Evolve Ecology

Williamtown Special Activation Precinct

Biodiversity Assessment

23 January 2023

Project No.: 0574306

Document details	
Document title	Williamtown Special Activation Precinct
Document subtitle	Biodiversity Assessment
Project No.	0574306
Date	23 January 2023
Version	2.0
Author	Evelyn Craigie (Evolve Ecology Pty Ltd)
Client Name	Department of Planning and Environment

Document history

				ERM approval to issue		
Version	Revision	Author	Reviewed by	Name	Date	Comments
Draft	01	Evelyn Craigie, Michael Murray	Karie Bradfield	Karie Bradfield	27 May 2021	Draft for DPE review
Draft	02	Evelyn Craigie, Michael Murray	Karie Bradfield	Karie Bradfield	14 December 2021	Draft for Agency Review based on updated Structure Plan
Final	1.0	Evelyn Craigie, Michael Murray	Karie Bradfield	Karie Bradfield	09 February 2022	Final for public exhibition
Final	2.0	Evelyn Craigie	Joanne Woodhouse	Karie Bradfield	23 January 2023	Final 02 based on revised Structure Plan boundary

Signature Page

23 January 2023

Williamtown Special Activation Precinct

Biodiversity Assessment

Evelyn Craigie
Evolve Ecology Pty Ltd
BAM Accredited Assessor

Michael Murray
Forest Fauna Surveys Pty Ltd

Joanne Woodhouse
Project Manager

Karie Bradfield
ERM Partner In Charge

Environmental Resources Management Australia Pty Ltd
Level 14 207 Kent Street
Sydney NSW 2000

EXECUTIVE SUMMARY

This Biodiversity Report has been prepared for the Department of Planning and Environment (DPE) to support the potential development of the Williamtown Special Activation Precinct (SAP) Masterplan.

This report addresses biodiversity values within the Williamtown SAP and identifies the constraints and opportunities for the potential development of the future Williamtown SAP Masterplan. It aims to test the Structure Plan that was developed as part of a series of Enquiry by Design Workshops and to establish the relevant specifications and requirements to assist in the development of the Masterplan.

It is noted that the legislative pathway for the development includes a potential State Significant Development application. This would create a simplified pathway to support new development within Williamtown SAP and would facilitate the development as 'complying development' subject to meeting the relevant consent conditions. This would require development of a Biodiversity Development Assessment Report (BDAR) and an EPBC referral. This assessment is not a BDAR and all credit obligations are provided as indicative only to support the Masterplan design process.

The Williamtown SAP boundary has been changed since previous versions of this report were prepared. The changes include:

- An overall reduction in the boundary, with removal of a large portion of the developable blocks, drainage and flood mitigation between the Environmental Protection Area and Cabbage Tree Road
- Change to the size and shape of the Environmental Protection Area
- Inclusion of parts of Newcastle Airport.

Further, the northern section of the Williamtown SAP includes areas that are already developed or have development approval. This includes parts of Newcastle Airport and an area known as DAREZ (Defence and Aerospace Related Employment Zone). Whilst this area is included in the Williamtown SAP boundary, assessment of impacts to biodiversity in this area is not required as the impacts have already been approved and are subject to existing biodiversity offset obligations.

This report has been updated to assess the direct and indirect impacts associated with the current Williamtown SAP boundary.

Field surveys included BAM plots, vegetation mapping and targeted fauna surveys undertaken in May, September and November 2021.

Seven Plant Community Types (PCT) were recorded within the Williamtown SAP as follows:

- PCT1637: Scribbly gum - Wallum Banksia - Prickly-leaved Paperbark heathy coastal woodland on coastal lowlands.
- PCT1646: Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast.
- PCT1651: Parramatta red gum - Fern-leaved banksia - *Melaleuca sieberi* swamp woodland of the Tomaree Peninsula.
- PCT1724: Broad-leaved Paperbark - Swamp Oak - Saw Sedge swamp forest on coastal lowlands of the Central Coast and Lower North Coast. This PCT is commensurate with Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions, which is listed as an endangered ecological community under the Biodiversity Conservation Act (BC Act).
- PCT1725: Swamp Mahogany - Broad-leaved Paperbark - Swamp Water Fern - Plume Rush swamp forest on coastal lowlands of the Central Coast and Lower North Coast. This PCT is commensurate with Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions, which is listed as an endangered ecological community under the BC Act.
- PCT1734: Wallum Bottlebrush – *Leptocarpus tenax* – *Baloskion pallens* Wallum sedge heath of the lower North Coast.

- PCT1742: Jointed Twig-rush sedgeland. This PCT is commensurate with Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions.

Four species credit species have been recorded at the Williamtown SAP: *Crinia tinnula* (Wallum Froglet), *Phascolarctos cinereus* (Koala), *Petaurus norfolcensis* (Squirrel Glider) and *Eucalyptus parramattensis* subsp. *decadens* (Earps Gum). A fifth species, *Lathamus discolor* (Swift Parrot), is included in the assessment as the Important Area Mapping for the species occurs within the Williamtown SAP.

Based on the retention of the Environmental Protection Area, and assuming full clearing within the development precincts, the Williamtown SAP would require a total of 51 ecosystem credits (indicative only). A breakdown of credits by PCT/vegetation zone is provided in the Table E.1 below.

Table E.1 Ecosystem Credits – Development Areas

Vegetation Zone	Area (ha) in Development Precincts	Ecosystem Credits
1646_good	0.06	1
1646_regrowth	0.54	6
1724_inundated	3.84	44
1724_low	4.47	0
Total	**8.91**	**51**

The development areas would require a total of 87 species credits (indicative only). A breakdown of credits by PCT/vegetation zone is provided in the Table E.2 below.

Table E.2 Species Credits – Development Areas

Vegetation Zone	Swift Parrot	Squirrel Glider	Koala	Wallum Froglet
1646_good	3	2	2	-
1646_regrowth	11	-	-	-
1724_inundated	15	-	-	33
1724_low	-	-	-	21
Total	**29**	**2**	**2**	**54**

It is noted that the above credit requirements are significantly lower than those provided in previous versions of this report. This is largely a result of:

1. All existing and approved development has now been excluded from the biodiversity impact assessment. Whilst this area is included in the Williamtown SAP boundary, assessment of impacts to biodiversity is not required as the impacts have already been approved and are subject to separate biodiversity offset obligations
2. An overall reduction in the SAP boundary.

The current development footprint is largely located in areas that do not support native vegetation or habitat, resulting in a significantly lower credit requirement.

At this stage the Biodiversity Assessment has considered the direct impacts of habitat clearance and provides indicative credit obligations in accordance with the BAM. It is important to note that further assessment will be undertaken to inform the delivery plan and will be based on the final flood mitigation and drainage design to consider:

- Any additional water that will flow into the retained habitats during major rainfall events may impact on the long term structure and diversity of these communities although it is noted that the swamp forest habitats are naturally adapted to being periodically inundated to some extent
- Drainage features that function as wetlands are incorporated into the Structure Plan which increases the surface area of water bodies in proximity to the airport, within the birdstrike zone area. The measures proposed for the management of the birdstrike risk will be included within the delivery plan and will include (as a minimum) steep batters to reduce foraging habitat and macrophyte planting designed to limit open water for large birds
- Indirect impacts on the nearby RAMSAR wetland and the important shorebird habitat within Fullerton Cove. This will be addressed separately as part of a targeted MNES report and will consider any changes to the existing water quality, volume and flows entering the local drainage channels which ultimately lead into Fullerton Cove. Specifically, it is recommended that the impact of increased freshwater runoff and total nitrogen load on wetlands at Fullerton Cove be further assessed to support the delivery plan and EPBC referral
- Further survey to meet the BAM survey requirements for species with the potential to occur that have not been adequately surveyed due to access limitations. Once these species have been surveyed in accordance with the BAM requirements, and if they are not recorded, they can be removed from further assessment.

The BAM requires that the *avoid, minimise, offset hierarchy* is applied to development projects and therefore, any future BDAR will be required to outline measures taken to avoid impacts to biodiversity and provide justification where avoidance is not applied. This is clearly evidenced through the Enquiry by Design process and the reduction in the Williamtown SAP from the original Investigation Area.

CONTENTS

List of Tables

List of Figures

Acronyms and Abbreviations

Name	Description
ALA	Atlas of Living Australia
AOBV	Area of Outstanding Biodiversity Value
BAM	Biodiversity Assessment Method
BAMC	Biodiversity Assessment Method Calculator
BC Act	NSW Biodiversity Conservation Act 2016
BC Reg	Biodiversity Conservation Regulation 2017
BC SEPP	State Environmental Planning Policy (Biodiversity and Conservation) 2021 (formerly the Koala SEPP)
BDAR	Biodiversity Development Assessment Report
Bionet	The NSW online BioNet database is made up of a number of data collections, specifically the BioNet Widlife Atlas and the BioNet Vegetation Classification.
BOS	Biodiversity Offset Scheme
BOSET	Biodiversity Offsets Scheme Entry Threshold
CKPoM	Comprehensive Koala Plan of Management
DAREZ	Defence and Aerospace Related Employment Zone
DAWE	Department of Agriculture, Water and the Environment
DPE	Department of Planning and Environment
EBD	Enquiry by Design
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
ERM	Environmental Resources Management Australia Pty Ltd
FM Act	Fisheries Management Act 1994
GDE	groundwater dependant ecosystems
HTW	high threat weeds
IBRA	Interim Biogeographic Regionalisation for Australia
LHCCREMS	Lower Hunter and Central Coast Regional Environment Strategy
MNES	Matter of Nation Environmental Significance
NSW	New South Wales
PCT	Plant Community Type
PMST	Protected Matters Search Tool
Precincts-Regional SEPP 2021	State Environmental Planning Policy (Precincts-Regional) 2021
SAII	Serious and Irreversible Impacts
SEPP	State Environmental Planning Policy
SAP	Special Activation Precinct
SPRAT	Species Profile and Threats Database
TDBC	Threatened Biodiversity Database Collection
TEC	Threatened Ecological Community
Williamtown SAP	The area within the Structure Plan
WONS	Weeds of National Significance
Worimi SCA	Worimi State Conservation Area

1. INTRODUCTION

Evolve Ecology Pty Ltd (Evolve Ecology) and Environmental Resources Management Australia Pty Ltd (ERM) have been engaged by the Department of Planning and Environment (DPE) to undertake a program of environmental and heritage studies to support the development of the Williamtown Special Activation Precinct (SAP) Masterplan. This report addresses biodiversity and identifies the constraints and opportunities for the future Williamtown SAP (refer to Figure 1).

It has been designed to test the Structure Plan that was developed as part of a series of Enquiry by Design Workshops and aims to establish the relevant specifications and requirements to assist in the development of the Masterplan.

This document is for design purposes only and has not been prepared to support any development application process. Field survey and reporting has been undertaken in accordance with the Biodiversity Assessment Method, however, this report is not a Biodiversity Development Assessment Report (BDAR) and the results provided are indicative only.

1.1 Project Background

Funded by the Snowy Hydro Legacy Fund, a Special Activation Precinct is a dedicated area in regional NSW identified by the NSW Government as places where business will thrive. They will create jobs, attract investors and fuel development. The precincts will support industries in line with the competitive advantages and economic strengths of each area.

The new Williamtown precinct will help to create a defence and aerospace hub, boost the local economy and generate thousands of new jobs for the region. It will build on the Hunter region's history of supporting Australia's defence industry and emerging aerospace industry around the Royal Australian Air Force (RAAF) base as well as its proximity to air, road, rail and sea transport.

The Williamtown SAP's vision is based on six key visions. The strategic need for growth in the Hunter Region involves:

1. The Place – leveraging the vicinity of the Royal Australian Air Force (RAAF) and civil aviation operators attract local employment
2. Environment and Sustainability– regionally coordinated approach to flooding, water cycle management and contamination while preserving and enhancing the natural environment
3. Infrastructure and Connectivity – providing infrastructure to resolve development constraints to reduce investment barriers to entry and enable effective connections to nearby Hunter Region infrastructure
4. Connection to Country – To preserve, respect and integrate Aboriginal cultural heritage, particularly the Worimi people
5. Social and Community Infrastructure – Enabling high skill employment, innovation, education and skill training opportunities and commercial investment
6. Economy and Industry – facilitate development of additional employment land for Defence and aerospace industries.

It aims to build on the NSW Government's existing investment into the Astra Aerolab and create highly-skilled, long-term job opportunities that will attract investors, and strengthen the region's economy. The Special Activation Precinct planning process will deliver coordinated and precinct-wide approach to addressing historical land constraints including flooding and drainage, which have acted as a barrier to development in the past.

The new State Environmental Planning Policy (Precincts-Regional) 2021 (Precincts-Regional SEPP 2021) and the Masterplan will replace existing planning instruments. It will provide for environmental protection and performance, land uses and planning pathways.

The goal is to undertake upfront assessment at a strategic level so industry and the community have certainty and clarity about what types of land uses and development can occur where. Following the exhibition of the draft Masterplan in early 2022, the structure plan has further refined and reduced as identified within Section 1.2.

