassarche eremita Chatham Albatross [64457]	Endangered	Foraging, feeding or related behaviour likely to occur within area

Name	Threatened	Type of Presence
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Migratory Marine Species		
Balaena glacialis australis Southern Right Whale [75529]	Endangered*	Species or species habitat likely to occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat may occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Caperea marginata Pygmy Right Whale [39]		Foraging, feeding or related behaviour may occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Breeding known to occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Breeding likely to occur within area
Dugong dugon Dugong [28]		Species or species habitat may occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat known to occur within area
Lamna nasus Porbeagle, Mackerel Shark [83288]		Species or species habitat may occur within area
Manta alfredi Reef Manta Ray, Coastal Manta Ray, Inshore Manta Ray, Prince Alfred's Ray, Resident Manta Ray [84994]		Species or species habitat may occur within area
Manta birostris Giant Manta Ray, Chevron Manta Ray, Pacific		Species or species

Name	Threatened	Type of Presence
Manta Ray, Pelagic Manta Ray, Oceanic Manta Ray [84995]		habitat may occur within area
Megaptera novaeangliae		
Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Natator depressus		
Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Orcinus orca		
Killer Whale, Orca [46]		Species or species habitat may occur within area
Rhincodon typus		
Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area
Sousa chinensis		
Indo-Pacific Humpback Dolphin [50]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Cuculus optatus		
Oriental Cuckoo, Horsfield's Cuckoo [86651]		Species or species habitat may occur within area
Hirundapus caudacutus		
White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area
Monarcha melanopsis		
Black-faced Monarch [609]		Species or species habitat known to occur within area
Monarcha trivirgatus		
Spectacled Monarch [610]		Species or species habitat known to occur within area
Myiagra cyanoleuca		
Satin Flycatcher [612]		Species or species habitat known to occur within area
Rhipidura rufifrons		
Rufous Fantail [592]		Species or species habitat known to occur within area
Migratory Wetlands Species		
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat known to occur within area
Arenaria interpres		
Ruddy Turnstone [872]		Roosting known to occur within area
Calidris acuminata		
Sharp-tailed Sandpiper [874]		Roosting known to occur within area
Calidris canutus		
Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos		
Pectoral Sandpiper [858]		Species or species habitat may occur within area
Calidris ruficollis		
Red-necked Stint [860]		Roosting known to occur within area

Name	Threatened	Type of Presence
Calidris tenuirostris Great Knot [862]	Critically Endangered	Roosting known to occur within area
Charadrius bicinctus Double-banded Plover [895]		Roosting known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Roosting may occur within area
Gallinago megala Swinhoe's Snipe [864]		Roosting likely to occur within area
Gallinago stenura Pin-tailed Snipe [841]		Roosting likely to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]		Roosting known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Numenius minutus Little Curlew, Little Whimbrel [848]		Roosting likely to occur within area
Numenius phaeopus Whimbrel [849]		Roosting known to occur within area
Pandion haliaetus Osprey [952]		Breeding known to occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Roosting known to occur within area
Pluvialis squatarola Grey Plover [865]		Roosting known to occur within area
Tringa brevipes Grey-tailed Tattler [851]		Roosting known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Roosting known to occur within area
Xenus cinereus Terek Sandpiper [59300]		Roosting known to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land -
Commonwealth Land - Australian Telecommunications Commission
Commonwealth Land - Defence Housing Authority

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Anous stolidus Common Noddy [825]		Species or species habitat likely to occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Arenaria interpres Ruddy Turnstone [872]		Roosting known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Roosting known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Calidris ruficollis Red-necked Stint [860]		Roosting known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Roosting known to occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat known to occur within area
Catharacta skua Great Skua [59472]		Species or species habitat may occur within area
Charadrius bicinctus Double-banded Plover [895]		Roosting known to occur

Name	Threatened	Type of Presence within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area
Charadrius ruficapillus Red-capped Plover [881]		Roosting known to occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea gibsoni Gibson's Albatross [64466]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat likely to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat likely to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Roosting may occur within area
Gallinago megala Swinhoe's Snipe [864]		Roosting likely to occur within area
Gallinago stenura Pin-tailed Snipe [841]		Roosting likely to occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Heteroscelus brevipes Grey-tailed Tattler [59311]		Roosting known to occur within area
Himantopus himantopus Pied Stilt, Black-winged Stilt [870]		Roosting known to occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat known to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]		Roosting known to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area

Name	Threatened	Type of Presence
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat known to occur within area
Monarcha trivirgatus Spectacled Monarch [610]		Species or species habitat known to occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Numenius minutus Little Curlew, Little Whimbrel [848]		Roosting likely to occur within area
Numenius phaeopus Whimbrel [849]		Roosting known to occur within area
Pachyptila turtur Fairy Prion [1066]		Species or species habitat known to occur within area
Pandion haliaetus Osprey [952]		Breeding known to occur within area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat may occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Roosting known to occur within area
Pluvialis squatarola Grey Plover [865]		Roosting known to occur within area
Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]		Foraging, feeding or related behaviour likely to occur within area
Puffinus griseus Sooty Shearwater [1024]		Species or species habitat likely to occur within area
Recurvirostra novaehollandiae Red-necked Avocet [871]		Roosting known to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat likely to occur within area
Sterna albifrons Little Tern [813]		Breeding likely to occur within area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Species or species habitat may occur within area

Name	Threatened	Type of Presence
Thalassarche cauta Shy Albatross [89224]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Thalassarche eremita Chatham Albatross [64457]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche sp. nov. Pacific Albatross [66511]	Vulnerable*	Species or species habitat may occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Thinornis rubricollis Hooded Plover [59510]		Species or species habitat known to occur within area
Thinornis rubricollis rubricollis Hooded Plover (eastern) [66726]	Vulnerable	Species or species habitat known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Roosting known to occur within area
Xenus cinereus Terek Sandpiper [59300]		Roosting known to occur within area
Fish		
Acentronura tentaculata Shortpouch Pygmy Pipehorse [66187]		Species or species habitat may occur within area
Festucalex cinctus Girdled Pipefish [66214]		Species or species habitat may occur within area
Filicampus tigris Tiger Pipefish [66217]		Species or species habitat may occur within area
Heraldia nocturna Upside-down Pipefish, Eastern Upside-down Pipefish, Eastern Upside-down Pipefish [66227]		Species or species habitat may occur within area
Hippichthys penicillus Beady Pipefish, Steep-nosed Pipefish [66231]		Species or species habitat may occur within area
Hippocampus abdominalis Big-belly Seahorse, Eastern Potbelly Seahorse, New Zealand Potbelly Seahorse [66233]		Species or species habitat may occur within area
Hippocampus whitei White's Seahorse, Crowned Seahorse, Sydney		Species or species

Name	Threatened	Type of Presence
Seahorse [66240]		habitat known to occur within area
Histiogamphelus briggsii Crested Pipefish, Briggs' Crested Pipefish, Briggs' Pipefish [66242]		Species or species habitat may occur within area
Lissocampus runa Javelin Pipefish [66251]		Species or species habitat may occur within area
Maroubra perserrata Sawtooth Pipefish [66252]		Species or species habitat may occur within area
Notiocampus ruber Red Pipefish [66265]		Species or species habitat may occur within area
Phyllopteryx taeniolatus Common Seadragon, Weedy Seadragon [66268]		Species or species habitat may occur within area
Solegnathus spinosissimus Spiny Pipehorse, Australian Spiny Pipehorse [66275]		Species or species habitat may occur within area
Solenostomus cyanopterus Robust Ghostpipefish, Blue-finned Ghost Pipefish, [66183]		Species or species habitat may occur within area
Solenostomus paradoxus Ornate Ghostpipefish, Harlequin Ghost Pipefish, Ornate Ghost Pipefish [66184]		Species or species habitat may occur within area
Stigmatopora argus Spotted Pipefish, Gulf Pipefish, Peacock Pipefish [66276]		Species or species habitat may occur within area
Stigmatopora nigra Widebody Pipefish, Wide-bodied Pipefish, Black Pipefish [66277]		Species or species habitat may occur within area
Syngnathoides biaculeatus Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish [66279]		Species or species habitat may occur within area
Trachyrhamphus bicoarctatus Bentstick Pipefish, Bend Stick Pipefish, Short-tailed Pipefish [66280]		Species or species habitat may occur within area
Urocampus carinirostris Hairy Pipefish [66282]		Species or species habitat may occur within area
Vanacampus margaritifer Mother-of-pearl Pipefish [66283]		Species or species habitat may occur within area
Mammals		
Arctocephalus forsteri Long-nosed Fur-seal, New Zealand Fur-seal [20]		Species or species habitat may occur within area
Arctocephalus pusillus Australian Fur-seal, Australo-African Fur-seal [21]		Species or species habitat may occur within area
Dugong dugon Dugong [28]		Species or species habitat may occur within area
Reptiles		

Name	Threatened	Type of Presence
Caretta caretta		
Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas		
Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dermochelys coriacea		
Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Breeding likely to occur within area
Eretmochelys imbricata		
Hawksbill Turtle [1766]	Vulnerable	Species or species habitat known to occur within area
Natator depressus		
Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Pelamis platurus		
Yellow-bellied Seasnake [1091]		Species or species habitat may occur within area

Whales and other Cetaceans		[Resource Information]
Name	Status	Type of Presence
Mammals		
Balaenoptera acutorostrata		
Minke Whale [33]		Species or species habitat may occur within area
Balaenoptera borealis		
Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera edeni		
Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus		
Blue Whale [36]	Endangered	Species or species habitat may occur within area
Balaenoptera physalus		
Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Caperea marginata		
Pygmy Right Whale [39]		Foraging, feeding or related behaviour may occur within area
Delphinus delphis		
Common Dophin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Eubalaena australis		
Southern Right Whale [40]	Endangered	Species or species habitat likely to occur within area
Grampus griseus		
Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
Megaptera novaeangliae		
Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Orcinus orca		
Killer Whale, Orca [46]		Species or species habitat may occur within area
Sousa chinensis		
Indo-Pacific Humpback Dolphin [50]		Species or species

Name	Status	Type of Presence
		habitat likely to occur within area
Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area

Extra Information

State and Territory Reserves [Resource Information]

Name	State
Bushy Island	NSW
Gir-um-bit	NSW
Gir-um-bit	NSW
One Tree Island	NSW
Snapper Island	NSW
Tilligerry	NSW
Tilligerry	NSW
Tilligerry	NSW
Tomaree	NSW
Worimi	NSW
Worimi	NSW

Regional Forest Agreements [Resource Information]

Note that all areas with completed RFAs have been included.