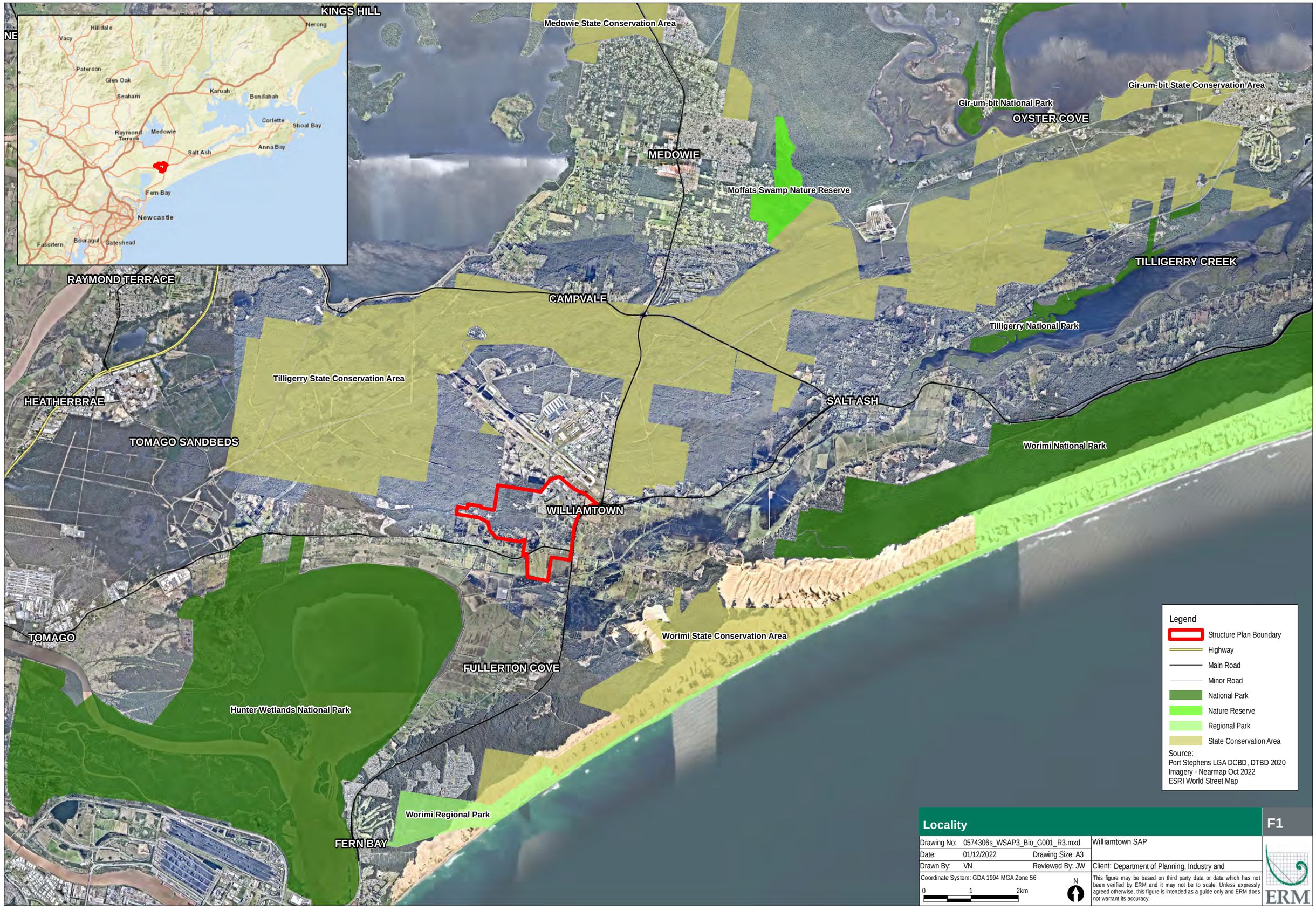
1.2 Structure Plan

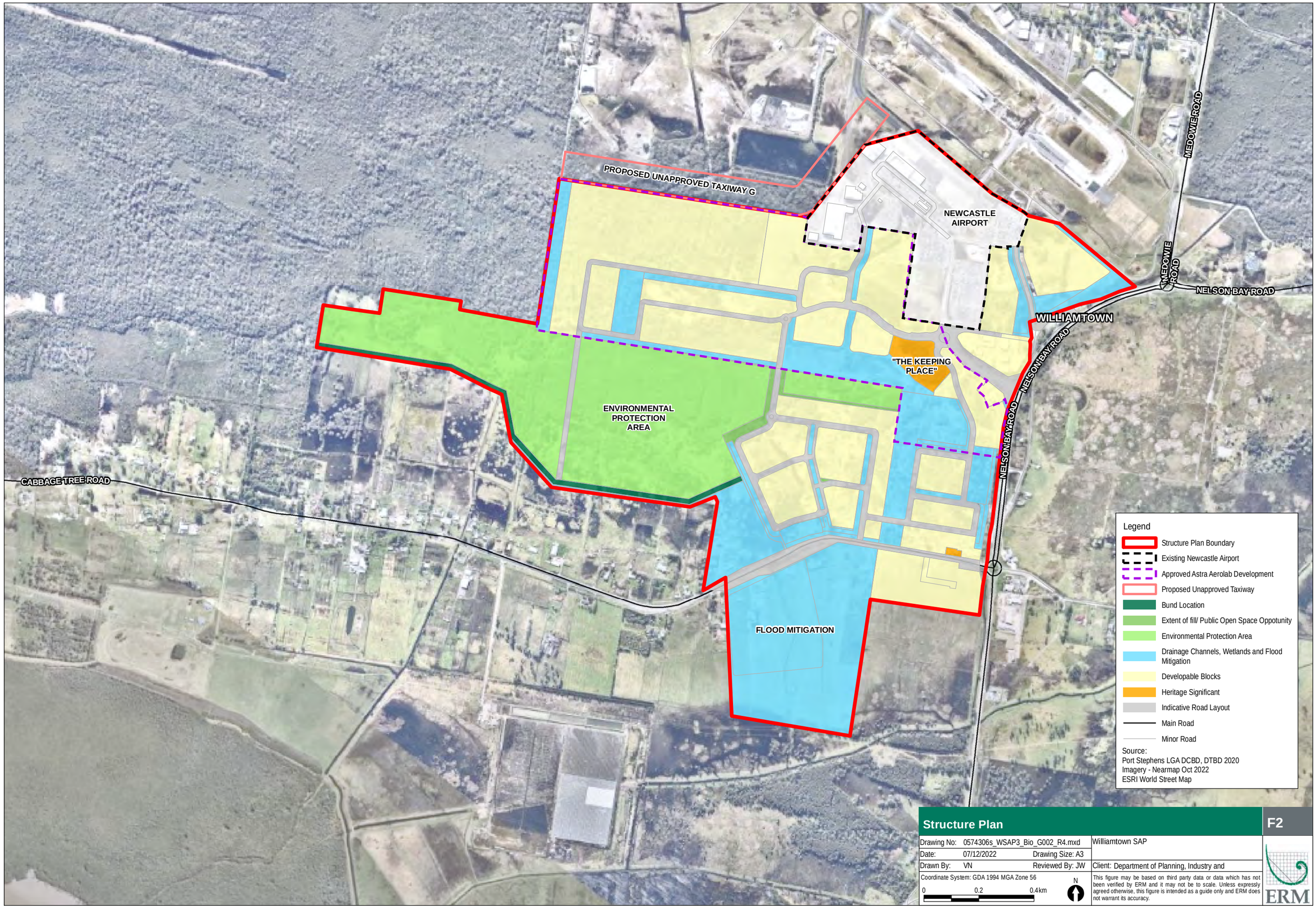
The Williamtown SAP Structure Plan has been defined through detailed assessment by ERM ecologists, noise and air quality specialists as well as engineers, stakeholders and urban planners. In close collaboration with DPE these technical experts and stakeholders tested and refined scenarios and ideas, and worked through each site constraint in order to create the revised Structure Plan (refer to Figure 2).

The Williamtown SAP as addressed within this report covers 285.4 hectares (ha) of land within the Port Stephens Local Government Area (LGA). It is centred on the Williamtown Aerospace Precinct and includes:

- Newcastle Airport
- The DAREZ (Defence and Aerospace Related Employment Zone):
  - Astra Aerolab Business and Technology Park (Astra Aerolab)
  - Williamtown Aerospace Centre including 1 Technology Place and Precinct 52
- Rural and agricultural land
- Small residential clusters (Williamtown).

Newcastle Airport has already undergone development and an existing development consent is applicable to the DAREZ (Figure 2). Whilst these areas are included in the Williamtown SAP, assessment of impacts to biodiversity in these areas is not required.


KINGS HILL
Medowie State Conservation Area
Gir-um-bit State Conservation Area
Gir-um-bit National Park
OYSTER COVE
MEDOWIE
Moffats Swamp Nature Reserve
TILLIGERRY CREEK
RAYMOND TERRACE
CAMPVALE
Tilligerry National Park
Tilligerry State Conservation Area
HEATHERBRAE
SALT ASH
TOMAGO SANDBEDS
Worimi National Park
WILLIAMTOWN
TOMAGO
Worimi State Conservation Area
FULLERTON COVE
Hunter Wetlands National Park
Worimi Regional Park
FERN BAY
Hilldale
Vacy
Nerong
Paterson
Glen Oak
Seaham
Karuah
Bundabah
Corlette
Shoal Bay
Raymond Terrace
Medowie
Salt Ash
Anna Bay
Fern Bay
Newcastle
Fassifern
Booragul
Gateshead
Legend
Structure Plan Boundary
Highway
Main Road
Minor Road
National Park
Nature Reserve
Regional Park
State Conservation Area
Source:
Port Stephens LGA DCBD, DTBD 2020
Imagery - Nearmap Oct 2022
ESRI World Street Map
Locality
F1
Drawing No: 0574306s_WSAP3_Bio_G001_R3.mxd
Williamtown SAP
Date: 01/12/2022
Drawing Size: A3
Drawn By: VN
Reviewed By: JW
Client: Department of Planning, Industry and
Coordinate System: GDA 1994 MGA Zone 56
0
1
2km
N
This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.
ERM



Structure Plan

F2

Drawing No:	0574306s_WSAP3_Bio_G002_R4.mxd		Williamtown SAP
Date:	07/12/2022	Drawing Size: A3	
Drawn By:	VN	Reviewed By: JW	Client: Department of Planning, Industry and

Coordinate System: GDA 1994 MGA Zone 56

0 0.2 0.4km

N

ERM

2. LEGISLATIVE AND POLICY CONTEXT

This biodiversity assessment has been undertaken with consideration of Commonwealth, State and Local regulatory frameworks and associated legislation. Table 2.1 summarises the legislation and policies relevant to the biodiversity assessment.

Of particular relevance to this assessment is consideration of complying and exempt development. It is understood that to streamline future building construction works it is intended to maximise the type and number of developments which can occur through complying development pathways under Precincts-Regional SEPP 2021.

The Precincts-Regional SEPP 2021 will replace existing local planning instruments. It will provide for environmental protection and performance, land uses and planning pathways. The goal is to undertake upfront assessment at a strategic level so industry and the community have certainty and clarity about what types of land uses and development can occur where. The legislative pathway for the development of the Williamtown SAP also includes a potential State Significant Development application to support the delivery plan. This will also aim to support the complying development pathway all impacts and biodiversity offsets can be confirmed and retired upfront.

The draft Masterplan is expected to go on public exhibition for comments and feedback in the first half of 2022

Table 2.1 Key Legislation and Policies

Commonwealth Legislation

Environment Protection and Biodiversity Conservation Act 1999

The EPBC Act requires approval of the Commonwealth Minister for the Environment for actions that are likely to have a significant impact on Matters of National Environmental Significance (MNES) as assessed in accordance with the EPBC Significant Impact Guidelines 1.1. The EPBC Act is administered by the Commonwealth Department of Agriculture, Water and the Environment (DAWE) and lists threatened species, ecological communities and other MNES. Any proposed action that is expected to have an impact on MNES must be referred to the Minister for assessment under the EPBC Act, or assessed under the existing bilateral agreement, or accredited process between the Commonwealth and the State of New South Wales (NSW).

Matters of National Environmental Significance	Application to Williamtown SAP
World heritage properties	Not identified within the Williamtown SAP
National heritage places	Not identified within the Williamtown SAP
Ramsar wetlands of international importance	The drainage area associated with the Williamtown SAP is within 1.5km of the Hunter Estuary Wetlands Ramsar site at its closest point.
Listed threatened species and communities	Threatened species and ecological communities occur within the Williamtown SAP.
Internationally protected migratory species	Migratory species occur within the Williamtown SAP.
Commonwealth marine areas	Not identified within the Williamtown SAP
The Great Barrier Reef Marine Park	Not identified within the Williamtown SAP
Nuclear actions	Not identified within the Williamtown SAP
A water resource, in relation to coal seam gas development and large coal mining development	Not identified within the Williamtown SAP

NSW Statutory Legislation and Guidelines

State Environmental Planning Policy (Precincts-Regional) 2021 (Precincts-Regional SEPP 2021)

On 1 March 2022, a new State Environmental Planning Policy (Precincts-Regional) 2021 (Precincts-Regional SEPP 2021) was introduced. The Precincts-Regional SEPP 2021 consolidates four SEPPs including State Environmental Planning Policy (Activation Precincts) 2020. It facilitates a new planning framework for Special Activation Precincts (SAPs) in regional NSW, streamlining planning processes and guiding the delivery of the Precincts.

The NSW Department of Planning, Industry and Environment is responsible for preparing the streamlined planning framework for each approved SAP in regional locations in NSW. The approach involves the department undertaking upfront strategic environmental impact assessment to identify the opportunities and constraints of each SAP and likely impacts of certain land uses.

This evidence informs the preparation of a Masterplan, land use controls, mapping for environmentally sensitive areas and development standards, which work together to create an envelope for development, that will allow relevant land uses to be undertaken as complying or exempt development. Each SAP will be included in the Precincts-Regional SEPP 2021 as its own Schedule.

The preparation of these strategic documents (including this biodiversity assessment) will ensure development is consistent with the vision and staging for the Precincts, and consistent with the planning controls (as outlined below).

Biodiversity Conservation Act 2016 (BC Act)

The BC Act establishes mechanisms for:

- The management and protection of listed threatened species of native flora and fauna (excluding fish and marine vegetation) and threatened ecological communities (TECs).
- The listing of threatened species, TECs and key threatening processes.
- The development and implementation of recovery and threat abatement plans.
- The declaration of critical habitat.
- The consideration and assessment of threatened species impacts in development assessment process.
- Biodiversity Offsets Scheme (BOS), including the Biodiversity Values Map and Biodiversity Assessment Method (BAM) to identify serious and irreversible impacts (SAII).

The BC Act establishes a regulatory framework for assessing and offsetting biodiversity impacts on proposed developments. Where development consent is granted, the authority may impose as a condition of consent an obligation to retire a number and type of biodiversity credits determined under the BAM. A Biodiversity Values Map and Biodiversity Offsets Scheme Entry Threshold (BOSET) tool are available to identify the presence of mapped biodiversity values within land proposed for development as well as the clearing thresholds that would trigger application of the BAM.

This biodiversity assessment has been undertaken in accordance with the BAM, however, this report does not comprise a BDAR.

Biosecurity Act 2015

The NSW *Biosecurity Act 2015* came into effect on 1 July 2017, effectively replacing the *Noxious Weeds Act 1993*, and 13 other Acts, with a single Act. Under the Noxious Weeds Act all landowners had a responsibility to control noxious weeds on their property. Under the Biosecurity Act broadly the same responsibility will apply and will be known as a General Biosecurity Duty.

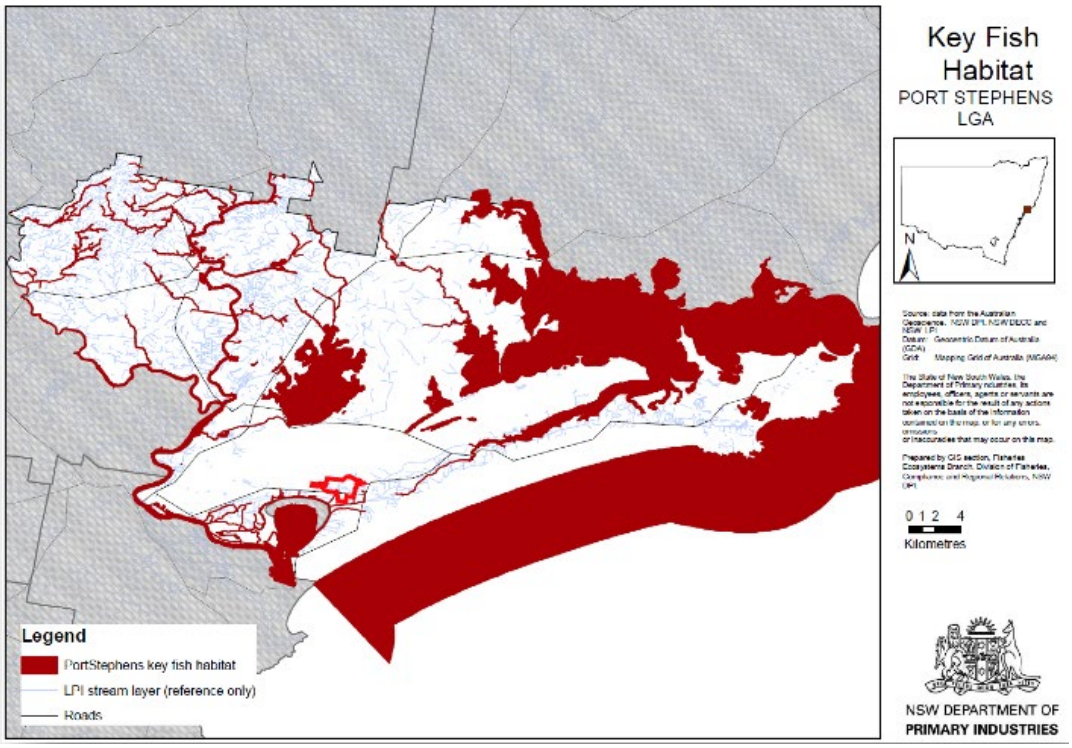
The General Biosecurity Duty states "*Any person who deals with biosecurity matter or a carrier and who knows, or ought reasonably to know, the biosecurity risk posed or likely to be posed by the biosecurity matter, carrier or dealing has a biosecurity duty to ensure that, so far as is reasonably practicable, the biosecurity risk is prevented, eliminated or minimised*." The general biosecurity duty applies to all weeds listed in Schedule 3 of the Biosecurity Act. Primary weeds have been identified in different Local Government Areas (LGA) due to the level of threat infestation they represent, some of the Weeds of National Significance (WoNS) are also listed as Primary Weeds in LGAs.

A strategic plan for each weed will be required within the final precinct to define responsibilities and identify strategies and actions to control the weed species. These can be downloaded from:
http://www.environment.gov.au/biodiversity/invasive/weeds/weeds/lists/wons.html

Fisheries Management Act 1994

The *Fisheries Management Act 1994* provides for the conservation, protection and management of fisheries, aquatic systems and habitats in NSW. Similar to the BC Act, the *Fisheries Management Act 1994* lists threatened species, populations and ecological communities of fish and marine vegetation.

Key fish habitat mapped for the Port Stephens LGA is shown below. Key Fish Habitat associated with drainage channels occur within the southernmost part of the drainage area of the Williamtown SAP.



Key fish habitat within the Port Stephens LGA

Consideration of likely occurrence of threatened fish in the waterways in the final precinct will be provided when the impacts to waterways to the south of Cabbage Tree Road are confirmed.

Schedule 6 of the *Fisheries Management Act 1994* also lists the following key threatening process that may be relevant to Masterplan design process:

- Degradation of native riparian vegetation along New South Wales water courses;
- Human-caused climate change; and
- Removal of large woody debris from New South Wales rivers and streams.

Any waterway crossings will need to consider an appropriately designed structure that does not obstruct fish passage and will be designed in accordance with the Policy and Guidelines for Fish Habitat Conservation and Management and the Policy and Guidelines for Fish Friendly Waterway Crossings.

State Environmental Planning Policy (Biodiversity and Conservation) 2021

The BC SEPP aims 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 reverse the current trend of Koala population decline. Two separate Chapters of the BC SEPP apply to the Port Stephens LGA, with their application dependant on the land zoning. Within the Williamtown SAP, Chapter 4 applies to land zoned B7 Business Park (i.e., the Astra Aerolab land), whilst Chapter 3 applies to land zoned RU2 Rural Landscape (the remaining areas).

The LGA has an existing approved Koala plan of management. It is anticipated that the Masterplan would, as far as practicable, aim to be consistent with the objectives of both the Port Stephens Koala Plan of Management and the BC SEPP.

SEPP (Resilience and Hazards) 2021

State Environmental Planning Policy (Resilience and Hazards) 2021 updates and consolidates into one integrated policy SEPP 14 (Coastal Wetlands), SEPP 26 (Littoral Rainforests) and SEPP 71 (Coastal Protection),

The Coastal Management SEPP commenced on 3 April 2018 and gives effect to the objectives of the Coastal Management Act 2016 from a land use planning perspective, by specifying how development proposals are to be assessed if they fall within the coastal zone.

An integrated and coordinated approach to land use planning is promoted by the SEPP. It defines the four coastal management areas in the Act through detailed mapping and specifies assessment criteria that are tailored for each coastal management area. Councils and other consent authorities must apply these criteria when assessing proposals for development that fall within one or more of the mapped areas.

A review of the detailed interactive maps confirm that the Williamtown SAP does not intersect with the mapped Coastal Environment Area or Coastal Use Area.

Port Stephens Local Environment Plan 2013 (LEP)

Whilst the Port Stephens LEP will largely not apply to the Williamtown SAP, it is noted that Clause 7.9 Wetlands is currently applicable to the area. Wetlands are mapped throughout the Williamtown SAP (see Figure below) and, under the current LEP, development in these areas are required to consider impacts to native flora and fauna, migratory species and hydrology.

Wetlands mapped in the Port Stephens LEP

3. ASSESSMENT METHODOLOGY

3.1 Desktop Review

Relevant information collated during preparation of the Biodiversity Baseline Assessment Report (ERM 2020) and Biodiversity Scenarios Report (ERM 2021) was used to inform the field surveys and has been incorporated into this report. These information sources are provided in Table 3.1, along with additional information sources reviewed specifically for this report.

Table 3.1 Key Information Sources

Information Source	Name	Search Date	Data Description
DAWE	PMST	6/12/2022	The search tool provides predictive results of Matters of National Environmental Significance based on mapping of known and potential species distribution, habitat, ecological communities and wetlands. The outputs are based on modelling results and do not necessarily reflect known records of species or communities.
DAWE	Species Profile and Threats Database (SPRAT)	N/A	The SPRAT profiles and associated conservation advice documents were consulted for information on: ■ Species distribution ■ Species habitat preferred The conservation advice documents are particularly important for assessing TECs found in field surveys, against the listed TEC guidelines.
ala.org.au	ALA	N/A	Australia national biodiversity database (supported by the National Collaborative Research Infrastructure Strategy, CSIRO). Database contains observation records accessed through an interactive spatial portal. Threatened species are searched to identify known records in proximity to the Williamtown SAP.
DPE	BioNet	6/12/2022	Observation data from the BioNet Atlas website [North: -32.73 West: 151.70 East: 151.99 South: -32.89]
Hunter Water (Bell & Driscoll 2006; Driscoll & Bell 2006)	Tomago and Tomaree Sandbeds vegetation classification, mapping and ground water dependent ecosystem analysis	N/A	A vegetation survey and mapping program of the Tomago Sandbeds and the Tomaree Sandbeds carried out during 2005-6, principally to identify Groundwater Dependent Ecosystems (GDEs). Intensive field survey producing a heavily ground-truthed vegetation classification and map of 43 vegetation communities, and discussion of 20 significant plant species and 3 endangered ecological communities. A two-volume document supports the mapping.

Information Source	Name	Search Date	Data Description
DECW (Bell & Driscoll 2010)	Worimi Conservation Lands vegetation classification and mapping	N/A	Vegetation survey and mapping program of the Worimi Conservation Lands carried out during 2009-10. Intensive field survey producing a heavily ground-truthed vegetation classification and map of 9 vegetation communities, and discussion of 3 significant plant species and 1 endangered ecological community.
DEC (Bell 2006)	Status, distribution and habitat of *Eucalyptus parramattensis subsp. decadens*	N/A	A review of existing records, taxonomy, habitat, ecology and threats for this Hunter Valley endemic. One of only two meta-populations occurs on the Tomago Sandbeds.
Hunter Water Corporation (Jacobs 2016)	Tomago Biodiversity Assessment Report	N/A	A biodiversity assessment prepared for the Hunter Water lands, including areas adjacent to the Williamtown SAP. Reporting includes vegetation mapping and records of threatened species.
DPE	BAM Calculator	8 December 2021	An initial run of the BAM Calculator, based on available vegetation mapping, was undertaken to provide a list of threatened species to be considered for the field survey and reporting.
Bureau of Meteorology	Groundwater Dependent Ecosystems Atlas (GDE Atlas)	December 2022	The GDE Atlas is a national dataset of Australian GDEs to inform groundwater planning and management.

3.2 Expert Technical Advice and Review

Expert advice and peer review regarding flora and vegetation communities was provided by Dr Stephen Bell, botanist and vegetation ecologist.

3.3 Field Survey

Field surveys were undertaken in May, September and November 2021 and included BAM plots and targeted flora and fauna surveys. Further details of dates and methods are provided below. Details of weather conditions during the surveys are provided in **Appendix D**.

3.4 BAM Plots

Plots were completed in accordance with the BAM survey requirements for assessing vegetation composition, structure and function. A total of 21 plots were completed between 10 – 14 May 2021 (Figure 3).

The floristic vegetation surveys included:

- Vehicle and walking meanders recording points at which the vegetation changed and other relevant features such as waterbodies, weeds, fencing and fauna habitat.

21 BAM plots recording the following floristic data within a 20 m x 20 quadrat:

- Growth form for each native species.
- Species name of each native and exotic species.
- Percent foliage cover of each native and exotic species.
- Number of each species.

21 BAM plots recording the following vegetation function attributes within a 20 m x 50 m plot:

- Number of large trees.
- Number of trees with hollows.
- Tree stem size class.
- The presence of tree regeneration.
- Length of fallen logs.
- Average percent groundcover of litter recorded from five 1 m x 1 m plots.

All data was collected on hand-held devices using the Fulcrum mobile data collection application, on digital forms specifically developed for BAM surveys.

It is noted that eight plots were undertaken within the previous Investigation Area and are now not within the Williamtown SAP. A further four plots were undertaken in the DAREZ and eight in the environment protection area. Data from some of these plots were used in the BAM Calculator as, subsequent to the Structure Plan amendments, only one plot remains in the development area. This is considered suitable at this stage of the biodiversity assessment, which is based on indicative results only.

3.5 Flora Survey

Targeted flora survey was undertaken for threatened flora species with potential to occur within the Williamtown SAP. Surveys were undertaken in accordance with *Surveying Threatened Plants and Their Habitats* (DPIE, 2020a). This comprised parallel transects 5 – 10m apart through areas of suitable habitat during the survey months identified in the BAMC. Where possible, a reference population was used to determine the optimal survey period for the species. Targeted surveys were undertaken at the following times:

- 28 – 30 September 2021
- 15 – 19 November 2021

Opportunistic surveys were also undertaken during the May survey period. Survey locations are shown in Figure 3. Further details are provided in Table 3.2.

Table 3.2 Threatened Flora Species Surveyed

Species	Survey Month	Reference Population Information
Allocasuarina simulans	All year	N/A
Angophora inopina	All year	N/A
Callistemon linearifolius	September, November	N/A
Commersonia prostata	September, November	N/A
Cryptostylis hunteriana	November	A reference population in Tomaree was observed to be in flower during the week of survey (15-19 November 2021).
Cynanchum elegans	All year	N/A
Diuris arenaria	September	A reference population in proximity to Nelson Bay Road was observed to be in flower during the week of survey (28-30 September 2021).
Diuris praecox	To be surveyed in August or assumed present, or expert report obtained.	
Eucalyptus parramattensis subsp. *decadens*	September, November	N/A
Galium australe	November	N/A
Genoplesium baueri	To be surveyed in February/March, or assumed present, or expert report obtained.	
Grevillea parviflora subsp. *parviflora*	September, November	N/A
Linderni alsinoides	November	N/A
Maundia triglochinoides	November	N/A
Persicaria elatior	To be surveyed in February/March, or assumed present, or expert report obtained.	
Syzygium paniculatum	September, November	N/A
Tetratheca juncea	September	A reference population at Blackbutt Reserve was observed to be in flower during the week of survey (28-30 September 2021).
Zannichellia palustris	November	N/A

3.6 Fauna Surveys

The fauna survey methodology follows standardised survey guidelines, including Biodiversity Assessment Method survey requirements (DPIE, 2020c). Following is a description of fauna survey methods employed for each fauna group. The main fauna survey was conducted over the period Monday 10 to Friday 14 May 2021. Additional fauna monitoring was conducted by use of remote field IR cameras (x5) and Wildlife Acoustic songmeters (x2) deployed over the period 10 May to Friday 28 May. An additional targeted fauna survey and monitoring period was conducted over the period 8 to 19 November.