Name	State
North East NSW RFA	New South Wales

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Alauda arvensis Skylark [656]		Species or species habitat likely to occur within area
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Lonchura punctulata Nutmeg Mannikin [399]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Passer montanus Eurasian Tree Sparrow [406]		Species or species habitat likely to occur within area
Pycnonotus jocosus Red-whiskered Bulbul [631]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Turdus merula Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area
Frogs		
Rhinella marina Cane Toad [83218]		Species or species habitat likely to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Feral deer Feral deer species in Australia [85733]		Species or species habitat likely to occur within area
Lepus capensis Brown Hare [127]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus norvegicus Brown Rat, Norway Rat [83]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur

Name	Status	Type of Presence within area
Plants		
Alternanthera philoxeroides Alligator Weed [11620]		Species or species habitat likely to occur within area
Anredera cordifolia Madeira Vine, Jalap, Lamb's-tail, Mignonette Vine, Anredera, Gulf Madeiravine, Heartleaf Madeiravine, Potato Vine [2643]		Species or species habitat likely to occur within area
Asparagus aethiopicus Asparagus Fern, Ground Asparagus, Basket Fern, Sprengi's Fern, Bushy Asparagus, Emerald Asparagus [62425]		Species or species habitat likely to occur within area
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Asparagus plumosus Climbing Asparagus-fern [48993]		Species or species habitat likely to occur within area
Cabomba caroliniana Cabomba, Fanwort, Carolina Watershield, Fish Grass, Washington Grass, Watershield, Carolina Fanwort, Common Cabomba [5171]		Species or species habitat likely to occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat likely to occur within area
Chrysanthemoides monilifera subsp. rotundata Bitou Bush [16332]		Species or species habitat likely to occur within area
Eichhornia crassipes Water Hyacinth, Water Orchid, Nile Lily [13466]		Species or species habitat likely to occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
Opuntia spp. Prickly Pears [82753]		Species or species habitat likely to occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Sagittaria platyphylla Delta Arrowhead, Arrowhead, Slender Arrowhead [68483]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Salvinia molesta Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
Senecio madagascariensis Fireweed, Madagascar Ragwort, Madagascar		Species or species

Name	Status	Type of Presence
Groundsel [2624]		habitat likely to occur within area

Nationally Important Wetlands	[Resource Information]
Name	State
Port Stephens Estuary	NSW

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-32.76978 152.05221

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

APPENDIX C
BAM FIELD DATA SHEETS

ANNA BAY

BAM Plot – Field Survey Form

Site Sheet no:

Date	29/3/2018	Survey Name	
Plot Identifier	BPDH1	Recorders	
Zone	411967	Datum	
IBRA region		Photo #	5350
Zone ID			
Easting	411967	Northing	6373475
Plot Dimensions		Orientation of midline from the 0 m point.	255°
Likely Vegetation Class		Confidence:	H M L
Plant Community Type	BRSAT - INTACTANC	EEC:	Confidence: H M L

Record easting and northing from the plot marker. If applicable, orient picket so that perforated rib points along direction of midline.
Dimensions (Shape) of 0.04 ha base plot inside 0.1 ha FA plot should be identified, magnetic bearing taken along midline.

BAM Attribute (400 m² plot)		Sum values
Count of Native Richness	Trees	2
	Shrubs	6
	Grasses etc.	5
	Forbs	3
	Ferns	1
	Other	0
Sum of Cover of native vascular plants by growth form group	Trees	0.4
	Shrubs	2
	Grasses etc.	4.1
	Forbs	0.5
	Ferns	5
	Other	0
High Threat Weed cover %		6.9

This table may be completed after entering data into a suitable tool - it is not required while in the field.

BAM Attribute (20 x 50 m plot) dbh	Euc*	Non Euc	Hollows†
80 + cm			0
50 – 79 cm			
30 – 49 cm			Hollows 20cm+
20 – 29 cm			0
10 – 19 cm			
5 – 9 cm			
< 5 cm	✓	✓	This size class records tree regeneration
Length of logs (m) (≥10 cm diameter, >50 cm in length)	0		total 0

Record living eucalypt* (Euc*) and living native non-eucalypt (Non Euc) stems separately.

Data needed is presence only (tick) unless a 'large tree' for that veg class.

* includes all species of *Eucalyptus*, *Corymbia*, *Angophora*, *Lophostemon* and *Syncarpia*

† For hollows count only the presence of a stem containing hollows, not the count of hollows in that stem. Only count as 1 stem per tree where tree is multi-stemmed. The hollow-bearing stem may be a dead stem.

Each size class is noted as present by the living tree stems only. Depending on the Vegetation Class, DBH values and counts may be needed for a size class. For a **multi-stemmed tree**, only the largest living stem is included in the count/estimate if it is required by the large tree category for that vegetation class.

Hollows at least 20cm across are recorded for the purposes of habitat of some threatened species.

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each)	10	10	5	10	8	30	25	35	20	10	0	0	0	0	0	0	0	0	0	0
Average of the 5 subplots	8.6					24														

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots located on alternate sides and 5 m from the plot midline at the locations 5, 15, 25, 35, and 45 m along the midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Within these 1 m x 1 m plots assessors may also record the cover of rock, bare ground and cryptogam soil crusts. Collection of these data is optional - the data do not currently contribute to assessment scores, they hold potential value for future vegetation integrity assessment attributes and benchmarks, and for enhancing PCT description.

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Landform Element		Landform Pattern		Microrelief	
Lithology		Soil Surface Texture		Soil Colour		Soil Depth	
Slope		Aspect		Site Drainage		Distance to nearest water and type	

Plot Disturbance	Severity code	Age code
Clearing (inc. logging)		
Cultivation (inc. pasture)		
Soil erosion		
Firewood / CWD removal		
Grazing (identify native/stock)		
Fire damage		
Storm damage		
Weediness		
Other		

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

Free Text Section for brief site description

Back Peg 5342, 43, 411917
6373475
Ausgrid power easement
Sandy Soil /

Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

Form version designed 15 September 2017

Printed 22 March 2018

400,m² plot: Sheet _ of _	Survey Name	Plot Identifier	Recorders
Date			

GF Code		Full species name mandatory, or a unique means of identifying separate taxa within a survey. Data from here will be used to assign growth form counts and covers.	N, E or HTE	Cover	Abund	stratum	voucher
S	1	Acacia sinuata	N	0.2	2		
S	2	Monotoca elliptica	N	0.3	5		
S	3	Hibbertia linearis	N	1	25		
S	4	Boss r	N	0.2	4		
S	5	Breyna oblongifolia	N	0.1	1		
T	6	Angophora costata	N	0.1	1		
FERN	7	Pteridium esculentum	N	5	200		
HTW	8	Andropogon virginicus		5	200		
W	9	Anthoxanthum odoratum		8	300	300	
HTW	10	African Love grass		1	50		
G	11	Cymbopogon refractus	N	0.4	30		
G	12	Themeda australis	N	1	25		
W	13	Red Natal Grass		0.2	5		
F	14	Gonocarpus teucrioides	N	0.2	10		
G	15	Lomandra longifolia	N	0.5	10		
F	16	Tricoyne elatior	N	0.1	10		
HTW	17	Buffalo Grass		0.8	20		
G	18	Blady Grass	N	2	300		
W	19	Coreopsis lanceolata		0.2	5		
W	20	Primrose (OENOTHERA SP.	1	0.2	6		
W	21	Richardia		0.1	5		
W	22	Bitou Bush		0.1	1		
W	23	Setaria parvi-		0.1	2		
F	24	Hydrocotyle bonariensis		0.2	5		
S	25	Acacia longifolia		0.2	2		
W	26	Flatweed		0.2	10		
W	27	Conyza parviflora		0.1	5		
T	28	Banksia serrata		0.2	1		
HG	29	Eragrostis "		0.2	10		
W	30	Plantago lanceolata		0.1	1		
	31						
	32						
	33						
	34						
	35						
	36						
	37						
	38						
	39						
	40						
	41						
	42						
	43						
	44						

Form version designed 15 September 2017

Printed 22 March 2018

- D ANNA B.

BAM Plot – Field Survey Form

Site Sheet no:

Survey Name		Plot Identifier		Recorders	
		BPDH2			

Date	29/3/18	Zone	Datum	IBRA region		Photo #	5362	Zone ID	
Easting	Northing	Plot Dimensions		Orientation of midline from the 0 m point.	265°				
412049	6373595								

Likely Vegetation Class		Confidence: H M L
Plant Community Type	BBSAF - ~~DISTURBED~~ INTACT	EEC: Confidence: H M L

Record easting and northing from the plot marker. If applicable, orient picket so that perforated nb points along direction of midline. Dimensions (Shape) of 0.04 ha base plot inside 0.1 ha FA plot should be identified, magnetic bearing taken along midline.

BAM Attribute (400 m² plot)		Sum values
Count of Native Richness	Trees	4
	Shrubs	7
	Grasses etc.	2
	Forbs	4
	Ferns	1
	Other	5
Sum of Cover of native vascular plants by growth form group	Trees	42.2
	Shrubs	1.5
	Grasses etc.	5.5
	Forbs	5.7
	Ferns	10
	Other	2.4
High Threat Weed cover %		1.3

BAM Attribute (20 x 50 m plot) dbh	Euc*	Non Euc	Hollows†	Stem Classes and Hollows
80 + cm			1	
50 – 79 cm	5 ✓			
30 – 49 cm	✓		Hollows 20cm+	
20 – 29 cm	✓	✓	0	
10 – 19 cm	✓	✓		
5 – 9 cm				
< 5 cm			This size class records tree regeneration	
Length of logs (m) (≥10 cm diameter, >50 cm in length)	2.3, 1.8, 2.4, 1.0, 1.8, 1.0, 1.4, 2.3, 2.2		3.2, 1.1, 1.0	total 21.5

Record living eucalypt* (Euc*) and living native non-eucalypt (Non Euc) stems separately.

Data needed is presence only (tick) unless a 'large tree' for that veg class.

* includes all species of *Eucalyptus, Corymbia, Angophora, Lophostemon* and *Syncarpia*

† For hollows count only the presence of a stem containing hollows, not the count of hollows in that stem. Only count as 1 stem per tree where tree is multi-stemmed. The hollow-bearing stem may be a dead stem.

Each size class is noted as present by the living tree stems only. Depending on the Vegetation Class, DBH values and counts may be needed for a size class. For a multi-stemmed tree, only the largest living stem is included in the count/estimate if it is required by the large tree category for that vegetation class.

Hollows at least 20cm across are recorded for the purposes of habitat of some threatened species

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each)	70	65	65	65	70	05	0	5	0		0	0	0	0		0	0	0	0	0
Average of the 5 subplots	67					2														

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots located on alternate sides and 5 m from the plot midline at the locations 5, 15, 25, 35 and 45 m along the midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Within these 1 m x 1 m plots assessors may also record the cover of rock, bare ground and cryptogam soil crusts. Collection of these data is optional - the data do not currently contribute to assessment scores, they hold potential value for future vegetation integrity assessment attributes and benchmarks, and for enhancing PCT description.