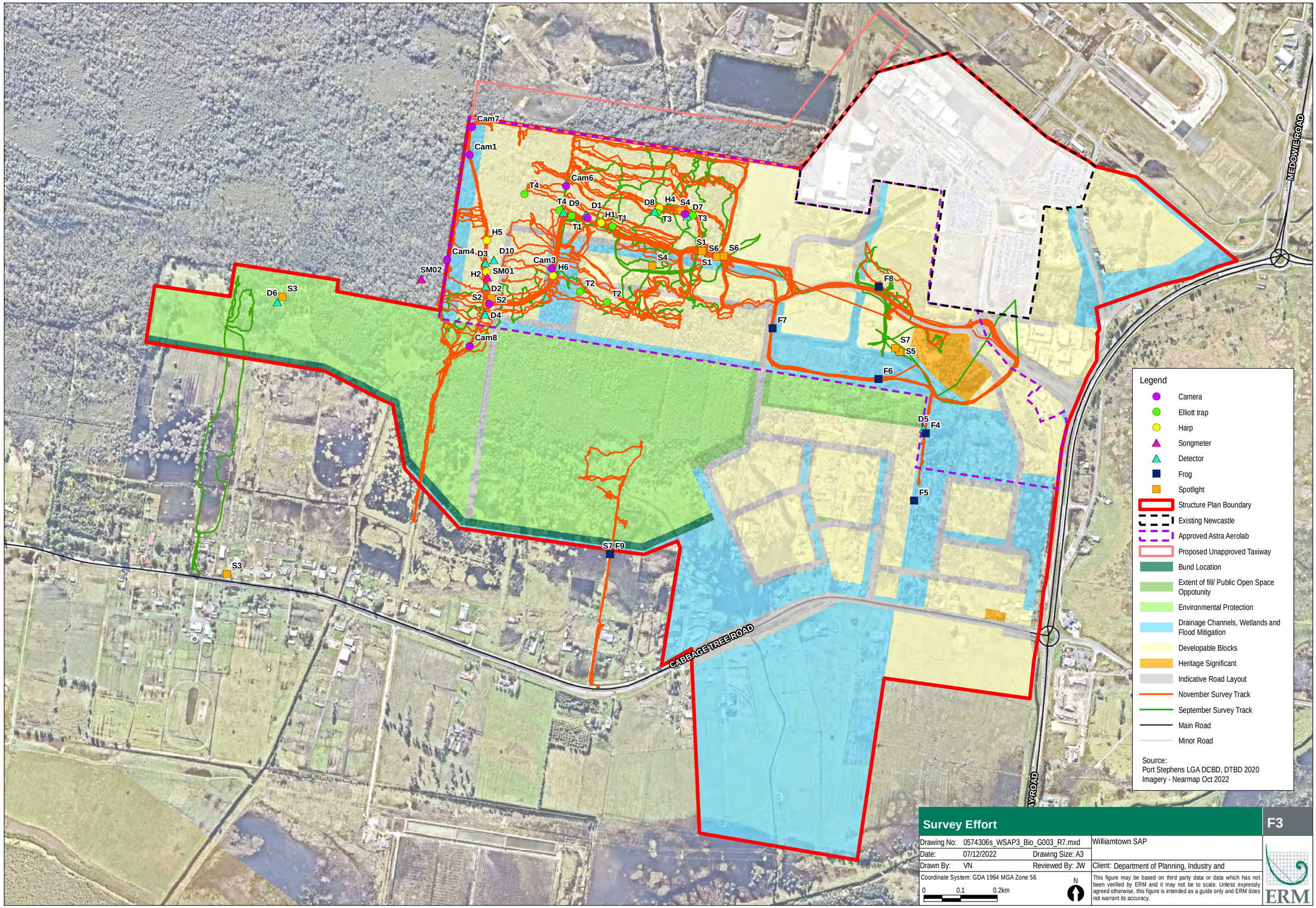
Survey locations are shown in Figure 3.

3.6.1 Birds

Birds were sampled by diurnal and nocturnal census and recorded opportunistically whilst undertaking other field duties. This includes direct observations of bird species and identification of their characteristic calls. The diurnal census was conducted each morning for a period of 20 minutes, recording all bird species heard or observed within a 1ha area (100 x 100m) area. Due to the high mobility of many avian species, species detected in the broader Investigation Area, but not necessarily recorded in the development precinct, are considered to occur in the development area and are included in the species list.

The nocturnal census comprised quiet listening for characteristic calls for a period of 30 minutes following dusk. Broad-cast of pre-recorded calls of threatened large forest owls (Powerful Owl, Sooty Owl, Masked Owl, Barking Owl) was conducted later in the evening following completion of spotlight surveys. Calls were broadcast for a period of 2 minutes per species, with a 5-minute quiet interval between each call to listen for responses from each species.

Two Wildlife Acoustics Mini Songmeters were installed on 11 May 2021 and programmed to switch on at dusk (17:00 hours) and switch off at dawn (06:00 hours). Each songmeter was left in-situ for 17 continuous nights and removed on 28 May 2021. Recordings were downloaded and analysed by Kaleidoscope Audio software. Two Titley-Scientific Chorus audio recorders were installed for 7 consecutive nights over the period 9 to 16 November, targeting nocturnal birds, but also programmed to document dawn and dusk bird chorus.



Survey Effort

F3

Drawing No:	0574306s_WSAP3_Bio_G003_R7.mxd		Williamtown SAP
Date:	07/12/2022	Drawing Size: A3	
Drawn By:	VN	Reviewed By: JW	Client: Department of Planning, Industry and

Coordinate System: GDA 1994 MGA Zone 56

0 0.1 0.2km

N

ERM

3.6.2 Mammals

Trapping

Trapping surveys for small terrestrial mammals was conducted using Elliott A folding aluminium traps. Two trap lines of 25 traps each were set in areas of suitable habitat in the Williamtown SAP in May 2021, and an additional 2 trap lines of 25 traps in November 2021. Each trap was spaced at an interval of 10-20m apart, baited with mixture of rolled oats, peanut butter and honey and set for 3 continuous nights. All animals captured were inspected, details recorded of species identification, sex, weight and released at point of capture.

No arboreal trapping for gliders was conducted as a combination of additional techniques were employed. A total of 32 existing nest boxes installed as part of the Astra development approval were found in the Williamtown SAP and were inspected by use of pole mounted camera.

Remote Infra-red Cameras

Five infra-red motion detection digital cameras were installed within the Williamtown SAP in May 2021, and an additional 4 cameras over the period late September to November, to photograph terrestrial fauna, such as bandicoots, dogs and quolls. The cameras were set at a height of 1.0 – 2.0m above ground.

Cameras were installed over two periods:

- Monday 10 May and retrieved on Friday 28 May, a total of 18 continuous nights per camera, or 90 camera trap nights when combined using 5 cameras.
- Tuesday 28 September to Thursday 18 November 2021, 50 continuous nights per camera, or 200 camera trap nights when combined using 4 cameras.

Stagwatch and Spotlight Searches

Stagwatch surveys are conducted where habitat trees (mature trees with hollows) occur within the Williamtown SAP. The technique relies on visual detection of arboreal fauna emerging from tree hollows or becoming active following dusk. Quiet listening for dusk calls of large forest owls was also undertaken during this observation period.

Spotlight searches were undertaken on foot across the Williamtown SAP with a 1,000 lumen spotlight for a period of 100 - 120 minutes per evening. The following data was recorded during each transect:

- time at commencement and completion of transects
- the identity and number of animal's observed and environmental conditions, e.g., presence of flowering trees.

Nestbox Inspections and Observations

A total of 32 nest boxes were located in Williamtown SAP during the fauna survey. It is unknown when the nest boxes were installed although it is assumed that they were installed as part of the Astra development approval conditions. A range of nest box styles were observed, designed for a range of fauna species, including microbats, small and larger gliders and possums, small and larger birds and also arboreal reptiles and frogs. Despite only 32 nest boxes being located, the numbering system on the boxes indicates a larger number of boxes do occur.

Nest boxes were inspected with the use of pole mounted bluetooth camera (Olympus Tough TG-6) which took a photograph of the internal cavity of each box to determine usage and presence of arboreal fauna.

3.6.3 Microchiropteran Bats

Harp Trap Captures

Harp traps are used to capture microbats to accurately determine the correct species identification. Three sites were sampled by harp trap over 2 nights each in May 2021, and 3 sites in November 2021, for a total of 12 harp trap nights for the Williamtown SAP. Harp traps were set in areas of suitable habitat (flyways) where there is a higher chance of captures. Individual microbats captured are identified, measured and released the following evening after dusk.

Echolocation Calls

Echolocation calls of microchiropteran bats were recorded at each bat monitoring site. Calls are recorded by an Anabat Express and Anabat II detectors and stored onto a digital storage card. This technique enables sampling of bat activity for the duration of the night, providing a more comprehensive recording of bat species utilising the Williamtown SAP. All recorded calls were downloaded to a computer for analysis by Anabat Insight (Titley Scientific) software. Seven sites were sampled over the period 10 to 14 May 2021, and three sites in November 2021.

Several species of insectivorous bats have distinctive echolocation calls that are unlikely to be confused with another species. However, some bat species overlap in call frequency and structure, making identification difficult in some cases. The degree of confidence attached to call identifications will depend on the duration of the recorded call and quality of the recording. For example, echolocation calls of the Lesser Long-eared Bat (*Nyctophilus geoffroyi*) and Gould's Long-eared Bat (*Nyctophilus gouldi*) cannot be reliably differentiated, and are therefore grouped as *Nyctophilus sp*. Similarly, calls of Greater Broad-nosed Bat (*Scoteanax rueppellii*), Eastern Broad-nosed Bat (*Scotorepens orion*) and Eastern Falsistrelle (*Falsistrellus tasmaniensis*) sometimes cannot be reliably differentiated, and are often grouped together.

3.6.4 Reptiles and Amphibians

Systematic and Opportunistic Searches

Reptiles were searched for under natural refuge areas (ground logs, rocks, leaf litter) across the Williamtown SAP. Searches for reptiles were conducted from early morning to late afternoon as well as nocturnal spotlight searches, and opportunistic sightings whilst conducting other phases of the field survey. The nocturnal survey for reptiles was conducted at the same time as the other fauna groups.

Aquatic habitat within the Williamtown SAP was sampled by combination of quiet listening for frog calls, and use of songmeter and Titley Scientific Chorus acoustic detectors placed at specific habitat (i.e., a small dam to record evening calls of frogs).

One Wildlife Acoustics Mini Songmeter was installed on 11 May 2021 at the edge of a small dam supporting emergent aquatic vegetation to record nocturnal frog calls. The songmeter was programmed to switch on at dusk (17:00 hours) and switch off at dawn (06:00 hours). The songmeter was left in-situ for 17 continuous nights and removed on 28 May 2021. One Titley-Scientific Chorus acoustic recorder was set at the same dam over 7 continuous nights from 9 to 16 November 2021. Recordings were downloaded and analysed by Kaleidoscope Audio software.

A summary of the fauna survey effort is provided in Table 3.3.

Table 3.3 Fauna Survey Effort, Williamtown SAP

Method	Survey Dates	Survey Duration	Total Survey Effort
Diurnal Birds	10 – 14 May 2021	Dawn and dusk 20 min census	5 days
	15 – 18 Nov 2021	Dawn and dusk 20 min census	4 days
Nocturnal Birds (Spotlight)	10 – 14 May 2021	4 nights @ ~ 118 mins per nights	473 mins (7.8 hrs)
	9 - 11 Nov 2021	3 nights @ ~ 120 mins per night	360 mins (6 hours)
Nocturnal Birds (recording)	11 – 28 May 2021	2 Mini Songmeters	34 nights
	9 – 16 Nov 2021	2 Titley-Scientific Chorus	14 cumulative nights
Elliott A trapping	10 – 14 May 2021	75 trap nights x 2 sites	150 trap nights
	15-18 Nov 2021	75 trap nights x 2 sites	150 trap nights
Remote IR Cameras	10 – 28 May 2021	5 sites x 19 nights	90 camera trap nights
	28/9 – 16/11/21	4 sites x 50 nights per camera	200 camera trap nights
Stagwatch Survey	10 – 14 May 2021	30 mins per night x 4 nights	120 minutes
Spotlight Searches	10 – 14 May 2021	4 nights @ ~ 118 mins per nights	473 mins (7.8 hrs)
	9 – 11 Nov 2021	3 nights @ ~ 120 mins per night	360 mins (6 hours)
Harp Traps	10 – 14 May 2021	3 sites x 2 nights	6 harp trap nights
	15 - 17 Nov 2021	3 sites x 2 nights	6 harp trap nights
Anabat Detector	10 – 14 May 2021	7 sites x 2 nights each	14 cumulative night
	15 - 17 Nov 2021	4 sites x 2 nights	8 cumulative nights
Reptile Searches	10 – 14 May 2021	5 consecutive days and 4 nights	120 minutes
	15-18 Nov 2021	4 consecutive days	~120 minutes
Amphibian Surveys	10 – 14 May 2021	Songmeter – 17 nights	34 cumulative nights
		4 nights spotlight searches	~ 8 hours
	9 – 11 Nov 2021	3 nights spotlight	~6 hours
		7 nights Acoustic Recorder	14 cumulative nights

3.7 Limitations

The duration of survey and limited access to areas within the Williamtown SAP also limited the number and location of BAM plots that could be undertaken. Therefore, data could not be collected for all PCTs, or the required number of plots were not completed for all PCTs. Any assumptions made are noted throughout the document. Further, numerous cryptic flora species can only be surveyed during their flowering period. This could not be undertaken for all cryptic threatened flora as surveys have not been undertaken through all seasons or through the entire Williamtown SAP.

The fauna survey in May 2021 was constrained by seasonal weather conditions and timing, with many summer migratory species absent from the Williamtown SAP, and cooler nocturnal temperatures. For several locations within Williamtown SAP, access to land was either not approved, or too late in the period to enable appropriate fauna survey techniques to be employed. However, the sampling for fauna over the period late September to mid-November resulted in recording of a much higher diversity of fauna species. This is attributed to sampling in appropriate periods of the year when many species are either present in the Williamtown SAP (seasonal migrants) or warmer and wetter conditions for specific species such as microbats, reptiles and frogs.

The Williamtown SAP boundary has undergone numerous iterations since surveys were undertaken and therefore, some survey locations are no longer within the Williamtown SAP or may not be in the most suitable location. The majority of surveys, including BAM plots, were undertaken in the DAREZ and are therefore now external to the current developable areas and cannot be used to inform credit calculations.