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Landform Element		Landform Pattern		Microrelief	
Lithology		Soil Surface Texture		Soil Colour		Soil Depth	
Slope		Aspect		Site Drainage		Distance to nearest water and type	

Plot Disturbance	Severity code	Age code
Clearing (inc. logging)		
Cultivation (inc. pasture)		
Soil erosion		
Firewood / CWD removal		
Grazing (identify native/stock)		
Fire damage		
Storm damage		
Weediness		
Other		

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

Free Text Section for brief site description

Back Peg 412003 Photo 5373
6373598

Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

Form version designed 15 September 2017

Printed 22 March 2018

400 m² plot: Sheet _ of _	Survey Name	Plot Identifier	Recorders
Date			

	GF Code		Full species name mandatory, or a unique means of identifying separate taxa within a survey. Data from here will be used to assign growth form counts and covers.	N, E or HTE	Cover	Abund	stratum	voucher
	T	1	Angophora costata	N	15	6		
	T	2	Eucalyptus pilularis	N	15	2		
	S	3	Acacia sp.	N	0.2	8		
	S	4	Breynia oblongifolia	N	0.3	4		
	S	5	Pittosporum undulatum	N	0.2	3		
	T	6	Banksia serrata	N	12	5		
	FERN	7	Pteridium esculentum	N	10	200		
	G	8	Lomandra longifolia	N	5	50		
	F	9	Dianella caerulea var. producta	N	5	200		
	O	10	Wonga wonga vine	N	BZ	5		
	F	11	Gonocarpus teucrioides	N	0.4	20		
	S	12	Hibbertia linearis	N	0.2	5		
	G	13	Imperata cylindrica var. major	N	0.5	200		
	F	14	Pomax	N	0.2	20		
HTW	W	15	Biton Bush		1	13		
HTW	W	16	Lantana camara		0.2	2		
	S	17	Leucopogon lanceolata		0.2	5		
	T	18	Glochidion ferdinandi		0.2	2		
HTW	W	19	Camphor laurel		0.1	1		
	O	20	Stephania japonica		0.1	2		
	O	21	Parsonsia straminea		0.1	2		
	S	22	Hibbertia scandens		0.2	2		
	S	23	Bossi sp.		0.1	1		
	F	24	Pratia purpurascens		0.1	2		
	O	25	Banksia mistletoe		0.1	1		
	O	26	Billardiera scandens		0.1	1		
		27						
		28						
		29						
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Form version designed 15 September 2017

Printed 22 March 2018

WILDTHING Environmental Consultants

BAM Plot – Field Survey Form

Site Sheet no:

		Survey Name	Plot Identifier	Recorders	
Date	2305 18		BPRE2	BE	
Zone 56	Datum GDA94	IBRA region		Photo # 6504	Zone ID
Easting 0412025	Northing 6373847	Plot Dimensions	20×50	Orientation of midline from the 0 m point.	184.5°
Likely Vegetation Class		BBSAF - US			Confidence: H M L
Plant Community Type				EEC:	Confidence: H M L

Record easting and northing from the plot marker. If applicable, orient picket so that perforated rib points along direction of midline. Dimensions (Shape) of 0.04 ha base plot inside 0.1 ha FA plot should be identified, magnetic bearing taken along midline.

BAM Attribute (400 m² plot)		Sum values
Count of Native Richness	Trees	3
	Shrubs	7
	Grasses etc.	3
	Forbs	3
	Ferns	1
	Other	5
Sum of Cover of native vascular plants by growth form group	Trees	34.1
	Shrubs	4
	Grasses etc.	3.2
	Forbs	4.2
	Ferns	4
	Other	1.8
High Threat Weed cover %		0.4

BAM Attribute (20 x 50 m plot) dbh	Stem Classes and Hollows Euc*	Non Euc	Hollows†
80 + cm	I		IIII
50 – 79 cm	III		
30 – 49 cm	✓		Hollows 20cm+
20 – 29 cm	✓		
10 – 19 cm	✓		
5 – 9 cm	✓		
< 5 cm	~ yes if sapling		This size class records tree regeneration
Length of logs (m) (≥10 cm diameter, >50 cm in length)	0		total

Record living eucalypt* (Euc*) and living native non-eucalypt (Non Euc) stems separately

Data needed is presence only (tick) unless a 'large tree' for that veg class

* includes all species of *Eucalyptus*, *Corymbia*, *Angophora*, *Lophostemon* and *Syncarpia*

† For hollows count only the presence of a stem containing hollows, not the count of hollows in that stem. Only count as 1 stem per tree where tree is multi-stemmed. The hollow-bearing stem may be a dead stem.

Each size class is noted as present by the living tree stems only. Depending on the Vegetation Class, DBH values and counts may be needed for a size class. For a multi-stemmed tree, only the largest living stem is included in the count/estimate if it is required by the large tree category for that vegetation class. Hollows at least 20cm across are recorded for the purposes of habitat of some threatened species.

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each)	20	50	25	60	80	70	45	75	40	20										
Average of the 5 subplots	47					50.6														

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots located on alternate sides and 5 m from the plot midline at the locations 5, 15, 25, 35, and 45 m along the midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Within these 1 m x 1 m plots assessors may also record the cover of rock, bare ground and cryptogam soil crusts. Collection of these data is optional - the data do not currently contribute to assessment scores, they hold potential value for future vegetation integrity assessment attributes and benchmarks, and for enhancing PCT description.

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Landform Element		Landform Pattern		Microrelief	
Lithology		Soil Surface Texture		Soil Colour		Soil Depth	
Slope		Aspect		Site Drainage		Distance to nearest water and type	

Plot Disturbance	Severity code	Age code
Clearing (inc. logging)		
Cultivation (inc. pasture)		
Soil erosion		
Firewood / CWD removal		
Grazing (identify native/stock)		
Fire damage		
Storm damage		
Weediness		
Other		

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

Free Text Section for brief site description

Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

Form version designed 15 September 2017

Printed 23 May 2018

30

400 m² plot: Sheet _ of _	Survey Name	Plot Identifier	Recorders
Date			

GF Code	Full species name mandatory, or a unique means of identifying separate taxa within a survey. Data from here will be used to assign growth form counts and covers.	N, E or HTE	Cover	Abund	stratum	voucher
T	1 E. PILULARIS		75	2		
T	2 A. COSTATA		12	5		
T	3 B. SERRATA		3	1		
T	4 GLICHEDION (CHEESE TREE) (TEGEN		~~4~~ 1	10		
FERN	5 PTERIDIUM E		75	130		
HTW	6 Bitou Bush		0.2	10		
F	7 ~~AGNALLIS / STELLARIA MED~~ POMAX UNDULATA		20 ↔ 0.2			✓
G	8 PASPALIDIUM DISTANS ✓		15 ↔ 0.1			
W	9 SETARIA PUMULA ✓		8 ↔ 0.1			✓
O	10 GLYCINE CLAN ✓		50 ↔ 0.3			✓
O	11 PANDOREA PANDORAMA		0.1	5		
S	12 ~~PHYLLANTHUS / B. RHOMB~~ B. RHOMBIFOLIA		0.5	40		✓
HTW	13 ANDROPOGON VIRGIN		0.1	2		
F	14 ACIANTHUS FORNICATUS		0.2	30		
S	15 ~~AAAYEENSE~~ GOMPHALOBIUM LATIFOLIUM		0.1	~~||||~~ |||		✓
S	16 HIBBERTIA SCABRA		0.1	1		✓
F	17 GONOCARPUS Teucroides		0.2	15		✓
G	18 LOMANDRA LONG		0.5	20		
S	19 RICINOCARPUS ✓ PINIFOLIUS		0.1	1		✓
HTW	20 LANTANA CAMERA		0.1	1		
S	21 ACACIA SUAVE		0.2	5		
S	22 DIANELLA CERULA VAR ~~CAERULEA~~ PRODUCTA		0.1	10		
G	23 ENTOLASIA MARGINATA		0.1	1		
O	24 HARDENBURGIA VIOLACEAE		0.1	3		
O	25 KENNDIA RUBICUNDA		0.1	1		
S	26 ACACIA BROWNII ? Leucopogon ? ericoides ?		0.1	1		✓
G	27 ~~Fimbrystilus~~? LOMANDRA GRACILIS		0.1	70		✓
G	28 DIGITARIA SANGUINALIS		0.1	1		✓
F	29 PTEROSTILUS - PHOTO 6503 WPT 58		0.1	1		
O	30 BILLIDARIA SCANDENS		0.1	3		
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Form version designed 15 September 2017 Printed 23 May 2018

BAM Plot – Field Survey Form

Site Sheet no:

Survey Name	Plot Identifier	Recorders
-	BPBE1	BE

Date	Zone	Datum	IBRA region	Photo #	Zone ID
23/05/18	56	GDA94	-	6502	

Easting	Northing	Plot Dimensions	Orientation of midline from the 0 m point.
0411926	6373731	20x50	2°N

Likely Vegetation Class		Confidence: H M L
Plant Community Type	SABEF-US	EEC: / Confidence: H M L

Record easting and northing from the plot marker. If applicable, orient picket so that perforated rib points along direction of midline.
Dimensions (Shape) of 0.04 ha base plot inside 0.1 ha FA plot should be identified, magnetic bearing taken along midline.

BAM Attribute (400 m² plot)		Sum values
Count of Native Richness	Trees	4
	Shrubs	7
	Grasses etc.	5
	Forbs	4
	Ferns	1
	Other	5
Sum of Cover of native vascular plants by growth form group	Trees	31
	Shrubs	1.2
	Grasses etc.	0.9
	Forbs	0.6
	Ferns	15
	Other	0.7
High Threat Weed cover %		0.4

BAM Attribute (20 x 50 m plot) dbh	Euc*	Non Euc	Stem Classes and Hollows: Hollows†
80 + cm	1		///
50 – 79 cm	///	1	
30 – 49 cm	✓		Hollows 20cm+
20 – 29 cm	✓		
10 – 19 cm	✓		
5 – 9 cm			
< 5 cm	✓		This size class records tree regeneration
Length of logs (m) (≥10 cm diameter, >50 cm in length)	5.7		total

Record living eucalypt* (Euc*) and living native non-eucalypt (Non Euc) stems separately

Data needed is presence only (tick) unless a 'large tree' for that veg class

* Includes all species of *Eucalyptus*, *Corymbia*, *Angophora*, *Lophostemon* and *Syncarpia*

† For hollows count only the presence of a stem containing hollows, not the count of hollows in that stem. Only count as 1 stem per tree where tree is multi-stemmed. The hollow-bearing stem may be a dead stem.

Each size class is noted as present by the **living tree stems** only. Depending on the Vegetation Class, DBH values and counts may be needed for a size class. For a **multi-stemmed tree**, only the largest living stem is included in the count/estimate if it is required by the large tree category for that vegetation class.

Hollows at least 20cm across are recorded for the purposes of habitat of some threatened species

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each)	50	90	7	60		70	20	20	90	40	0	0	6	0	0	0	0	0	0	0
Average of the 5 subplots	51.8					48														

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots located on alternate sides and 5 m from the plot midline at the locations 5, 15, 25, 35, and 45 m along the midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Within these 1 m x 1 m plots assessors may also record the cover of rock, bare ground and cryptogam soil crusts. Collection of these data is optional - the data do not currently contribute to assessment scores, they hold potential value for future vegetation integrity assessment attributes and benchmarks, and for enhancing PCT description.

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Landform Element		Landform Pattern		Microrelief	
Lithology		Soil Surface Texture		Soil Colour		Soil Depth	
Slope		Aspect		Site Drainage		Distance to nearest water and type	

Plot Disturbance	Severity code	Age code
Clearing (inc. logging)		
Cultivation (inc. pasture)		
Soil erosion		
Firewood / CWD removal		
Grazing (identify native/stock)		
Fire damage		
Storm damage		
Weediness		
Other		

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

Free Text Section for brief site description

Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

Form version designed 15 September 2017

Printed 23 May 2018

WILDTHING Environmental Consultants

400 m² plot: Sheet _ of _	Survey Name	Plot Identifier	Recorders
Date			

GF Code		*Full species name mandatory, or a unique means of identifying separate taxa within a survey. Data from here will be used to assign growth form counts and covers.*	N, E or HTE	Cover	Abund	stratum	voucher
T	1	A. Costata		~~1~~ 20	3		
T	2	E. Pilularis		~~[illegible]~~ 14	3		
S	3	~~L[illegible]~~ DIANELLA CERULEA		3	40		
F	4	POMAX UMBELLATUM		4	8		
HTW	5	CONYZA B		0.1	111		
FERN	6	P. esculentum		4	~~30~~ ~~[illegible]~~ 40		
S	7	~~[illegible]~~ LEUCOPOGON LANCE		0.1	2		
O	8	PANDOREA PANO		0.3	15		
O	9	HARDENBURGIA VIOLACEAE		0.1	10		
S	10	BOSSEA THING - Pic 6506 B. HETEROPHYLLA		0.1	1		✓
S	11	~~PHYLLANTHUS THING~~ B. RHOMBIFOLIA		0.3	15		✓
HTW	12	SCENCIO M		0.1	111		
F	13	ACIANTHUS FORNICATUS		0.1	20		
O	14	PARSONSIA STRAMINEA		0.1	1		
	15	[illegible]					✓
S ~~[illegible]~~	16	~~[illegible]~~ ? / ~~[illegible]~~ GOMPHALOBIUM	LAT	0.1	1		
G	17	PASPALIDIUM DISTANS		3	70		
O	18	KENNEDIA RUBICUNDA		1	25		
HTW	19	Bitou BUSH		0.2	3		
S	20	Acacia Suave		0.3	15		
F	21	GOMPHACARPUS teracoides		0.1	5		✓
O	22	GLYCINE CLAN		0.3	50		
G	23	ENTOLASIA MARGIN		0.1	10		
G	24	IMPERETRA CYLINDER		0.1	16		
T	25	GLICHEDION FERNANDI		0.1	1		
S	26	RICINOCARPOS PINIFOLIUS		0.1	1		
W	27	HYPOCHARIS RADICATA		0.1	1		
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Form version designed 15 September 2017 Printed 23 May 2018

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GF Code: see Growth Form definitions in BAM Appendix 1. Identify top 3 dominants in the veg zone. **N:** native, **E:** exotic, **HTE:** high threat exotic.
Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); ***Note:*** *0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m*
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Print more copies of this sheet to allow for higher species counts at a plot. All species at a plot need to be recorded.

Form version designed 15 September 2017

Printed 23 May 2018

BAM Plot – Field Survey Form

Site Sheet no:

Survey Name	Plot Identifier	Recorders
	BPBE03	BE

Date: 23 05 18	Zone: 56	Datum: 94	IBRA region:	Photo #: 6507	Zone ID:
Easting: 0411894	Northing: 6373629	Plot Dimensions: 20 x 50	Orientation of midline from the 0 m point: 180°S		
Likely Vegetation Class:					Confidence: H M L
Plant Community Type: BBSAF - INTACT			EEC:		Confidence: H M L

Record easting and northing from the plot marker. If applicable, orient picket so that perforated rib points along direction of midline.
Dimensions (Shape) of 0.04 ha base plot inside 0.1 ha FA plot should be identified, magnetic bearing taken along midline.

BAM Attribute (400 m² plot)		Sum values
Count of Native Richness	Trees	4
	Shrubs	4
	Grasses etc.	4
	Forbs	4
	Ferns	1
	Other	6
Sum of Cover of native vascular plants by growth form group	Trees	70.1
	Shrubs	24.5
	Grasses etc.	25.6
	Forbs	3.9
	Ferns	4.5
	Other	7.6
High Threat Weed cover %		8.3

BAM Attribute (20 x 50 m plot) dbh	Euc*	Non Euc	Stem Classes and Hollows: Hollows†
80 + cm			1/1
50 – 79 cm	11		
30 – 49 cm	✓		Hollows 20cm+
20 – 29 cm	✓		0
10 – 19 cm	✓		
5 – 9 cm	✓		
< 5 cm	✓		This size class records tree regeneration
Length of logs (m) (≥10 cm diameter, >50 cm in length)	3, 1.3,		total 4.3

Record living eucalypt* (Euc*) and living native non-eucalypt (Non Euc) stems separately

Data needed is presence only (tick) unless a 'large tree' for that veg class

* includes all species of *Eucalyptus*, *Corymbia*, *Angophora*, *Lophostemon* and *Syncarpia*

† For **hollows** count only the presence of a stem containing hollows, not the count of hollows in that stem. Only count as 1 stem per tree where tree is multi-stemmed. The hollow-bearing stem may be a dead stem.

Each size class is noted as present by the **living tree stems** only. Depending on the Vegetation Class, DBH values and counts may be needed for a size class. For a **multi-stemmed tree**, only the largest living stem is included in the count/estimate if it is required by the large tree category for that vegetation class

Hollows at least 20cm across are recorded for the purposes of habitat of some threatened species

BAM Attribute (1 x 1 m plots)	Litter cover (%)	Bare ground cover (%)	Cryptogam cover (%)	Rock cover (%)
Subplot score (% in each)	98 100 75 90 95	2 5 0 0 5	0 0 0 0 0	0 0 0 0 0
Average of the 5 subplots	95.6	2.4		

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots located on alternate sides and 5 m from the plot midline at the locations 5, 15, 25, 35, and 45 m along the midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Within these 1 m x 1 m plots assessors may also record the cover of rock, bare ground and cryptogam soil crusts. Collection of these data is optional - the data do not currently contribute to assessment scores, they hold potential value for future vegetation integrity assessment attributes and benchmarks, and for enhancing PCT description

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Landform Element		Landform Pattern		Microrelief	
Lithology		Soil Surface Texture		Soil Colour		Soil Depth	
Slope		Aspect		Site Drainage		Distance to nearest water and type	

Plot Disturbance	Severity code	Age code
Clearing (inc. logging)		
Cultivation (inc. pasture)		
Soil erosion		
Firewood / CWD removal		
Grazing (identify native/stock)		
Fire damage		
Storm damage		
Weediness		
Other		

Severity 0=no evidence, 1=light, 2=moderate, 3=severe

Free Text Section for brief site description

Age R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

Form version designed 15 September 2017

Printed 23 May 2018

Quote - Salamander - Book it in

400 m² plot: Sheet _ of _	Survey Name	Plot Identifier	Recorders
Date			

6th under scribing

Next week

Agreed on Price

GF Code	Full species name mandatory, or a unique means of identifying separate taxa within a survey. Data from here will be used to assign growth form counts and covers.	N, E or HTE	Cover	Abund	stratum	voucher
T	1 A. COSTATA		31	13		
T	2 E. PILULARIS		8	1		
T	3 B. SERRATA		31	13		
S	4 MONOTOCA ELLIPTICA		10	24		
FERN	5 P. esculentum		75	500		
S	6 P. LEVIS		0.2	1		
G	7 D. CYLINDRICA		10	200		
G	8 L. LONGIFOLIA		15	110		
O	9 PANDOREA PANDO		3	100		
HTN	10 BITOU BUSH		8			
S	11 LEUCOPOGON LANCEOLATUM		4	25		
F	12 ADIANTHUS CORNICATUS		3	200		
O	13 DARWINIA STRAFFN		1.5	10		
G	14 SMALL LOMANDRA - FLUVIATILIS		.5	30		✓
S	15 PITO UNDULATUM		0.1	1		
F	16 PTEROSTYLIS SP		0.3	40		
S	17 D. CAERULA VAR PRODUCT		7	50		
O	18 E. RUBICUNDA		1.0	40		✓
S	19 ZIERIA SM[illegible]? / MA[illegible] / ? COMPHLOSIUM Lat		0.2	5		✓
F	20 POMAX UMBELLATA		0.5	30		
F	21 LONDICARPUS Tetracoides		0.1	10		
S	22 BOSSIA RHOMBIFOLIA? PH[illegible]		1	20		
O	23 ~~NATIVE CLOVER~~ DESMODIUM VARIANS		0.1	4		
O	24 Additional climber maybe still Pandorea / Billardiera Scandens		1	0.1		
G	25 TRIEMEDA TRIANDRA		0.1	1		
O	26 HIBBERTIA SCANDENS		2	40		
T	27 GLICHISEDON FERNANDI		0.1	11		
S	28 LEUCOPOGON MARGARODES MARGARODES		2	3		
HTN	29 LANTANA CAMERA		0.3	1		
	30 ~~LOMANDRA FLUVIATILIS~~		~~0.1~~	~~10~~		
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Form version designed 15 September 2017

Printed 23 May 2018

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GF Code: see Growth Form definitions in BAM Appendix 1. Identify top 3 dominants in the veg zone. **N:** native, **E:** exotic, **HTE:** high threat exotic.
Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); ***Note:*** *0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m*
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Print more copies of this sheet to allow for higher species counts at a plot. All species at a plot need to be recorded.

Form version designed 15 September 2017

Printed 23 May 2018

Wildthing Environmental Consultants - Office # (02) 49513311

BAM Site – Field Survey Form | Site Sheet no:

		Plot Size	Photo #	Plot Waypoint ID	Recorders
Date	29 05 16	20×50		BPBE4	DE
Midline start	Midline end	IBRA region			
6612	6601				
E- 6412043 N- 6373398	E- 412020 N- 6373444	Vegetation Class			
Bearing 314 NW	Bearing 140 SE	Vegetation Zone	SPINIFEX FORE DUNE		
PCT #		PCT Name			
Consistent BC ACT TEC?					

BAM Attribute (400 m² plot)		Sum values
Count of Native Richness	Trees	0
	Shrubs	0
	Grasses etc.	1
	Forbs	0
	Ferns	0
	Other	0
Sum of Cover of native vascular plants by growth form group	Trees	0
	Shrubs	7
	Grasses etc.	0
	Forbs	0
	Ferns	0
	Other	0
High Threat Weed cover		4

BAM Attribute (1000 m² plot)		
DBH	# Tree Stems Count	# Stems with Hollows
80 + cm	–	
50 – 79 cm	–	
30 – 49 cm	–	
20 – 29 cm	–	
10 – 19 cm	–	
5 – 9 cm	–	
Regeneration < 5 cm	–	
Length of logs (m) (≥10 cm diameter, >50 cm in length)	–	

Large Tree Sizes

Dry Sclerophyll Forests - ≥50, Forested Wetlands - ≥50, Freshwater Wetlands - NA, Grasslands - NA, Grassy Woodlands - ≥50, Heathlands - ≥30, Rainforests - ≥50, Saline Wetlands - NA, Semi-arid Woodland (grassy sub-formation) ≥30, Semi-arid woodlands (shrubby sub-formation) ≥30, Wet sclerophyll forests (grassy sub-formation) ≥79, Wetland sclerophyll forests (shrubby sub-formation) ≥79

BAM Attribute (1 x 1 m plots)	Litter cover (%)	Bare ground cover (%)	Cryptogam cover (%)	Rock cover (%)
Subplot score (% in each)	2 3 5 0 0	98 97 95 100 100		
Average of the 5 subplots	2	98		

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Landform Element		Landform Pattern		Microrelief	
Lithology		Soil Surface Texture		Soil Colour		Soil Depth	
Slope		Aspect		Site Drainage		Distance to nearest water and type	

Additional Plot Comments

Wildthing Environmental Consultants - Office # (02) 49513311

400 m² plot: Sheet _ of _	Survey Name	Plot Identifier	Recorders
Date			

GF Code	Species	Cover	Abund	voucher	GF Code	Species	Cover	Abund	Voucher
HTW	Bitou Bush	[illegible]	4						
G	SPINIFEX	7	40						
W	SEA ROCKET	0-1	1						

GF Code: see Growth Form definitions in Appendix 1 **N:** native, **E:** exotic, **HTE:** high threat exotic **GF – circle code** if 'top 3'.
Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); ***Note:*** *0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m*
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Wildthing Environmental Consultants - Office # (02) 49513311

BAM Site – Field Survey Form | Site Sheet no:

		Plot Size	Photo #	Plot Waypoint ID	Recorders
Date	29 5 19	20×50		BPBE 5	DE
Midline start 6617	Midline end 0613	IBRA region			
E- 0411935 N- 6373575	E- 411952 N- 6375530	Vegetation Class			
Bearing 127 SE	Bearing 215 NW	Vegetation Zone	@ BBSAF - TDNP INTACT		
PCT #	PCT Name				
Consistent BC ACT TEC?					