ERM and DPE recognise that access constraints across the SAP have limited the survey effort undertaken to date and confirm that additional survey over at least two separate survey periods will be undertaken across the precinct to support the Delivery Plan and preparation of a Biodiversity Development Assessment Report (BDAR) as the next phase of this project. This will be prepared in accordance with the Biodiversity Assessment Method (BAM 2020) and will identify the credit profile required to offset any residual impacts of the development in accordance with the NSW Biodiversity Conservation Act 2016 (BC Act). As soon as access is available across the entire precinct, ERM will prepare a gaps analysis and develop a detailed survey plan. At this stage a meeting with BCD may be scheduled to discuss any remaining limitations, survey requirements or other considerations that will need to be addressed during the preparation of the BDAR. In summary, whilst there are some limitations in the existing survey effort due to access constraints these could not be avoid and will be covered during subsequent surveys and reported within a BDAR in accordance with BCD guidelines. The information provided to date together with the avoidance of the identified high biodiversity values within the Environmental Protection Area provides a detailed baseline to support assessment of the Masterplan.

4. LANDSCAPE FEATURES

Landscape features contain biodiversity values that are important for the site context and habitat suitability of the preferred Williamtown SAP and as such, are used to identify the threatened species likely to occur. The specific landscape feature requirements of Section 3 of the BAM are provided in Table 4.1 and will be used in any future Biodiversity Development Assessment Report (BDAR) prepared to support the Masterplan.

Table 4.1 Landscape Features (Section 3 of the BAM)

Landscape Feature	Williamtown SAP
IBRA Region	NSW North Coast
IBRA Subregion	Karuah Manning
(NSW) Mitchell Landscapes	Sydney – Newcastle Barriers and Beaches (total area 364.4 km^2)
Rivers and Streams	A number of unnamed 1st and 2nd order streams flow through the Williamtown SAP. The mapping of biodiversity values include a 10m buffer for first order and 20m buffer for 2nd order streams.
Wetlands	The drainage area associated with the Williamtown SAP is within 1.5km of the Hunter Estuary Wetlands: Ramsar Wetland incorporating Fullerton Cove and Kooragang Nature Reserve. Wetlands, as identified in Port Stephens LEP 2013, occur throughout Williamtown SAP. Further consideration of wetlands is provided in **Section 11**
Connectivity	Vegetation within Williamtown SAP is connected to large areas of native vegetation to the north-west, incorporating Hunter Water Land and Tilligerry State Conservation Area, via Hunter Water Corporation land. The drainage area associated with the Williamtown SAP is within 1.5km of the Hunter Wetlands National Park. These conservation areas are all part of the 'green corridor' stretching from the Watagan Ranges, through to Hexham Swamp and Port Stephens. The Environment Protection Area, together with the drainage channels and constructed wetlands will provide some connectivity within the Williamtown SAP. The Environment Protection Area is the primary connection from the Williamtown SAP to other areas of native vegetation.
Native vegetation cover: (an estimate of the percent cover of native vegetation within the Williamtown SAP and a 1500 m buffer around the Williamtown SAP, relative to the approximate benchmarks for the plant community type (PCT))**.**	Estimated to be >30-70%,. This estimate is applicable to the entire SAP. The cover for a future BDAR would be calculated in relation to the development areas only.
Areas of geological significance and soil hazard features	Areas of Geological Significance include karst, caves, crevices and cliffs. None of these features occur within Williamtown SAP.
Areas of outstanding biodiversity value (AOBV)	No AOBV have been identified within Williamtown SAP.
Patch Size: (the area of intact native vegetation that occurs on the Williamtown SAP and the vegetation within 100 m of the next area of native vegetation in moderate to good condition. It is used to determine the habitat suitability of the Williamtown SAP for threatened species).	>101 ha (the patch size is larger than this, however, this is the largest area that can be entered into the BAM-C).

5. NATIVE VEGETATION

5.1 Native Vegetation Extent

The extent of native vegetation within the Williamtown SAP is 54.46 ha. This was determined through initial analysis of aerial photography and refined via vehicle and walking meanders, and BAM plots during three field survey events.

5.2 PCT Descriptions

Seven PCTs were recorded within Williamtown SAP during field surveys (Figure 4). Three of the PCTs are commensurate with TECs listed under the BC Act. Details are provided in Table 5.1 and detailed descriptions of each PCT within Williamtown SAP are provided in Appendix A.

The condition of the PCTs was determined based on a visual assessment of the structural diversity and species assemblage of the vegetation compared to its benchmark appearance, i.e. the presence/absence of an overstorey, mid-storey and understorey, the percent cover of these layers and the presence and extent of weeds. Further details for each PCT are provided in Appendix A.

5.3 Vegetation Integrity Assessment

The vegetation integrity comprises an assessment of the condition of the vegetation within the Williamtown SAP against the benchmark (best attainable) condition for each PCT and is used to determine the vegetation integrity score. It is calculated for each vegetation zone (areas of vegetation that are the same PCT in the same broad condition). The vegetation integrity score is calculated by the BAM-C and determined by the following factors:

- Vegetation zone: areas of vegetation that are the same PCT in the same broad condition state.
- Patch size: area of native vegetation within Williamtown SAP and areas of native vegetation external to the Williamtown SAP that it is connected to (including native vegetation with a gap of less than 100 m from the next area of native vegetation. Patch size is calculated separately for each vegetation zone.
- The data collected from BAM plots.

It should be noted that all required BAM data could not be collected for all plots due to flooding and in these cases, the plot data is based on a combination of visual observation from the vicinity of the plot and data collected from other similar plots. Further, the required number of plots were not undertaken for all PCTs and data for some PCTs was not collected due to survey limitations including access and timing. Where plot data was not collected, the default benchmark data, or data from other plots, was used. Thus, the results of the vegetation integrity assessment and subsequent BAM-C results are indicative only.

There are 14 vegetation zones within Williamtown SAP as shown in Table 5.2 and Figure 4.

Table 5.1 PCT Descriptions

PCT	PCT Name	TEC (BC Act)	Condition	Area (ha) (Development Precincts)	Area (ha) (Environment Protection Area)	Area (ha) (Flood Mitigation Area)
1646	Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast	N/A	Good	0.06	2.88	0.0
			Regrowth	0.54	1.68	0.0
			Canopy Only	N/A (in DAREZ only)	0.5	N/A (in DAREZ only)
1724	Broad-leaved Paperbark - Swamp Oak - Saw Sedge swamp forest on coastal lowlands of the Central Coast and Lower North Coast	Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions	Inundated	3.84	25.86	0.01
			Low	4.47	10.4	1.66
1725	Swamp Mahogany - Broad-leaved Paperbark - Swamp Water Fern - Plume Rush swamp forest on coastal lowlands of the Central Coast and Lower North Coast	Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions	Good	N/A (in DAREZ only)	2.56	N/A (in DAREZ only)
			Regrowth	N/A (in DAREZ only)	N/A (in DAREZ only)	N/A (in DAREZ only)
1637	Scribbly gum - Wallum Banksia - Prickly-leaved Paperbark heathy coastal woodland on coastal lowlands	N/A	Good	N/A (in DAREZ only)	N/A (in DAREZ only)	N/A (in DAREZ only)
1651	Parramatta red gum - Fern-leaved banksia - Melaleuca sieberi swamp woodland of the Tomaree Peninsula	N/A	Good	N/A (in DAREZ only)	N/A (in DAREZ only)	N/A (in DAREZ only)
1734	Wallum Bottlebrush – Leptocarpus tenax – Baloskion pallens Wallum sedge heath of the lower North Coast	N/A	Good	N/A (in DAREZ only)	N/A (in DAREZ only)	N/A (in DAREZ only)
1742	Jointed Twig-rush sedgeland	Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions.	Good	N/A (in DAREZ only)	N/A (in DAREZ only)	N/A (in DAREZ only)

Table 5.2 Vegetation Zone

PCT	Vegetation Zone	Patch Size (ha)	Number plots required (Development Area)	Plots undertaken***
1646	1646_good	>100*	1	3 (SAP2, SAP11, SAP12)
	1646_regrowth	>100*	1	2 (SAP4, SAP10)
1724	1724_inundated	>100*	2	4 (SAP3, SAP5, SAP9, SAP13)
	1724_low	>100*	2	1 (SAP6)

*The actual patch size is larger, however, >100 ha is the largest category that can be used in the BAM-C.
**Some plot data collected via visual observation only due to access restrictions.
***Data from plots external to Williamtown SAP / in DAREZ / in Environment Protection Area used

5.4 High Threat Weeds

A number of high threat weeds (HTW), Primary Weeds and Weeds of National Significance (WONS) were recorded within Williamtown SAP, as shown in Table 5.3.

Table 5.3 High Threat Weeds

Scientific Name	Common Name	Location/Plot	HTW	Biosecurity Act	WONS
Alternanthera philoxeroides	Alligator Weed	Observed in areas of 724_low	✓	✓	✓
Andropogon virginicus	Whisky Grass	SAP10	✓	-	-
Conyza sp.	Fleabane	SAP4, SAP10,	-	✓	-
Eragrostis curvula	African Lovegrass	SAP4	✓	✓	-
Ipomoea indica	Morning Glory	SAP7	✓	✓	-
Lantana camara	Lantana	SAP4	✓	✓	✓
Senecio madagascariensis	Fireweed	SAP10	✓	✓	✓
Tradescentia fluminensis	Trad	SAP4	✓	✓	-

5.5 Flora Survey Results

One threatened flora species was recorded in the Williamtown SAP: *Eucalyptus parramattensis* subsp. *decadens* (Earps Gum). The majority of the recorded individuals occur within PCT1651; however, they are also scattered in PCT1725 and PCT1637. All individuals were recorded within the DAREZ.

A second flora species has previously been recorded in the Williamtown SAP: *Maundia triglochinoides.* The presence of this species has not been confirmed and large areas of potential habitat could not be accessed. The presence/absence and extent of this species will require confirmation as part of any future development assessment.

Callistemon linearifolius (Netted Bottle Brush) has potential to occur in the Williamtown SAP, however, a sample sent to the Royal Botanic Gardens Identification Service was identified as the non-threatened *Callistemon rigidus*.

A full list of flora species recorded is provided in **Appendix B**.

MEDOWIE ROAD

CABBAGE TREE ROAD

SOLDIERS BAY ROAD

Legend

- Structure Plan Boundary
- Existing and Approved Development

Vegetation Condition

- good
- low
- regrowth
- canopy only
- inundated
- Main Road
- Minor Road

Coastal Dune Dry Sclerophyll Forest

- 1637 Scribbly gum - Wallum Banksia - Prickly-leaved Paperbark
- 1646 Smooth-barked Apple - Blackbutt - Old Man Banksia woodland

Coastal Swamp Forest

- 1724 Broad-leaved Paperbark - Swamp Oak - Saw Sedge swamp
- 1725 Swamp Mahogany - Broad-leaved Paperbark - Swamp Water

Freshwater Wetland

- 1734 Wallum Bottlebrush - Leptocarpus tenax - Baloskion pallens
- 1742 Jointed Twig-rush sedgeland
- Constructed Wetland

Source:
Vegetation - ERM 2021
Port Stephens LGA DCBD, DTBD 2020
Imagery - Nearmap Oct 2022

Plant Community Types and Threatened Ecological Communities

F4

Drawing No:	0574306s_WSAP3_Bio_G004_R7.mxd		Williamtown SAP
Date:	07/12/2022	Drawing Size: A3	
Drawn By:	VN	Reviewed By: JW	Client: Department of Planning, Industry and

Coordinate System: GDA 1994 MGA Zone 56

0 0.1 0.2km

N

ERM

6. NATIVE FAUNA

6.1 Birds

The total bird species recorded in the Williamtown SAP during May and November 2021 surveys is summarised below:

- May 2021 – 79 native and 4 introduced
- November 2021 – 94 native and 3 introduced.

Total overall bird species diversity for the Williamtown SAP based on survey in May and November 2021 is 110 bird species.

Several summer migrant bird species such as Sacred Kingfisher, several cuckoo species, Dollarbird, White-throated Needletail and Rainbow Bee-eater were detected in November 2021. Several nocturnal birds were also recorded, including Tawny Frogmouth, Southern Boobook and White-throated Nightjar. The White-throated Nightjar was not detected by nocturnal spotlight searches but recorded on audio songmeter installed at a small dam in the western part of the Williamtown SAP.

No threatened large forest owls were detected, despite three species, the Powerful Owl, Masked Owl and Eastern Grass Owl all known from the immediate area. Williamtown SAP supports suitable habitat for all three species, and discarded wings of threatened Grey-headed Flying-fox were found, suggesting the Powerful Owl forages in Williamtown SAP. A number of large mature habitat trees with hollows exist in Williamtown SAP and provide potential breeding and roosting opportunities for Powerful Owl and Masked Owl. Whitewash characteristic of large forest owls was located in the central Scribbly Gum forest, but no direct evidence of regurgitation pellets, or roosting adult birds, was observed. Limited areas of sheltering habitat for the Eastern Grass Owl occur.

Threatened birds recorded in the Williamtown SAP include Little Lorikeet, with a number of small flocks to 20+ birds observed daily. An abundance of flowering Swamp Mahogany and Broad-leaved Paperbark trees resulted in regular movements of Lorikeets across the area. The White-bellied Sea Eagle was observed flying overhead on several occasions, and one adult bird was observed roosting in tall *Melaleuca quinquenervia* forest near the Astra lands.

A list of all bird species recorded during the fauna survey period is presented in **Appendix C.**

6.2 Mammals

Trapping recorded two small terrestrial mammals - Brown Antechinus and introduced Black Rat. Despite not being captured, high activity of bandicoot species, most likely Northern Brown Bandicoot, was also observed throughout the remnant forested areas.

A number of terrestrial mammals were recorded via the remote field cameras, including Short-beaked Echidna, Eastern Grey Kangaroo, Red-necked Wallaby, Swamp Wallaby, Dog and Fox. Several images recorded Fox carrying prey. A summary of images captured by each remote camera is presented below in Table 6.1.

Stagwatch surveys recorded Koala active on a Swamp Mahogany tree on one evening, and large numbers of flying-fox arriving in the Williamtown SAP. No other arboreal or scansorial fauna species were detected by this technique during the spotlighting surveys.