BAM Attribute (400 m² plot)		Sum values
Count of Native Richness	Trees	4
	Shrubs	7
	Grasses etc.	6
	Forbs	3
	Ferns	1
	Other	4
Sum of Cover of native vascular plants by growth form group	Trees	42-1
	Shrubs	13-6
	Grasses etc.	26-4
	Forbs	2-3
	Ferns	25
	Other	3-4
High Threat Weed cover		4-1

BAM Attribute (1000 m² plot)		
DBH	# Tree Stems Count	# Stems with Hollows
80 + cm	–	1
50 – 79 cm	–	
30 – 49 cm	✓	
20 – 29 cm	✓	
10 – 19 cm	✓	
5 – 9 cm	✓	
Regeneration < 5 cm	✓	
Length of logs (m) (≥10 cm diameter, >50 cm in length)	14, 40, 1	

Large Tree Sizes

Dry Sclerophyll Forests - ≥50, Forested Wetlands - ≥50, Freshwater Wetlands - NA, Grasslands - NA, Grassy Woodlands - ≥50, Heathlands - ≥30, Rainforests - ≥50, Saline Wetlands - NA, Semi-arid Woodland (grassy sub-formation) ≥30, Semi-arid woodlands (shrubby sub-formation) ≥30, Wet sclerophyll forests (grassy sub-formation) ≥79, Wetland sclerophyll forests (shrubby sub-formation) ≥79

BAM Attribute (1 x 1 m plots)	Litter cover (%)	Bare ground cover (%)	Cryptogam cover (%)	Rock cover (%)
Subplot score (% in each)	90 | 95 | 90 | 97 | 100	4 | 5 | 0 | 3 | 0		
Average of the 5 subplots	92-4	2-4		

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Landform Element		Landform Pattern		Microrelief	
Lithology		Soil Surface Texture		Soil Colour		Soil Depth	
Slope		Aspect		Site Drainage		Distance to nearest water and type	

Additional Plot Comments

Wildthing Environmental Consultants - Office # (02) 49513311

400 m² plot: Sheet _ of _	Survey Name	Plot Identifier	Recorders
Date			

GF Code	Species	Cover	Abund	voucher	GF Code	Species	Cover	Abund	Voucher
T	A. Costata	12	6						
T	B. Serrata	22	10	40%					
T	E. pilularis	8	2						
S	M. elliptica	5	7						
S	P. UNDULATUM	3	8						
O	P. PANDORANA	3	250						
S	D. CERERULA VAR P	5	80						
G	I. CYLINDRICA	20	600						
G	L. filicifolia M	0.7	40						
HTW	B. tou	4	30						
F	Asplenium	2	400						
S	D. RHOMBIFOLIA	0.2	10						
S	L. LANCEOLATUM	0.2	8						
O	P. STRAMINEA	0.1	3						
G	E. MARGINATA	0.3	25						
G	L. Longifolia	5	15						
F	Pomax umbell	0.1	15						
F	Pteridium	0.2	30						
O	Dipodium punctatum	0.2	15						
S	A. SCAVE	0.1	3						
HTW	L. CAMARA	0.1	1						
FERN	Pteridium esculentum	25	110						
O	GLYCINE CLAN	0.1	3						
G	THEMEDA T	0.3	10						
G	PASPALIDIUM DISTANS	0.1	4						
T	~~EUCALYPTUS~~ Glochidion	0.1	1	✓					
S	Polyscias S	0.1	1	✓					

GF Code: see Growth Form definitions in Appendix 1 **N:** native, **E:** exotic, **HTE:** high threat exotic **GF – circle code** if 'top 3'.

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); ***Note:*** *0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m*

Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Wildthing Environmental Consultants - Office # (02) 49513311

BAM Site – Field Survey Form | Site Sheet no:

		Plot Size	Photo #	Plot Waypoint ID	Recorders
Date	29 5	10 x 30		BPBE6	
Midline start 6619	Midline end 6620	IBRA region			
E- 418164 N- 6378625	E- 0417210 N- 6373519	Vegetation Class			
Bearing 168°	Bearing 340°	Vegetation Zone	BTSSAF_DN01		
PCT #		PCT Name			
Consistent BC ACT TEC?					

BAM Attribute (400 m² plot)		Sum values
Count of Native Richness	Trees	2
	Shrubs	9
	Grasses etc.	6
	Forbs	4
	Ferns	1
	Other	3
Sum of Cover of native vascular plants by growth form group	Trees	0.2
	Shrubs	6.2
	Grasses etc.	45.5
	Forbs	3.5
	Ferns	15
	Other	0.3
High Threat Weed cover		11.2

BAM Attribute (1000 m² plot)		
DBH	# Tree Stems Count	# Stems with Hollows
80 + cm		
50 – 79 cm		
30 – 49 cm		
20 – 29 cm		
10 – 19 cm		
5 – 9 cm		
Regeneration < 5 cm	✓	
Length of logs (m) (≥10 cm diameter, >50 cm in length)		

Large Tree Sizes

Dry Sclerophyll Forests - ≥50, Forested Wetlands - ≥50, Freshwater Wetlands - NA, Grasslands - NA, Grassy Woodlands - ≥50, Heathlands - ≥30, Rainforests - ≥50, Saline Wetlands - NA, Semi-arid Woodland (grassy sub-formation) ≥30, Semi-arid woodlands (shrubby sub-formation) ≥30, Wet sclerophyll forests (grassy sub-formation) ≥79, Wetland sclerophyll forests (shrubby sub-formation) ≥79

BAM Attribute (1 x 1 m plots)	Litter cover (%)	Bare ground cover (%)	Cryptogam cover (%)	Rock cover (%)
Subplot score (% in each)	75 65 50 10 30	0 20 30 80 40		
Average of the 5 subplots	47	34		

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Landform Element		Landform Pattern		Microrelief	
Lithology		Soil Surface Texture		Soil Colour		Soil Depth	
Slope		Aspect		Site Drainage		Distance to nearest water and type	

Additional Plot Comments

WILDTHING Environmental Consultants

Wildthing Environmental Consultants - Office # (02) 49513311

400 m² plot: Sheet _ of _		Survey Name	Plot Identifier	Recorders
Date				

V-tall

3% 50

GF Code	Species	Cover	Abund	voucher	GF Code	Species	Cover	Abund	Voucher
G	I. CYLINDRICA	20	~~200~~ 250						
F	LOMPHOCARPUS T	3	50						
FERN	P. esculentum	15	80						
G	T. TRIANDRA	~~35~~ 25	300						
S	~~SHRUB NOT RHINO~~ Hibbertia L	3	50						
W	DESMAZERIA RIGIDA	5	40						
S	M. elliptica	0.2	4						
S	B. rhombifolia	1	10						
G	ERAGROSTIS BROWNII	0.1	5						
G	Digitaria S	0.2	15						
HTW	ANDROPOGON V	~~4~~ 7	50						
HTW	Biton	4	25						
S	B. oblong	0.1	1						
W	~~ACANTHOS~~ ...SPERMUM AUSTRALE	0.1	1						
S	A. SUAVE	0.2	5						
S	~~L..~~ LEUCOP lance	1	15						
O	D. Pogon Rhytido	0.1	3						
W	Solenia P	0.5	~~20~~ 30						
T	J. Serrata	0.1	2						
HTW	Conyza B	0.1	10						
S	D. caerula var?	0.4	30						
F	PORANTHERA ...M - kinda like black eyed susan								
F	Acianthus	0.1	25						
W	Hypochaeris R	0.2	15						
HTW	L. camera	0.1	3						
S	Acacia Ulici	0.1	2						
T	Glichedion F	0.1	1						
S	Lomandra Long	0.2	3						
G	ENTOLASIA M	0.1	5						
O	PANDOREA	0.1	1						
F	~~WILY CAL~~ T. BILORNE	0.1	3						
O	HARDENBURGIA V	0.1	1						
G	PANICUM S	0.1	1						

GF Code: see Growth Form definitions in Appendix 1 **N:** native, **E:** exotic, **HTE:** high threat exotic **GF – circle code** if 'top 3'.
Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); ***Note:*** *0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m*
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Wildthing Environmental Consultants - Office # (02) 49513311

BAM Site – Field Survey Form | Site Sheet no:

		Plot Size	Photo #	Plot Waypoint ID	Recorders
Date	25 5 19	20×80		BPLE7	BE
Midline start: 6622	Midline end: 6624	IBRA region			
E- 412637 N- 6373906	E- 0411985 N- 6373895	Vegetation Class			
Bearing 235	Bearing 51 NE	Vegetation Zone	CLEARED		
PCT #		PCT Name			
Consistent BC ACT TEC?					

BAM Attribute (400 m² plot)		Sum values
Count of Native Richness	Trees	1
	Shrubs	0
	Grasses etc.	2
	Forbs	1
	Ferns	0
	Other	0
Sum of Cover of native vascular plants by growth form group	Trees	0.1
	Shrubs	0
	Grasses etc.	10
	Forbs	0.1
	Ferns	0
	Other	0
High Threat Weed cover		51

BAM Attribute (1000 m² plot)		
DBH	# Tree Stems Count	# Stems with Hollows
80 + cm	—	1
50 – 79 cm	1	
30 – 49 cm	—	
20 – 29 cm	—	
10 – 19 cm	—	
5 – 9 cm	—	
Regeneration < 5 cm		
Length of logs (m) (≥10 cm diameter, >50 cm in length)	0	

Large Tree Sizes

Dry Sclerophyll Forests - ≥50, Forested Wetlands - ≥50, Freshwater Wetlands - NA, Grasslands - NA, Grassy Woodlands - ≥50, Heathlands - ≥30, Rainforests - ≥50, Saline Wetlands - NA, Semi-arid Woodland (grassy sub-formation) ≥30, Semi-arid woodlands (shrubby sub-formation) ≥30, Wet sclerophyll forests (grassy sub-formation) ≥79, Wetland sclerophyll forests (shrubby sub-formation) ≥79

BAM Attribute (1 x 1 m plots)	Litter cover (%)	Bare ground cover (%)	Cryptogam cover (%)	Rock cover (%)
Subplot score (% in each)	2 1 2 9 11	30 50 40 70 30		
Average of the 5 subplots	5	44		

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Landform Element		Landform Pattern		Microrelief	
Lithology		Soil Surface Texture		Soil Colour		Soil Depth	
Slope		Aspect		Site Drainage		Distance to nearest water and type	

Additional Plot Comments

Wildthing Environmental Consultants - Office # (02) 49513311

400 m² plot: Sheet _ of _		Survey Name	Plot Identifier	Recorders
Date				

GF Code	Species	Cover	Abund	voucher	GF Code	Species	Cover	Abund	Voucher
W	FUMATORY	0.3	40						
W	PLANTAGO	0.1	10						
W	KIDNEYWEED	0.4	40						
G	CYNADON D	6	70						
HTW	KIKUYU	30	4000						
W	VERBASCUM	0.1	2						
W	BLACKBERRY	1	10						
W	SETARIA .P	6	30						
T	GLICHEDION	0.1	1						
W	CYPERUS KUGRENATUS	2	50						
W	SONCHUS ASPER	1	5						
W	CIRCIUM ✓	0.8	5						
F	POMAX ✓	0.1	1						
W	D repens	0.1	10						
W	flatweed	3	50						
W	ELUSINE IND	4	30						
W	PURSLANE	0.1	5						
HTW	~~fork~~ CONYZA A+B	20	2000						
G	MICROLENAS	4	50						
HTW	~~Sorr~~ Acetosella vulgaris	1	25						
W	~~Small leaf~~ ~~[illegible]~~	0.1							
	Poranthera microphylla								

GF Code: see Growth Form definitions in Appendix 1 **N:** native, **E:** exotic, **HTE:** high threat exotic **GF – circle code** if 'top 3'.
Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); ***Note:*** *0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m*
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

APPENDIX D

BAM CREDIT CALCULATOR OUTPUT

BAM Credit Summary Report

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00019470/BAAS17074/20/00019471	12462_Anna Bay_Sand Mine_BDAR	26/11/2019
Assessor Name	Report Created	BAM Data version *
	18/03/2020	22
Assessor Number	BAM Case Status	Date Finalised
	Finalised	18/03/2020
Assessment Revision	Assessment Type	
0	Part 4 Developments (General)	

* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

Ecosystem credits for plant communities types (PCT), ecological communities & threatened species habitat

Zone	Vegetation zone name	Vegetation integrity loss / gain	Area (ha)	Constant	Species sensitivity to gain class (for BRW)	Biodiversity risk weighting	Potential SAII	Ecosystem credits
Smooth-barked Apple - Blackbutt heathy open forest of the Tomaree Peninsula								
1	1648_Intact	62.5	0.6	0.25	High Sensitivity to Potential Gain	1.75		17
							Subtotal	**17**

Spinifex beach strand grassland, Sydney Basin Bioregion and South East Corner Bioregion							
2	1204_Sparse	0.6	0.1	0.25	High Sensitivity to Potential Gain	1.50	0
						Subtotal	**0**
						Total	**17**

Species credits for threatened species

Vegetation zone name	Habitat condition (HC)	Area (ha) / individual (HL)	Constant	Biodiversity risk weighting	Potential SAII	Species credits
Burhinus grallarius / Bush Stone-curlew (Fauna)						
1648_Intact	62.5	0.64	0.25	2	False	20
					Subtotal	**20**
Diuris praecox / Rough Doubletail (Flora)						
1648_Intact	62.5	0.64	0.25	1.5	False	15
					Subtotal	**15**

APPENDIX E
FLORA LIST

Introduced species are indicated by an asterisk ("*").

The following standard abbreviations are used to indicate subspecific taxa:

subsp. - subspecies
var.- variety
× **-** hybrid between the two indicated species

Biodiversity Conservation Act (BC Act)

V Vulnerable
E1 Endangered
E2 Endangered Population
E4A Critically Endangered Population

Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)

V Vulnerable
E Endangered
CE Critically Endangered

FLORA LIST FOR THE STUDY AREA

SCIENTIFIC NAME	COMMON NAME	BC ACT	EPBC ACT
CLASS FILICOPSIDA (Ferns)			
Davalliaceae			
**Nephrolepis cordifolia*	Fishbone Fern		
Dennstaedtiaceae			
Pteridium esculentum	Bracken		
Pinaceae			
**Pinus elliotii*	Slash Pine		
MAGNOLIOPSIDA: Magnoliidae			
LILOPSIDA: (Monocotyledons)			
Anthericaceae			
Tricoryne elatior	Yellow Rush-lily		
Araceae			
**Colocasia esculenta*	Taro		
Cyperaceae			
**Cyperus eragrostis*	Umbrella Sedge		
Liliaceae			
**Lilium formosanum*	Formosan Lily		
Lomandraceae			
Lomandra filiformis	Wattle Mat- Rush		
Lomandra longifolia	Spiny Mat Rush		

SCIENTIFIC NAME	COMMON NAME	BC ACT	EPBC ACT
Orchidaceae			
Acianthus fornicatus	Pixie Orchid		
Diuris praecox	**Sand Doubletail**	**V**	**V**
Pterostylis nutans	Nodding Greenhood		
Phormiaceae			
Dianella caerulea var. *producta*	Blue Flax-lily		
Poaceae			
**Andropogon virginicus*	Whisky Grass		
**Anthoxanthum odoratum*	Sweet Vernal Grass		
**Arundo donax*	Giant Reed		
**Axonopus fissifolius*	Narrow-leaved Carpet Grass		
**Briza maxima*	Quaking Grass		
Cenchrus spinifex	Spiny Burrgrass		
**Chloris gayana*	Rhodes Grass		
Cymbopogon refractus	Barbed-wire Grass		
Cynodon dactylon	Common Couch		
Digitaria parviflora	Smallflower Fingergrass		
Entolasia marginata	Bordered Panic		
**Eragrostis curvula*	African Love Grass		
Eragrostis brownii	Brown's Love Grass		
Imperata cylindrica var. *major*	Blady Grass		
**Melinis repens*	Red Natal Grass		
Microlaena stipoides var. *stipoides*	Weeping Meadow Grass		
Paspalidium distans	Spreading Panic Grass		
**Paspalum dilatatum*	Paspalum		
**Setaria gracilis*	Slender Pigeon Grass		
**Setaria parviflora*			
Spinifex sericeus	Coastal Spinifex		
Themeda australis	Kangaroo Grass		

SCIENTIFIC NAME	COMMON NAME	BC ACT	EPBC ACT
Smilacaceae			
Smilax australis	Smilax		
Smilax glyciphylla	Native Sarsaparilla		
MAGNOLIIDAE (Dicotyledons)			
Anacardiaceae			
**Schinus terebinthifolius*	Brazilian Pepper Tree		
Apiaceae			
Centella cordifolia			
**Foeniculum vulgare*	Fennel		
**Hydrocotyle bonariensis*	Kurnell Curse		
Apocynaceae			
Parsonsia straminea var. *straminea*	Common Silkpod/Monkey Rope		
Araliaceae			
**Hedera helix*			
Asteraceae			
**Bidens pilosa*	Cobblers Pegs		
**Cirsium vulgare*	Spear Thistle		
**Conyza bonariensis*	Flax-leaved Fleabane		
**Conyza parva*	Whorled Fleabane		
**Chrysanthemoides monilifera* subsp. *rotundata*	Bitou Bush		
**Coreopsis lanceolata*	Coreopsis		
Epaltes australis	Spreading Nut-heads		
**Hypochaeris glabra*	Smooth Catsear		
**Hypochaeris radicata*	Catsear		
**Senecio madagascariensis*	Fireweed		
**Sonchus oleraceus*	Common Sow Thistle		

SCIENTIFIC NAME	COMMON NAME	BC ACT	EPBC ACT
Bignoniaceae			
**Jacaranda mimosifolia*	Jacaranda		
Pandorea pandorana	Wonga-wonga Vine		
Brassicaceae			
**Cakile edentula*	American Sea Rocket		
Caesalpiniaceae			
Senna pendula var. *glabrata*			
Caryophyllaceae			
**Paronychia brasiliana*	Chilean Whitlow Wort		
Cassythaceae			
Cassytha glabella	Slender Devil's Twine		
Dilleniaceae			
Hibbertia linearis			
Hibbertia scandens	Climbing Guinea Flower		
Epacridaceae			
Brachyloma daphnoides subsp. *daphnoides*	Daphne Heath		
Leucopogon lanceolatus	Lance Beard-heath		
Leucopogon margarodes	Pink Bearded Heath		
Monotoca elliptica	Tree Broom-heath		
Euphorbiaceae			
Breynia oblongifolia	Coffee Bush		
Glochidion ferdinandi var. *ferdinandi*	Cheese Tree		
Poranthera microphylla			
Ricinocarpus pinifolius	Wedding Bush		
**Ricinus communis*	Castor Oil Plant		

SCIENTIFIC NAME	COMMON NAME	BC ACT	EPBC ACT
Fabaceae (Faboideae)			
Aotus ericoides	Heath Aotus		
Bossiaea rhombifolia			
Desmodium rhytidophyllum	Tick-treefoil		
Desmodium varians	Tick-treefoil		
Dillwynia retorta subsp. *retorta*	Heathy Parrot Pea		
**Erythrina x sykesii*	Coral Tree		
Glycine clandestina sp. complex	Love Creeper		
Hardenbergia violacea	False Sarsaparilla		
Kennedia rubicunda	Dusky Coral Pea		
**Medicago polymorpha*	Burr Medic		
**Trifolium repens*	White Clover		
Fabaceae (Mimosoideae)			
Acacia irrorata subsp. *irrorata*			
Acacia longifolia	Sydney Golden Wattle		
Acacia suaveolens	Sweet-scented Wattle		
Acacia ulicifolia	Prickly Moses		
Haloragaceae			
Gonocarpus teucrioides	Germander Raspwort		
Lamiaceae			
Clerodendrum tomentosum	Hairy Clerorodendrum		
Lauraceae			
**Cinnamomum camphora*	Camphor Laurel		
Loranthaceae			
Muellerina celastroides	Coastal Mistletoe		

SCIENTIFIC NAME	COMMON NAME	BC ACT	EPBC ACT
Malvaceae			
**Modiola caroliniana*	Red-flowered Mallow		
Menispermaceae			
Stephania japonica var. *japonica*	Snake Vine		
Myrtaceae			
Angophora costata	Smooth-barked Apple		
Eucalyptus pilularis subsp. *pilularis*	Blackbutt		
Onagraceae			
**Oenothera* sp.	Primrose		
Oxalidaceae			
**Oxalis corniculata*	Creeping Oxalis		
Pittosporaceae			
Billardiera scandens	Apple Dumplings		
Pittosporum undulatum	Sweet Pittosporum		
Plantaginaceae			
**Plantago lanceolata*	Plantain		
Polygalaceae			
Comesperma ericinum	Matchheads		
Primulaceae			
**Anagallis arvensis* var. *arvensis*	Scarlet Pimpernel		
Proteaceae			
Banksia integrifolia	Silver Banksia		
Banksia serrata	Old Man Banksia		
Persoonia levis	Broad-leaved Geebung		

SCIENTIFIC NAME	COMMON NAME	BC ACT	EPBC ACT
Ranunculaceae			
Clematis aristida	Old Man's Beard		
Rubiaceae			
Pomax umbellata	Pomax		
**Richardia humistrata*			
Sapindaceae			
Dodonea triquetra	Hop Bush		
Solanaceae			
**Solanum mauritianum*	Wild Tobacco		
**Solanum nigrum*	Blackberry Nightshade		
Thymelaeaceae			
Pimelea linifolia	Rice Flower		
Verbenaceae			
**Lantana camara*	Lantana		
**Verbena bonariensis*	Purple Top		
Vitaceae			
Cayratia clematidea	Slender Grape		

APPENDIX F

FAUNA LIST

FAUNA LIST

Family sequencing and taxonomy follow for each fauna class:
Herpetofauna
Cogger (2014).