Table 6.1 Fauna species recorded by remote field cameras, Williamtown SAP.

Common Name	No. Field Days images captured								Sample of the Images Captured
	Cam3	Cam11	Cam16	Cam19	Cam21	Cam24	Cam25	Cam26	
Short-beaked Echidna					3				
Eastern Grey Kangaroo	1	1			1		1	1	

Common Name	No. Field Days images captured								Sample of the Images Captured
	Cam3	Cam11	Cam16	Cam19	Cam21	Cam24	Cam25	Cam26	
Red-necked Wallaby					15	1		1	
Swamp Wallaby		1		1	5	1	8	2	
Common Brushtail Possum					5		6		

Common Name	No. Field Days images captured								Sample of the Images Captured
	Cam3	Cam11	Cam16	Cam19	Cam21	Cam24	Cam25	Cam26	
Fox		4		2	3	1	23	1	
Dog / Dingo		3			2		5		
Total No. Days *	**1**	**9**	**0**	**3**	**34**	**3**	**43**	**5**	

Note: Total number of days indicates the number of days an image of a species was recorded. For instance, Camera 25 recorded 5,742 images during period 28 September to 16 November. However, no. of days a species was detected is 43 of the 50 days.

A list of species detected by spotlight searches is presented below in Table 6.2.

Table 6.2 Fauna species recorded by Stagwatch and Spotlight, Williamtown SAP.

Common Name	Scientific Name	Number Observed	Method
Koala	*Phascolarctos cinereus*	1	Stagwatch
Common Brushtail Possum	*Trichosurus vulpecula*	3	Spotlight + photo
Common Ringtail Possum	*Pseudocheirus peregrinus*	1	spotlight
Grey-headed Flying-fox	*Pteropus poliocephalus*	100+	Stagwatch + spotlight

A total of 32 nest boxes were located in Williamtown SAP during the fauna survey. The nest boxes installed provide sheltering habitat for a range of fauna species, including microbats, small and larger gliders and possums, small and larger birds and also arboreal reptiles and frogs. Despite only 32 nest boxes being located, the numbering system on the boxes indicates a larger number of boxes occur. A total of 12 individuals of 2 arboreal mammal species were found in the boxes, including Common Brushtail Possum and threatened Squirrel Glider.

Diurnal observations of fauna were also conducted whilst undertaking other survey techniques. An adult female Koala and dependent cub was observed in a mature Swamp Mahogany tree to the immediate west of Dawson's Drain (external to Williamtown SAP). This area supported very high quality habitat for Koala, with dense stand of Swamp Mahogany trees, with Broad-leaved Paperbark trees along Dawson's Drain. A number of additional Schedule 3 food trees for Koala occur in this area. A summary of fauna species observed by nest box inspections and direct observations is summarised below in Table 6.3.

Table 6.3 Fauna species recorded by Nest Box Inspections and Observations, Williamtown SAP.

Common Name	Scientific Name	Number Observed	Method
Koala	*Phascolarctos cinereus*	1 adult + cub	Observed diurnal
Red-necked Wallaby	*Macropus rufogriseus*	10+	Observed diurnal
Eastern Grey Kangaroo	*Macropus giganteus*	2	Observed diurnal
Squirrel Glider	*Petaurus norfolcensis*	6	Nest box
Common Brushtail Possum	*Trichosurus vulpecula*	6	Nest box

Photograph 1. Squirrel Gliders found in installed nest boxes, Williamtown SAP

6.3 Microchiropteran bats

Microchiropteran bat species were sampled by standard 4.2m^2 double bank harp traps set at 6 sites for 2 consecutive nights each. Seven individuals belonging to 3 species were captured for a total survey effort of 12 harp trap nights in November 2021. No captures were recorded in the May 2021 survey.

Those species captured include Lesser Long-eared Bat *Nyctophilus geoffroyi,* Little Forest Bat *Vespadelus vulturnus* and the threatened Little Bentwing-bat *Miniopterus australis.* The captures of Lesser Long-eared Bat confirm the presence of the species within Williamtown SAP, as this species cannot be differentiated from other long-eared bat species by echolocation call recordings alone.

Microbats were also sampled at ten sites with Anabat Express, Anabat II and Chorus detectors set for 2 continuous nights. Each detector was located adjacent to a suitable flyway. A summary of the bat species recorded by echolocation calls is presented below in Table 6.4**.**

Overall microbat species diversity and abundance is considered low, with only 10 species recorded in the Williamtown SAP. One constraint to sampling for microbats, particularly by harp trapping, is a paucity of suitable flyways to sample by trapping. Whilst the diversity of species detected by trapping is considered low (only 7 individuals belonging to 3 species), the echolocation call recordings did not record many additional species known to occur in the local area. Reference to the DPE Wildlife Atlas reveal at least 17 microbat species have been detected in the locality.

Table 6.4 Microbat species detected by Anabat recording, Williamtown SAP.

Common Name	Scientific Name	D1	D2	D3	D4	D5	D6	D7	D8	D8	D10	Total
White-striped Freetail-bat	*Austronomus australis*					2	1			1	8	12
Eastern Coastal Freetailed-bat	*Micronomus norfolkensis*						2		21	4	28	55
Eastern Bentwing-bat	*Miniopterus schreibersi oceansis*					3	4		1		9	17
Little Bentwing-bat	*Miniopterus australis*	58	7	33		1	44		3	16	28	190
Gould's Wattled Bat	*Chalinolobus gouldi*	25	2	7		4	26	1	27	10	191	293
Chocolate Wattled Bat	*Chalinolobus morio*	1		8					5	77	10	101
Long-eared Bat	*Nyctophilus sp.*	1				2	1			1	4	9
Greater Broad-nosed Bat / Eastern Broad-nosed Bat	*Scoteanax rueppellii / Scotorepens balstoni*								3	4	55	62
Large Forest Bat	*Vespadelus darlingtoni*			1			3					4
Little Forest Bat	*Vespadelus vulturnus*	1		7		1				12	160	181
TOTAL CALLS		**86**	**9**	**56**	**0**	**13**	**81**	**1**	**60**	**125**	**493**	**924**

6.4 Reptiles and Amphibians

Reptile species diversity detected by diurnal and nocturnal searches was low in the May 2021 survey, with only 6 species recorded. However, the November 2021 survey recorded an additional 6 species, resulting in overall diversity of 12 reptile species.

Small and larger skinks and Lace Monitor was regularly observed during the November 2021 survey. The larger Lace Monitor was also photographed on a number of occasions by field cameras. Three elapid snakes were observed, the Yellow-faced Whipsnake, Eastern Brown Snake and Black-bellied Snake. One Diamond Python was observed climbing a habitat tree with a hollow during nocturnal spotlight search in May, despite colder temperatures experienced during that survey. It is possible the individual was retreating to the hollow to prepare for winter hibernation.

The diversity of frog species at Williamtown SAP was also considered low in May 2021 survey, but much higher diversity and abundance recorded in November 2021. Several frog species were detected in low numbers despite ideal survey conditions in November 2021. Of interest was the large number (100+) of juvenile Ornate Burrowing Frog observed on a large sand dune in the centre of the Williamtown SAP in May 2021. The recent rains may have triggered a large breeding event for the species. The installed audio recorders at a small dam in the western part of the Williamtown SAP recorded calling activity of several frogs species, including the threatened Wallum Froglet *Crinia tinnula*.

The threatened Wallum Froglet occurs across the majority of Williamtown SAP lands, from open grassland off Cabbage Tree Road, wet heath in the western portion of the Williamtown SAP, and newly created wetlands associated with the AstraLab land. In all instances, only small numbers of calling individuals were heard. No large choruses of 100+ frogs were detected, despite some favourable areas of habitat for the species, and suitable weather conditions for their detection. A summary of frog species detected across Williamtown SAP lands is presented below in Table 6.5.

The November 2021 survey was conducted during the ideal season and weather conditions for detection of the threatened Mahony's Toadlet *Uperoleia mahonyi*, however, the species was not recorded.

Table 6.5 Frog Species detected in Williamtown SAP lands.

Common Name		S1	S2	S3	S4	S5	S6	S7	S8	S9	Dam
Common Eastern Froglet	*Crinia signifera*							2		5+	10
Wallum Froglet	*Crinia tinnula*	5+									10+
Brown-striped Frog	*Limnodynastes peronii*				2	10+	10+		10+		5
Spotted Grass Frog	*Limnodynastes tasmaniensis*				20+						
Ornate Burrowing Frog	*Platyplectrum ornatum*						2	50+			5+
Bleating Tree Frog	*Litoria dentata*									5+	
Eastern Dwarf Tree Frog	*Litoria fallax*	20+			10+	2	10+	20+	20+		20+
Jervis Bay Tree Frog	*Litoria jervisiensis*										5+

Common Name		S1	S2	S3	S4	S5	S6	S7	S8	S9	Dam
Broad-palmed Frog	*Litoria latopalmata*	50+							10+		
Peron's Tree Frog	*Litoria peronii*						10+				
Tyler's Tree Frog	*Litoria tyleri*	20+	10+		20+		30+		10+		
Verreaux's Frog	*Litoria verreauxii*					5+					
*Mosquito Fish	**Gambusia holbrookei*	+++	+++		+++			+++	++		

7. THREATENED SPECIES CONSIDERED WITHIN BIODIVERISTY ASSESSMENT

7.1 Ecosystem Credit Species

Threatened species assigned to ecosystem credits are those that can be reliably predicted to occur based on the vegetation and/or landscape features within the Williamtown SAP (also referred to as the 'subject land' within the BAM). It also includes species with a low probability of detection using targeted surveys. They are also known as predicted species and do not require targeted survey.

The ecosystem credit species predicted to occur within the Williamtown SAP are shown in **Appendix F**. This list is automatically populated in the BAM Calculator. One species was added to the predicted species list in the BAM-C as it has been recorded in the locality: *Pseudomys gracilicaudatus* (Eastern Chestnut Mouse).

The following nine ecosystem credit species were recorded during the field surveys:

- *Glossopsitta pusilla* (Little Lorikeet)
- *Haliaeetus leucogaster* (White-bellied Sea-Eagle)
- *Pteropus poliocephalus* (Grey-headed Flying Fox)
- *Phascolarctos cinereus* (Koala)
- *Miniopterus australis* (Little Bentwing-bat)
- *Miniopterus orianae oceanensis* (Eastern Bentwing-bat)
- *Micronomus norfolkensis* (Eastern Coastal Freetailed Bat)
- *Ninox strenua* (Powerful Owl)
- *Scoteanax rueppellii* (Greater Broad-nosed Bat)

Ecosystem credit species previously recorded within the Williamtown SAP are also identified in **Appendix F.**

7.2 Species Credit Species

Threatened species assigned to species credits are those that cannot be confidently predicted to occur by vegetation and landscape features. They are also known as candidate species. The candidate species predicted to occur at the Williamtown SAP by the BAM Calculator are shown in Appendix F. A number of these species are only classed as candidate species in relation to their breeding habitat, i.e., the species only requires targeted survey if suitable breeding habitat occurs at the subject land.

The following species credit species were recorded within the Williamtown SAP during the May and November 2021 surveys or have Important Area Mapping that occurs within the Williamtown SAP:

- *Phascolarctos cinereus* (Koala) (recorded)
- *Petaurus norfolcensis* (Squirrel Glider) (recorded)
- *Crinia tinnula* (Wallum Froglet) (recorded)
- *Eucalyptus parramattensis* subsp. *parramattensis* (Earps Gum) (recorded)
- Swift Parrot (Important Area Mapping)

Species habitat polygons are discussed within Section 8.

The following species credit species were also recorded within the Williamtown SAP; however, they are species credit species for breeding habitat only and breeding habitat is not present within the Williamtown SAP:

- *Pteropus poliocephalus* (Grey-headed Flying-fox)
- *Miniopterus australis* (Little Bentwing-bat)
- *Miniopterus orianae oceanensis* (Eastern Bentwing-bat)

8. THREATENED SPECIES HABITAT MAPPING

8.1 Koala

Three Koalas were observed during spotlighting and diurnal searches. One was observed within the Williamtown SAP and one female with young was observed in the land immediately to the west of the Williamtown SAP and areas that contain preferred feed tree species are considered to comprise breeding habitat for the local population.

The species polygon for the Koala is provided in Figure 5b and includes the following vegetation zone in which Koala feed trees occur:

- PCT1646_good: Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast.

Koala habitat also occurs in the following vegetation zones, however, these zones are restricted to the DAREZ or Environment Protection Area and are not included in the species polygon:

- PCT1637_good: Scribbly gum - Wallum Banksia - Prickly-leaved Paperbark heathy coastal woodland on coastal lowlands. This vegetation zone is restricted to the DAREZ.
- PCT1646_canopyonly: Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast. This vegetation zone is restricted to the Environment Protection Area.
- PCT1651_good: Parramatta red gum - Fern-leaved banksia - Melaleuca sieberi swamp woodland of the Tomaree Peninsula. This vegetation zone is restricted to the DAREZ.
- PCT1725_good: Swamp Mahogany - Broad-leaved Paperbark - Swamp Water Fern - Plume Rush swamp forest on coastal lowlands of the Central Coast and Lower North Coast. This vegetation zone is restricted to the DAREZ and Environmental Protection Area.

It is noted the Koala's threatened species listing status under both the BC Act and EPBC Act was recently upgraded to endangered (from vulnerable). The upgrade provides additional protection for the species as it lowers the threshold at which development may pose a significant impact under the EPBC Act. It is also now a species credit species only, where previously it was a dual credit ecosystem/species credit species. Thus, foraging and breeding habitat present at a development site would require assessment for species credits. This is supported by new survey guidelines to be implemented to meet BAM requirements.

8.2 Squirrel Glider

Five Squirrel Gliders were observed using the existing nest boxes within the Williamtown SAP. Both foraging and breeding habitat contributes to the species polygon for the Squirrel Glider (refer to Figure 5c) and includes all woodland PCTs which also include hollow bearing trees. The species polygon also extends 50 m into areas of wet heath (from woodland areas) as the species is likely to forage in these areas where they are in close proximity to woodland areas.

The species polygon for the Squirrel Glider includes the following vegetation zone:

- PCT1646_good: Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast.

Squirrel Glider habitat also occurs in the following vegetation zones, however, these zones are restricted to the DAREZ or Environment Protection Area and are not included in the species polygon:

- PCT1637_good: Scribbly gum - Wallum Banksia - Prickly-leaved Paperbark heathy coastal woodland on coastal lowlands. This vegetation zone is restricted to the DAREZ.
- PCT1646_canopyonly: Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast. This vegetation zone is restricted to the Environment Protection Area.

- PCT1651_good: Parramatta red gum - Fern-leaved banksia - Melaleuca sieberi swamp woodland of the Tomaree Peninsula. This vegetation zone is restricted to the DAREZ.
- PCT1725_good: Swamp Mahogany - Broad-leaved Paperbark - Swamp Water Fern - Plume Rush swamp forest on coastal lowlands of the Central Coast and Lower North Coast. This vegetation zone is restricted to the DAREZ and Environmental Protection Area.

8.3 Wallum Froglet

Wallum Froglet were heard calling within the Williamtown SAP. The species polygon for the Wallum Froglet was identified in accordance with the *NSW Survey Guide for Threatened Frogs* (DPIE 2020b). It includes the aquatic habitats within which the species was recorded plus a 50m wide buffer from the top of bank, incorporating the PCTs with which the species is associated. The area in which the species was recorded was flooded all the time and it is therefore difficult to determine the top of the bank.

The species polygon (refer to Figure 5d) incorporates the entire PCT in which the Wallum Froglet was recorded, the adjacent swamp forest areas and areas of wet heath, namely:

- PCT1724 (inundated and low condition): Broad-leaved Paperbark - Swamp Oak - Saw Sedge swamp forest on coastal lowlands of the Central Coast and Lower North Coast.

The Wallum Froglet was also recorded in the following vegetation zones; however, these zones are restricted to the DAREZ or Environment Protection Area and are not included in the species polygon:

- PCT1725 (regrowth): Swamp Mahogany - Broad-leaved Paperbark - Swamp Water Fern - Plume Rush swamp forest on coastal lowlands of the Central Coast and Lower North Coast. This vegetation zone is restricted to the DAREZ.
- PCT1734: Wallum Bottlebrush – Leptocarpus tenax – Baloskion pallens Wallum sedge heath of the lower North Coast. This vegetation zone is restricted to the DAREZ.
- PCT1742: Jointed Twig-rush sedgeland. This vegetation zone is restricted to the DAREZ.

8.4 Earps Gum

Numerous Earps Gum individuals were recorded throughout the Williamtown SAP, mainly in areas of PCT1651. The species also occurs sporadically in other PCTs. The species is assessed in the BAM-C based on the number of individuals, rather than a species polygon.

A detailed count of individual plants within the Williamtown SAP was undertaken during the November 2021 survey period. A total of 144 individuals were recorded, however, all were recorded within the DAREZ.

8.5 Swift Parrot

The Swift Parrot was not recorded during the May 2021 or November 2021 field surveys, however, Important Area Mapping for the species covers the northern portion of the Williamtown SAP.

The species polygon presented in Figure 5e and included within the offset calculation is in accordance with the Important Area Map, however, areas that no longer support a native canopy do not provide suitable habitat and these areas have been removed.

MEDOWIE ROAD

CABBAGE TREE ROAD

DAWSONS DRAIN

THE FOURTEEN FOOT DRAIN

NELSON BAY ROAD

TILLIGERRY CREEK

Legend

Threatened Species
- Eastern Bentwing-bat
- Eastern Coastal Freetailed-bat
- Greater Broad-nosed Bat
- Grey-headed Flying-fox
- Koala
- Little Bentwing-bat
- Little Lorikeet
- Powerful Owl
- Squirrel Glider
- Wallum Froglet
- White-bellied Sea Eagle

Bionet Records - Flora
- Maundia triglochinoides
- Eucalyptus parramattensis subsp. decadens

Bionet Records - Fauna
- Black-necked Stork
- Eastern Coastal Free-tailed Bat
- Emu
- Greater Broad-nosed Bat
- Grey-headed Flying-fox
- Koala
- Little Bent-winged Bat
- Long-nosed Potoroo
- New Holland Mouse
- Southern Myotis
- Squirrel Glider
- Wallum Froglet
- White-bellied Sea-Eagle
- Structure Plan Boundary
- Existing and Approved Development
- Main Road
- Minor Road
- Minor Watercourse

Source:
Species - ERM 2021, Bionet 2020
Port Stephens LGA DCBD, DTBD 2020
Imagery - Nearmap Oct 2022

Threatened Species Records

F5a

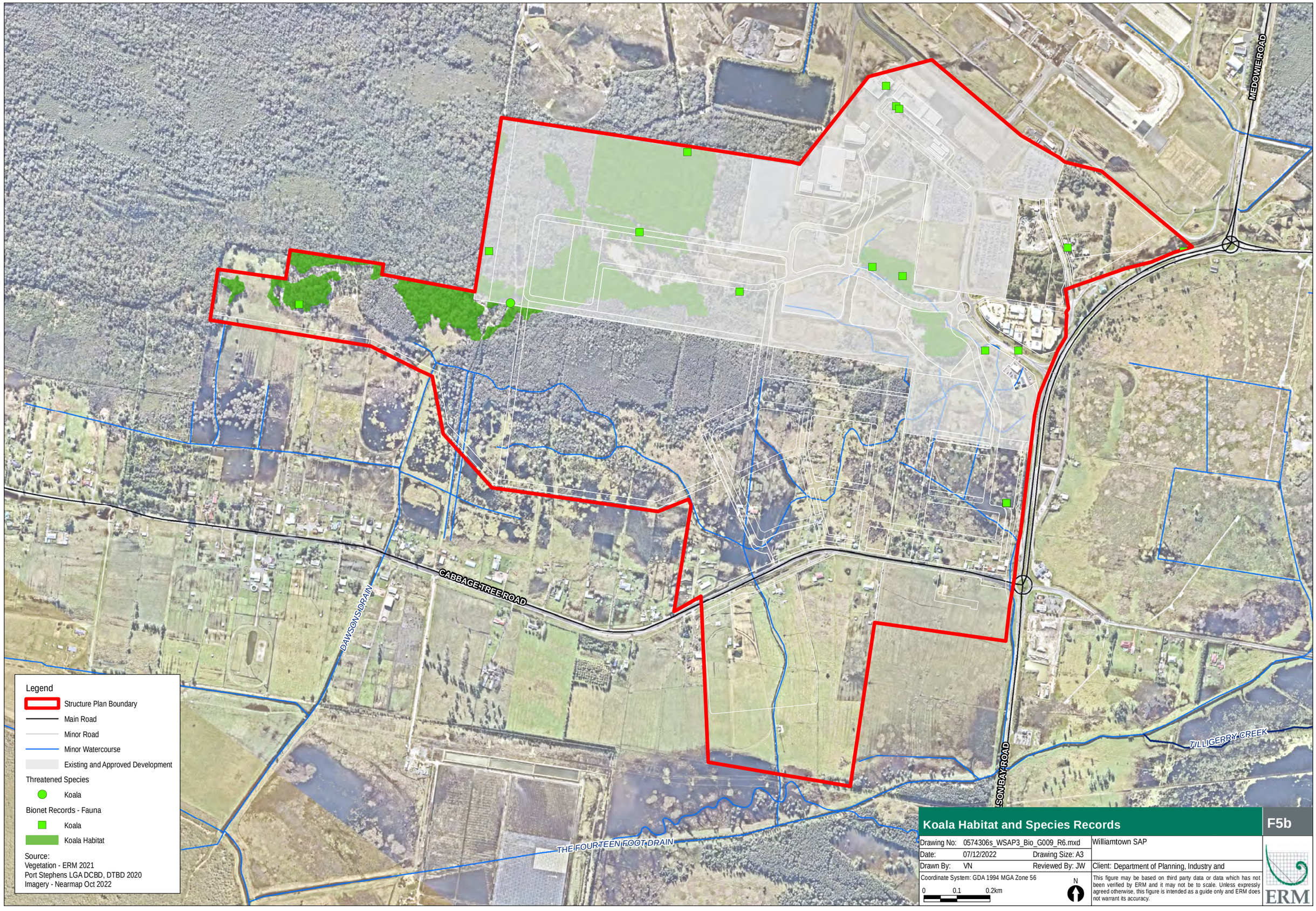
Drawing No:	0574306s_WSAP3_Bio_G005_R11.mxd		Williamtown SAP
Date:	07/12/2022	Drawing Size: A3	
Drawn By:	VN	Reviewed By: JW	Client: Department of Planning, Industry and

Coordinate System: GDA 1994 MGA Zone 56

0 0.1 0.2km

N

ERM



Koala Habitat and Species Records

F5b

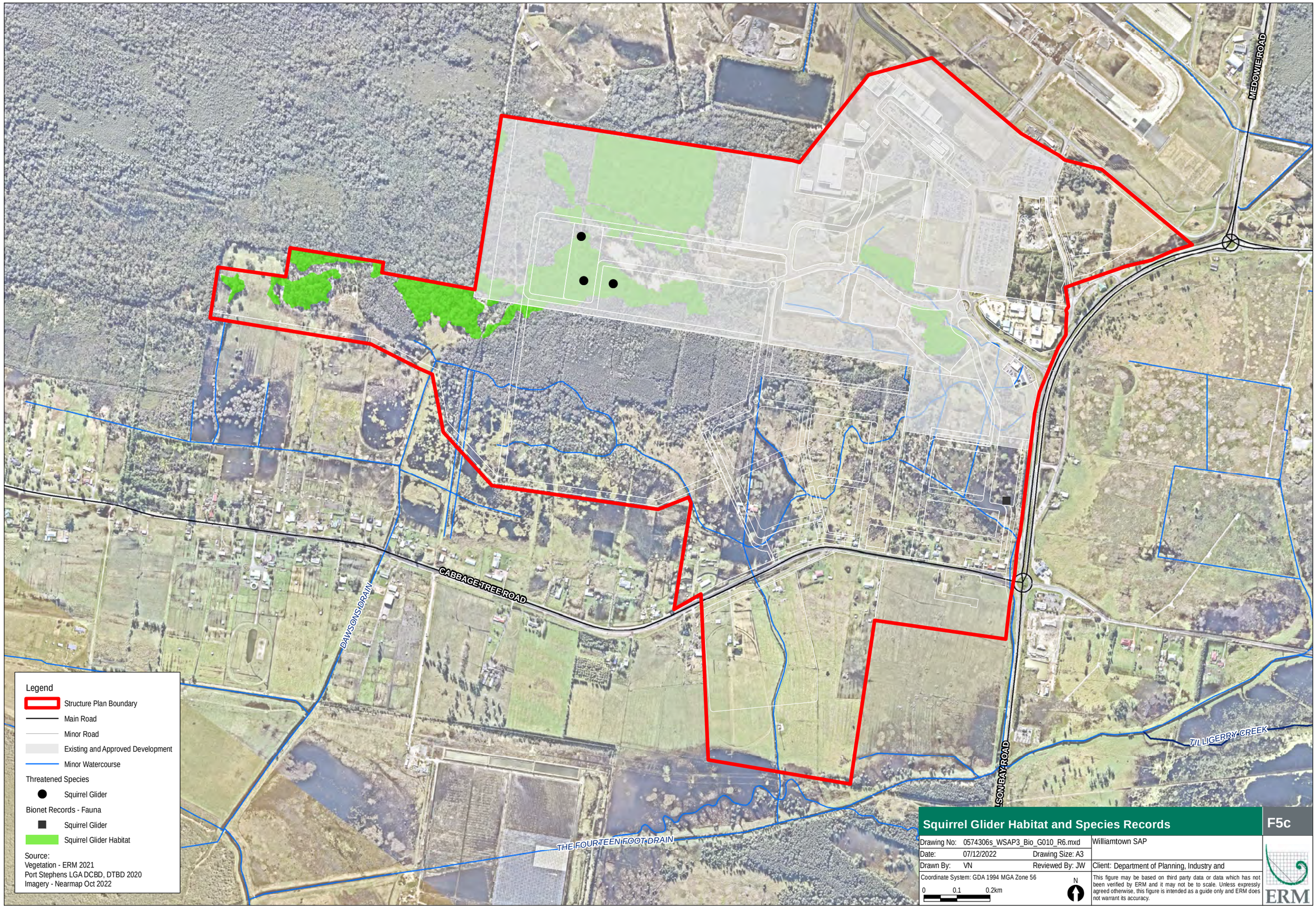
Drawing No:	0574306s_WSAP3_Bio_G009_R6.mxd		Williamtown SAP
Date:	07/12/2022	Drawing Size: A3	
Drawn By:	VN	Reviewed By: JW	Client: Department of Planning, Industry and