Birds
Pizzey and Knight (2012)(9th edn).

Mammals - Van Dyck & Strahan (Ed) (2008) and Churchill (2008).

Churchill, S. (2008). *Australian Bats*. (2nd edn.). Allen & Unwin Australia.

(?) - Indicates a species identified without certainty or to a Genus level only.

* - Indicates an introduced species.

The following symbols are used to indicate species recorded during previous surveys.
@ - Previous record Lot 10 DP 1071458 (Wildthing Environmental Consultants, 2008)

Threatened species addressed within this assessment appear in **bold** font.

Introduced species are indicated by an asterisk ("*").

The following standard abbreviations are used to indicate subspecific taxa:

subsp. -	subspecies
var.-	variety
× -	hybrid between the two indicated species

Biodiversity Conservation Act 1995 (BC Act)

V	Vulnerable
E1	Endangered
E2	Endangered Population
E4A	Critically Endangered Population

Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)

V	**Vulnerable**
E	**Endangered**
CE	**Critically Endangered Population**

Observation Type

O - Observed (sighted)
W - Heard call
OW – Observed and heard call
X - In scat
P – Scat
T - Trapped or netted
H – Hair, feathers or skin
A - Stranded/Beached
G – Crushed cones
R – Road Kill
D – Dog Kill
Q – Camera
C – Cat Kill
V – Fox Kill
K – Dead
S – Shot
I – Fossil/subfossil
FB – Burrow
F – Tracks, scratching
Z – In raptor/owl Pellet
U – Ultrasonic recording
M - Miscellaneous
E – Nest/roost
B - Burnt
Y – Bones, teeth or shell
N – Not located
AR – Acoustic Recording

SCIENTIFIC NAME	COMMON NAME	BC ACT	EPBC ACT	OBSERVATION TYPE	HABITAT TYPE
Phylum - Chordata					
Subphylum - Vertebrata					
Class Amphibia - Amphibians					
Family Limnodynastidae					
Platyplectrum ornatum	Ornate Burrowing Frog			O	6
Family Myobatrachidae - 'Southern Frogs'					
Crinia signifera	Common Eastern Froglet			W	6
Order Squamata – Lizards and Snakes					
Suborder Sauria - Lizards					
Family Scincidae - Skinks					
Lampropholis delicata	Grass Skink			O	1
Saiphos equalis	Three-toed Skink			T	1
Class Aves - Birds					
Family Columbidae - Pigeons, Doves					
Columba leucomela	White-headed Pigeon			O	1
Family Accipitridae - Osprey, Hawks, Eagles and Harriers					
Haliaeetus leucogaster	**White-bellied Sea-Eagle**		**M**	**O**	**1**
Family Cacatuidae - Cockatoos and Corellas					
Cacatua galerita	Sulphur-crested Cockatoo			W	1
Cacatua roseicapilla	Galah			OW	1, 8
Family Psittacidae - Parrots, Rosellas and Lorikeets					
Trichoglossus haematodus	Rainbow Lorikeet			OW	1, 3, 4
Family Halcyonidae - Tree Kingfishers					
Dacelo novaeguineae	Laughing Kookaburra			OW	1, 3, 4

SCIENTIFIC NAME	COMMON NAME	BC ACT	EPBC ACT	OBSERVATION TYPE	HABITAT TYPE
Family Maluridae					
Malurus cyaneus	Superb Fairy-wren			OW	1, 3, 4
Family Pardalotidae - Pardalotes, Gerygones, Scrubwrens, Heathwrens and Thornbills					
Acanthiza pusilla	Brown Thornbill			W	1, 3, 4
Pardalotus punctatus	Spotted Pardalote			W	1
Family Meliphagidae - Honeyeaters					
Acanthorhynchus tenuirostris	Eastern Spinebill			W	1, 3
Lichenostomus chrysops	Yellow-faced Honeyeater			W	1, 3, 4, 5
Manorina melanocephala	Noisy Miner			W	1
Meliphaga lewinii	Lewin's Honeyeater			W	1, 2, 3, 4, 5
Family Petroicidae - Robins and Jacky Winter					
Eopsaltria australis	Eastern Yellow Robin			OW	1, 3
Family Pachycephalidae - Whistlers, Shrike-tit and Shrike-thrushes					
Pachycephala pectoralis	Golden Whistler			W	1
Family Cinclosomatidae - Whipbird and Quail-thrushes					
Psophodes olivaceus	Eastern Whipbird			W	1, 3, 4, 5
Family Dicruridae - Monarchs, Flycatchers, Fantails, Drongo and Magpie-Lark					
Rhipidura fuliginosa	Grey Fantail			OW	1, 3, 4, 5
Grallina cyanoleuca	Magpie-lark			OW	1, 3, 7, 8
Family Campephagidae - Cuckoo-shrikes and Trillers					
Coracina novaehollandiae	Black-faced Cuckoo-shrike			OW	1, 3, 7, 8
Family Zosteropidae - White-eyes					

SCIENTIFIC NAME	COMMON NAME	BC ACT	EPBC ACT	OBSERVATION TYPE	HABITAT TYPE
Zosterops lateralis	Silvereye			OW	1, 3, 4
Family Artamidae - Wood-swallows, Butcherbirds, Magpie and Currawongs					
Cracticus tibicen	Australian Magpie			OW	1, 2, 3, 7, 8
Family Corvidae - Crows, Raven					
Corvus coronoides	Australian Raven			OW	1, 2, 3, 7, 8
Family Estrildidae - Grassfinches					
Neochmia temporalis	Red-browed Finch			O	
Class Mammalia - Mammals					
Subclass Prototheria - Monotremes					
Order Monotremata					
Order Dasyuromorphia – Carnivorus Marsupials					
Family Dasyuridae - Dasyurids					
Antechinus stuartii	Brown Antechinus			T	1, 2, 3, 4
Order Peramelemorphia					
Family Peramelidae - Bandicoots					
Isoodon macrourus	Northern Brown Bandicoot			T	1, 2, 3, 4
Order Diprotodontia					
Suborder Vombatiformes					
Superfamily - Phalangeroidea					
Family Phalangeridae - Brushtail Possums					
Trichosurus vulpecula	Common Brushtail Possum			O	1, 3
Superfamily - Macropodoidae					
Family Macropodidae - Kangaroos, Wallabies					

SCIENTIFIC NAME	COMMON NAME	BC ACT	EPBC ACT	OBSERVATION TYPE	HABITAT TYPE
Macropus rufogriseus	Red-necked Wallaby			O	1
Subclass Eutheria - Eutherian Mammals					
Order Chiroptera					
Suborder Megachiroptera - Megabats					
Family Pteropodidae - Fruit Bats					
Pteropus poliocephalus	**Grey-headed Flying-fox**	**V**	**V**	O	1
Family Vespertilionidae - Plain-nosed Bats					
Chalinolobus gouldii	Gould's Wattled bat			U	1
Falsistrellus tasmaniensis	**Eastern False Pipistrelle**	**V**		**U**	**1**
Miniopterus australis	**Little Bentwing-bat**	**V**		**U, T**	**1**
Nyctophilus sp.	South-eastern Long-eared Bat			U	1
Scoteanax rueppellii	**Greater Broad-nosed Bat**	**V**		**U**	1
Vespadelus vulturnus	Little Forest Bat			U	1
Order Rodentia					
Family Muridae - Rodents					
Rattus fuscipes	Bush Rat			T	1
**Rattus rattus*	Black Rat			T	3
Order Carnivora					
Family Canidae					
**Vulpes vulpes*	Red Fox			O, Q, P	1
Order Lagomorpha					
Family Leporidae					
**Lepus capensis*	European Hare			O, Q	1

APPENDIX G
TARGETED SURVEY EFFORT

Date	Time (24hr)	Survey Effort (Expressed in Person Hours)	Activity	Weather
26-May-17	1215 - 1415	2 (two persons)	• General Site Inspection • Random Meander Flora Survey • Targeted Survey for Threatened Diurnal Birds	0/8 Cloud, 19 C, WSW 2km/h, 52% humidity
21-Jun-17	1500 - 1700	2 (two persons)	• Significant Tree Inventory • Targeted Survey for Threatened Trees	3/8 Cloud, 18.5 C, SW 18km/h, 66% humidity
	1700 - 1830	1.5 (two persons)	• Targeted Survey for Threatened Diurnal Birds • Targeted Survey for Threatened Microchiropteran Bats • Targeted Survey for Threatened Nocturnal Birds • Targeted Survey for Threatened Amphibians	7/8 Cloud, light rain, 15 C, WSW 9km/h, 82% humidity
3-Jul-17	0830 - 1600	7.5 (two persons)	• Significant Tree Inventory • Targeted Survey for Threatened Trees • Targeted Survey for Threatened Orchid • Targeted Survey for Threatened Diurnal Birds	0/8 Cloud, 7.5 C, WNW 9km/h, 97% humidity

17-Jul-17	0945 - 1400	8.5 (two persons)	• Trap Deployment (Targeted Survey for Small Nocturnal Mammals)	3/8 Cloud, 11.7C, WNW 17km/h, 82% humidity
18-Jul-17	0630 - 0830	2 (one person)	• Checking Traps (Targeted Survey for Small Nocturnal Mammals)	0/8 Cloud, light fog, 8.5C, NW 19km/h, 95% humidity
19-Jul-17	0645 - 0930	2 (two persons)	• Checking Traps (Targeted Survey for Small Nocturnal Mammals)	0/8 Cloud, 9.3C, WNW 19km/h, 59% humidity
	1230 - 1400	6 (two persons)	• Targeted Survey for Threatened Forbs and Shrubs and Orchids	1/8 Cloud, 16C, W 43km/h, 43% humidity
20-Jul-17	0645 - 0930	2.75 (one person)	• Checking traps (Targeted Survey for Small Nocturnal Mammals) • Targeted Survey for Threatened Amphibians	1/8 Cloud, 12.7C, SW 26km/h, 69% humidity
	1645 - 1715 1730 - 1930	0.5 (one person) 2 (One person)	• Targeted Survey for Threatened Diurnal Birds • Targeted Survey for Threatened Reptiles • Targeted Survey for Small Nocturnal Mammals • Targeted Survey for Threatened	3/8 Cloud, 15C, SW 36km/h, 71% humidity

			Microchiropteran Bats	
21-Jul-17	0645 - 1100	4.25 (one person)	• Checking Traps and Trap Retrieval (Targeted Survey for Small Nocturnal Mammals)	5/8 Cloud, 6.0C, WNW 22km/h, 74% humidity
	1700 - 1900	2 (two person hours)	• Targeted Survey for Small Nocturnal Mammals • Targeted Survey for Threatened Microchiropteran Bats	5/8 Cloud, 12C, WNW 32km/h, 52% humidity
30-Aug-17	0900-1300	4 (one person)	• Targeted Survey for Threatened Orchid • Targeted Survey for Little Eagle	3/8 Cloud, W 15km/h, 13.0□C on arrival. 17.0C when leaving.
22-Sept-17	0830-1030	2 (one person)	• Targeted Survey for Threatened Orchid and *Tetratheca juncea* • Targeted Survey for Threatened Diurnal Birds	5/8 Cloud, SW 5km/h, 16C 62% humidity
27-Oct-17	0800-0900	1 (one person)	• Targeted Survey for Threatened Orchid and *Tetratheca juncea* • Targeted Survey for Little Eagle	8/8 Cloud, 17.3C, SW 22km/h, 84% humidity
30-Oct-17	1200-1300	1 (one person)	• Targeted Survey for Threatened Orchid and *Tetratheca juncea*	1/8 Cloud, 27.9C, N 22km/h, 50% humidity
21-Dec-17	0700-0900	2 (One Person)	• Targeted Survey for Threatened Orchid and *Tetratheca juncea*	8/8 Cloud, 21C, E 10km/h, 87% humidity, Precipitation 7%.

11-Jan-18	1130-1330	2 (One person)	• Targeted Survey for Threatened Orchid	3/8 Cloud, 30C, SE 5km/h, 42% humidity
23-Jan-18	0800-0930	1.5 (One Person)	• Targeted Survey for Threatened Forbs and Shrubs • Targeted Survey for Threatened Diurnal Birds	2/8 Cloud, 23.8C, NNE 6km/h, 71% humidity
27-Mar-18	1800-1900	1 (One Person)	• Targeted Survey for Threatened Amphibians • Targeted Survey for Threatened Reptiles • Targeted Survey for Small Nocturnal Mammals • Targeted Survey for Koala	8/8 Cloud, 18C, NE 6km/h, 60% humidity
23-May-18	0930-1600	6.5 hours (One Person)	• Vegetation Integrity Assessment	6/8 Cloud, 14.1C, NE 9km/h, 87% humidity
29-May-18	1030-1500	5 hours (One Person)	• Vegetation Integrity Assessment	6/8 Cloud, 16.5C, NNW 4km/h, 85% humidity
14-Jun-18	1600-1900	3 (One Person)	• Vegetation Survey • Targeted Survey for Threatened Nocturnal Birds • Targeted Survey for Koala • Targeted Survey for Small Nocturnal Mammals • Targeted Survey for Threatened	0/8 Cloud, 13C, W 6km/h, 78% humidity

			Microchiropteran Bats	
12-Dec-19	1330-1630	4 (two persons)	• Targeted Survey for Threatened Orchid and *Tetratheca juncea* • Targeted Survey for Bush-Stone Curlew • Targeted Search for White-bellied Sea Eagle • Targeted Search for Gang-Gang Cockatoo	4/8 Cloud, 24C, SE 19km/h, 49% humidity
13-Jan-20	1130-2230	22 (two persons)	• Trap Deployment (Targeted Survey for Small Nocturnal Mammals Pale Headed Snake and Mahony's Toadlet) • Targeted Survey for Bush-Stone Curlew • Targeted Survey for Small Nocturnal Mammals and birds	6/8 Cloud, 25C, ENE 24km/h, 61% humidity
14-Jan-20	0600-0700	1 (one person)	• Checking Traps (Targeted Survey for Small Nocturnal Mammals, Pale Headed Snake and Mahony's Toadlet)	2/8 Cloud, 20C, ESE 4km/h, 78% humidity

15-Jan-20	0600-0730 0730-1030	1.5 (one person) 6 (two persons)	• Checking Traps (Targeted Survey for Small Nocturnal Mammals, Pale Headed Snake and Mahony's Toadlet) • Targeted Survey for Koala - Spot Assessment Technique. • Vegetation Survey • Targeted Survey for Threatened Diurnal Birds • Targeted Survey for Amphibians	7/8 Cloud, 20C, SE 5km/h, 93% humidity
16-Jan-20	0600-0630	0.5 (one person)	• Checking Traps (Targeted Survey for Small Nocturnal Mammals, Pale Headed Snake and Mahony's Toadlet)	1/8 Cloud, 22C, N 5km/h, 81% humidity
17-Jan-20	0600-0730 0730-0800	1.5 (One person) 1 (two persons)	• Checking Traps (Targeted Survey for Small Nocturnal Mammals, Pale Headed Snake and Mahony's Toadlet) and trap retrieval. • Targeted Survey for Threatened Diurnal Birds	8/8 Cloud, 19C, SW 9km/h, 91% humidity

21-Jan-2020	1945-2145	2 (One person)	• Targeted Survey for Small Nocturnal Mammals and birds • Targeted Survey for Threatened Microchiropteran Bats • Targeted Amphibian Survey	0/8 Cloud, 25C, ESE 15km/h, 67% humidity
2-Mar-20	1000-1145	5.25 (Three persons)	• Trap Deployment (Targeted Survey for Pygmy Possum and Common Planigale) • Anabat deployment - Targeted Survey for Southern Myotis • Targeted Survey for Little Tern	1/8 Cloud, 29C, W 14km/h, 54% humidity
3-Mar-20	0700-0800	1 (One person)	• Checking Traps (Targeted Survey for Pygmy Possum and Common Planigale) • Checking Anabat is still *in situ* and operational.	8/8 Cloud, 20C, SSW 19km/h, 96% humidity

4-Mar-20	0700-0800	1 (One person)	• Checking Traps (Targeted Survey for Pygmy Possum and Common Planigale) • Checking Anabat is still *in situ* and operational. • Incidental observations.	8/8 Cloud, 21C, NE 13km/h, 90% humidity
5-Mar-20	0700-0730	0.5 (One person)	• Checking Traps (Targeted Survey for Pygmy Possum and Common Planigale) • Checking Anabat is still *in situ* and operational.	8/8 Cloud, 23C, NNE 19km/h, 80% humidity
6-Mar-20	0715-0830	1.25 (One person)	• Checking Traps (Targeted Survey for Pygmy Possum and Common Planigale) and trap retrieval • Retrieval of Anabat detector.	0/8 Cloud, 23C, N 8km/h, 84% humidity

APPENDIX H

FULL BAM-CALCULATOR REPORT

BAM Biodiversity Credit Report (Like for like)

Proposal Details

Assessment Id 00019470/BAAS17074/20/00019471	Proposal Name 12462_Anna Bay_Sand Mine_BDAR	BAM data last updated * 26/11/2019
Assessor Name	Assessor Number	BAM Data version * 22
Proponent Names RAGUSA AUSTRALIA PTY LTD	Report Created 18/03/2020	BAM Case Status Finalised
Assessment Revision 0	Assessment Type Part 4 Developments (General)	Date Finalised 18/03/2020

* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

Potential Serious and Irreversible Impacts

Nil

Nil

Additional Information for Approval

PCTs With Customized Benchmarks

No Changes

BAM Biodiversity Credit Report (Like for like)

Predicted Threatened Species Not On Site

Name
Esacus magnirostris / Beach Stone-curlew
Xenus cinereus / Terek Sandpiper

Ecosystem Credit Summary (Number and class of biodiversity credits to be retired)

Name of Plant Community Type/ID	Name of threatened ecological community	Area of impact	Number of credits to be retired
1648-Smooth-barked Apple - Blackbutt heathy open forest of the Tomaree Peninsula	Not a TEC	0.6	17.00
1204-Spinifex beach strand grassland, Sydney Basin Bioregion and South East Corner Bioregion	Not a TEC	0.1	0.00

1204-Spinifex beach strand grassland, Sydney Basin Bioregion and South East Corner Bioregion

Like-for-like credit retirement options

Class	Trading group	HBT	IBRA region
Maritime Grasslands This includes PCT's: 779, 897, 898, 1204, 1272, 1697	Maritime Grasslands <50%	No	Karuah Manning, Hunter, Macleay Hastings, Mummel Escarpment and Upper Hunter. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

BAM Biodiversity Credit Report (Like for like)

1204-Spinifex beach strand grassland, Sydney Basin Bioregion and South East Corner Bioregion	
1648-Smooth-barked Apple - Blackbutt heathy open forest of the Tomaree Peninsula	**Like-for-like credit retirement options**

Class	Trading group	HBT	IBRA region
Coastal Dune Dry Sclerophyll Forests This includes PCT's: 1618, 1648, 1775	Coastal Dune Dry Sclerophyll Forests >=50% and <70%	Yes	Karuah Manning, Hunter, Macleay Hastings, Mummel Escarpment and Upper Hunter. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

Species Credit Summary

Species	Area	Credits
Burhinus grallarius / Bush Stone-curlew	0.6	20.00
Diuris praecox / Rough Doubletail	0.6	15.00

Burhinus grallarius/ Bush Stone-curlew	1648_Intact	**Like-for-like credit retirement options**	
		Spp	IBRA region

		Burhinus grallarius/Bush Stone-curlew	Any in NSW
Diuris praecox/ Rough Doubletail	1648_Intact	**Like-for-like credit retirement options**	
		Spp	IBRA region
		Diuris praecox/Rough Doubletail	Any in NSW

Biodiversity payment summary report

Assessment Id	Payment data version	Assessment Revision	Report created
00019470/BAAS17074/20/00019471	63	0	18/03/2020

Assessor Name	Assessor Number	Proposal Name	BAM Case Status
		12462_Anna Bay_Sand Mine_BDAR	Finalised

Assessment Type	Date Finalised
Part 4 Developments (General)	18/03/2020

PCT list

Price calculated	PCT common name	Credits
Yes	**1648 -** Smooth-barked Apple - Blackbutt heathy open forest of the Tomaree Peninsula	17
Yes	**1204 -** Spinifex beach strand grassland, Sydney Basin Bioregion and South East Corner Bioregion	0

Species list

Price calculated	Species	Credits
Yes	***Burhinus grallarius*** (Bush Stone-curlew)	20
Yes	***Diuris praecox*** (Rough Doubletail)	15

Ecosystem credits for plant communities types (PCT), ecological communities & threatened species habitat

Biodiversity payment summary report

IBRA sub region	PCT common name	Threat status	Offset trading group	Risk premium	Administrative cost	Methodology adjustment factor	Price per credit	No. of ecosystem credits	Final credits price
Karuah Manning	**1648 -** Smooth-barked Apple - Blackbutt heathy open forest of the Tomaree Peninsula	No	Coastal Dune Dry Sclerophyll Forests >=50% and <70%	23.65%	$146.85	2.1827	$4,686.47	17	$79,670.06
Karuah Manning	**1204 -** Spinifex beach strand grassland, Sydney Basin Bioregion and South East Corner Bioregion	No	Maritime Grasslands <50%	23.65%	$726.54	2.0318	$ 23,185.75	0	$0.00
								Subtotal (excl. GST)	**$79,670.06**
								GST	**$7,967.01**
								Total ecosystem credits (incl. GST)	**$87,637.07**

Species credits for threatened species

Species profile ID	Species	Threat status	Price per credit	Risk premium	Administrative cost	No. of species credits	Final credits price
10113	***Burhinus grallarius*** (Bush Stone-curlew)	Endangered	$636.69	34.3100%	$80.00	20	$18,702.77
10240	***Diuris praecox*** (Rough Doubletail)	Vulnerable	$150.00	34.3100%	$80.00	15	$4,221.98

	Subtotal (excl. GST)	**$22,924.75**
	GST	**$2,292.48**
Total species credits (incl. GST)		**$25,217.22**

Grand total	**$112,854.29**