Coordinate System: GDA 1994 MGA Zone 56

0 0.1 0.2km

N

ERM



Squirrel Glider Habitat and Species Records

F5c

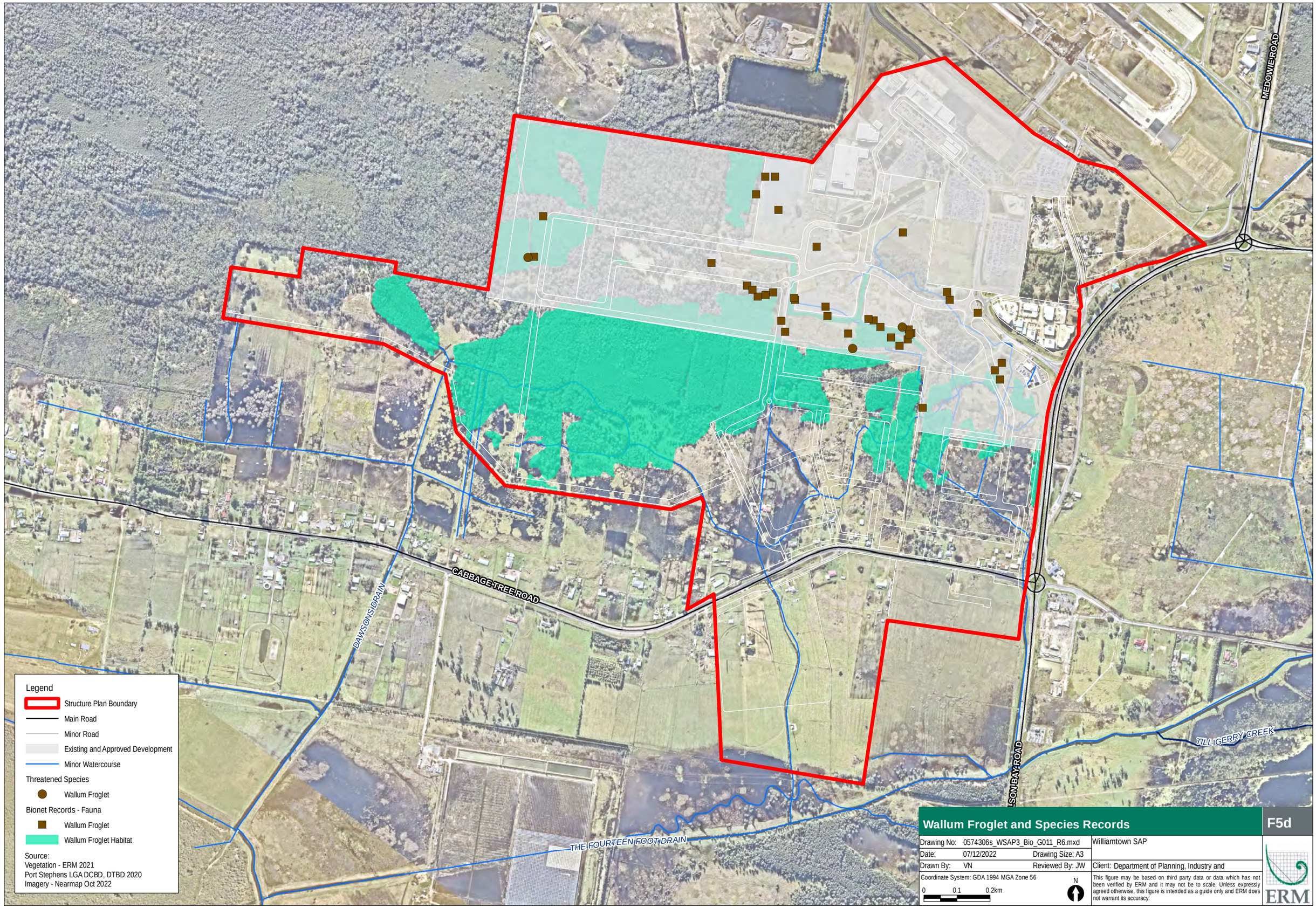
Drawing No:	0574306s_WSAP3_Bio_G010_R6.mxd		Williamtown SAP
Date:	07/12/2022	Drawing Size: A3	
Drawn By:	VN	Reviewed By: JW	Client: Department of Planning, Industry and

Coordinate System: GDA 1994 MGA Zone 56

0 0.1 0.2km

N

ERM



Wallum Froglet and Species Records

F5d

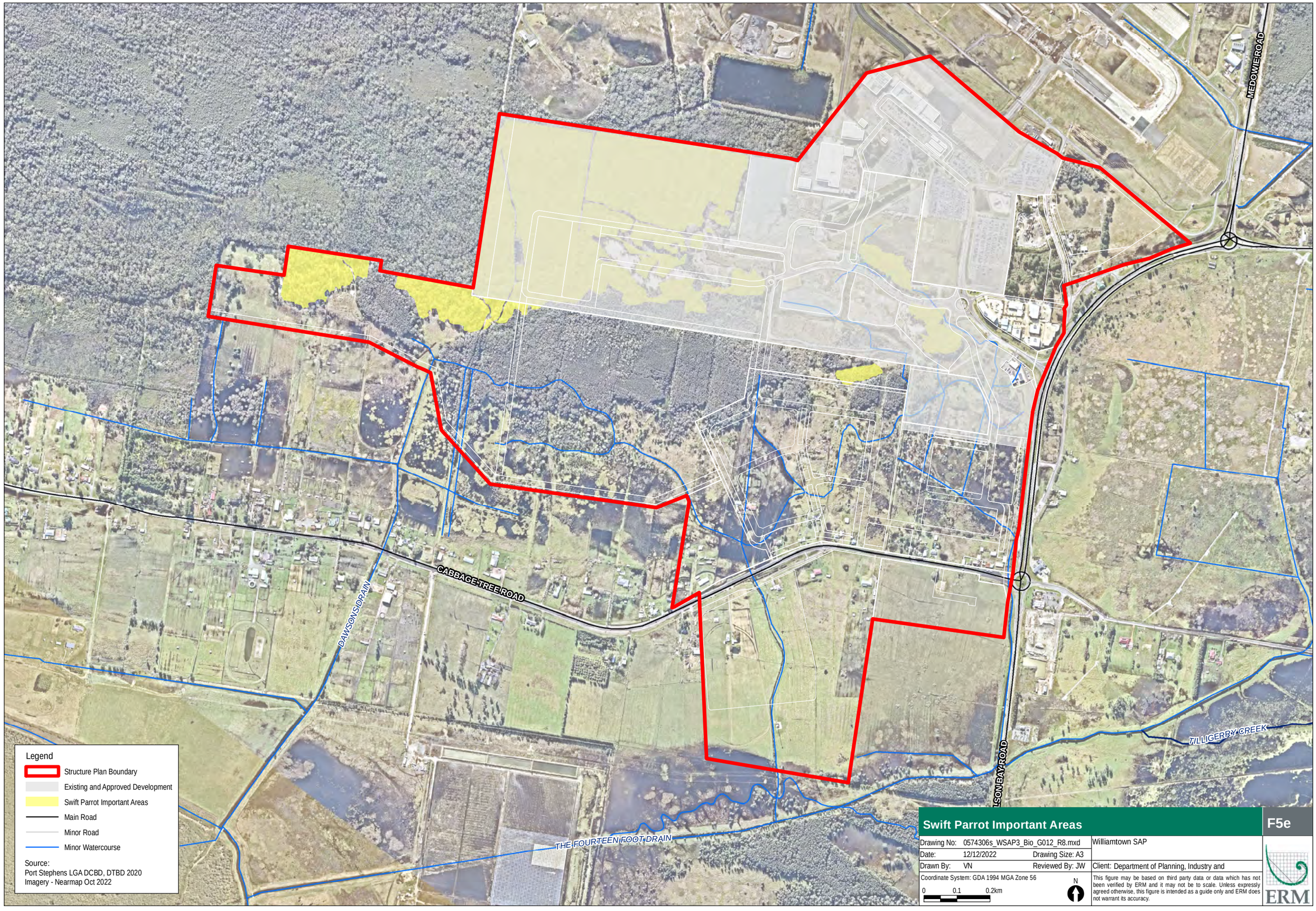
Drawing No:	0574306s_WSAP3_Bio_G011_R6.mxd		Williamtown SAP
Date:	07/12/2022	Drawing Size: A3	
Drawn By:	VN	Reviewed By: JW	Client: Department of Planning, Industry and

Coordinate System: GDA 1994 MGA Zone 56

0 0.1 0.2km

N

ERM



Swift Parrot Important Areas

F5e

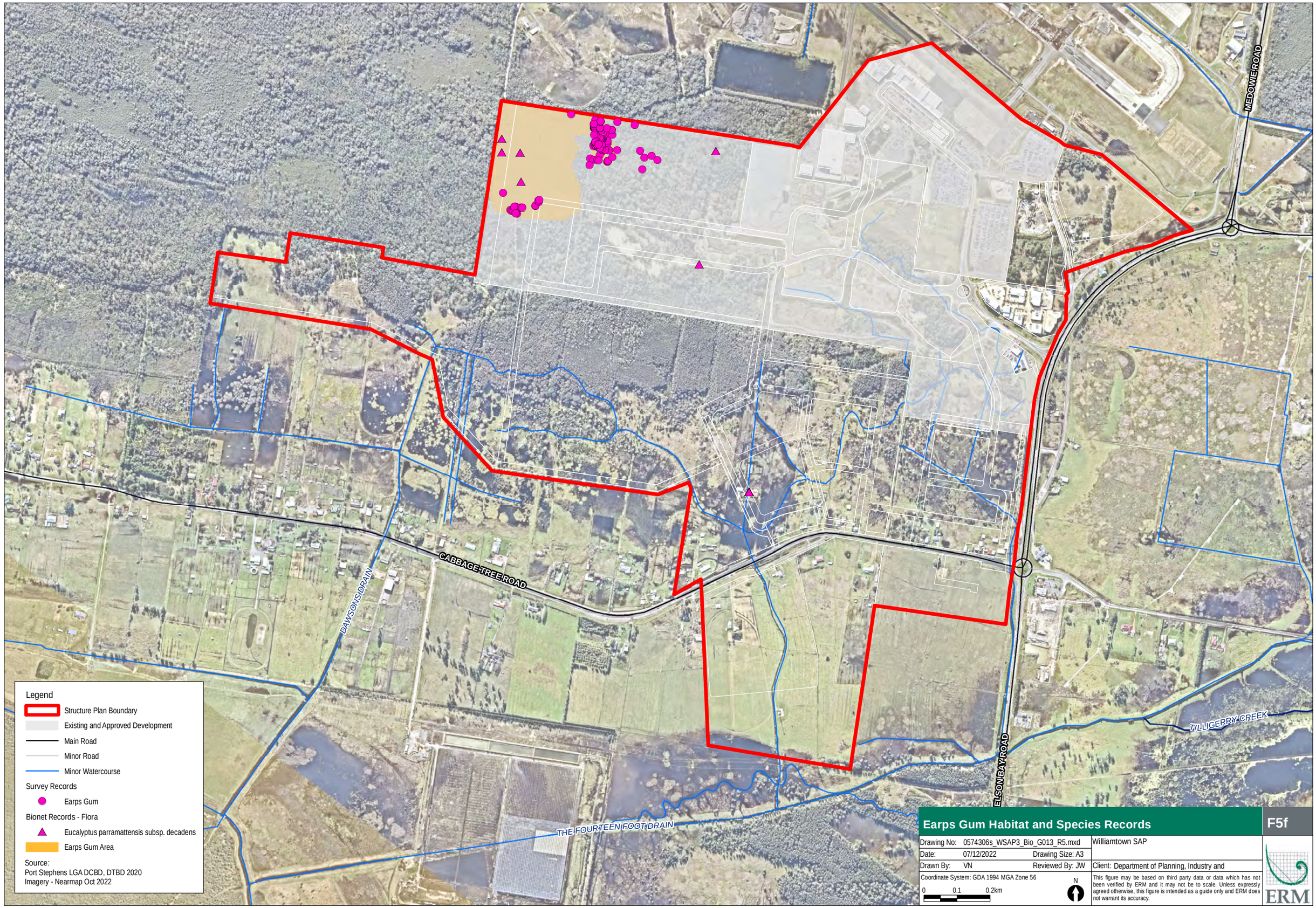
Drawing No:	0574306s_WSAP3_Bio_G012_R8.mxd		Williamtown SAP
Date:	12/12/2022	Drawing Size: A3	
Drawn By:	VN	Reviewed By: JW	Client: Department of Planning, Industry and

Coordinate System: GDA 1994 MGA Zone 56

0 0.1 0.2km

N

ERM



Earps Gum Habitat and Species Records

F5f

Drawing No:	0574306s_WSAP3_Bio_G013_R5.mxd		Williamtown SAP
Date:	07/12/2022	Drawing Size: A3	
Drawn By:	VN	Reviewed By: JW	Client: Department of Planning, Industry and

Coordinate System: GDA 1994 MGA Zone 56

0 0.1 0.2km

N

ERM

9. BAM-C RESULTS

9.1 Indicative Ecosystem Credits

The development areas will require an indicative total of 51 ecosystem credits. A breakdown per vegetation zone is provided in Table 9.1. The credit report generated by the BAM-C is provided in Appendix G. The results in the credit report are indicative only as they are based on data extrapolated from BAM plots undertaken within the Williamtown SAP and BAM plots undertaken within a broader study area and therefore, do not meet the requirements of the BAM. Additional BAM plot data is required for preparation of a BDAR.

Table 9.1 Preliminary Ecosystem Credits – Development Areas

Vegetation Zone	Ecosystem Credits	Total Price for payment to Biodiversity Conservation Fund* (as at 8 December 2021) (excl. GST)
1646_good	1	$49.042.00
1646_regrowth	6	
1724_inundated	44	$176,224.40
1724_low	0	
Total	**51**	**$225,266.40**

**The BAM Calculator no longer provides credit pricing and therefore, the price us an estimate based on price per credit from an earlier version of this report (8 December 2021).*

9.2 Indicative Species Credits

The development areas will require a total of 87 species credits. A breakdown per vegetation zone is provided in Table 9.2.

The preliminary credit report generated by the BAM-C is provided in **Appendix G**.

Table 9.2 Preliminary Species Credits – Development Areas

Vegetation Zone	Swift Parrot	Squirrel Glider	Koala	Wallum Froglet	Total Credits/Price for Payment to BCT
1646_good	3	2	2	-	
1646_regrowth	11	-	-	-	
1724_inundated	15	-	-	33	
1724_low	-	-	-	21	
Total	**29**	**2**	**2**	**54**	**87**
Total Price for payment to Biodiversity Conservation Fund*	**$13,169.00**	**$1355.40**	**$1355.40**	**$36,596.10**	**$57,471.00**

***The BAM Calculator no longer provides credit pricing and therefore, the price us an estimate based on price per credit from an earlier version of this report (8 December 2021).*

10. POTENTIAL SERIOUS AND IRRIVERSIBLE IMPACTS

Species and ecological communities with a 'very high' biodiversity risk weighting are potential serious and irreversible impact (SAII) entities. Principles for determining serious and irreversible impacts are set out in clause 6.7 of the Biodiversity Conservation Regulation 2017. An impact is to be regarded as serious and irreversible if it is likely to contribute significantly to the risk of a threatened species or ecological community becoming extinct because:

- it will cause a further decline of a species or ecological community that is currently observed, estimated, inferred or reasonably suspected to be in a rapid rate of decline
- it 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
- it is an impact on the habitat of the species or ecological community that is currently observed, estimated, inferred or reasonably suspected to have a very limited geographic distribution
- the impacted species or ecological community is unlikely to respond to measures to improve its habitat and vegetation integrity and therefore its members are not replaceable.

Of the species identified in the BAM-C as being associated with the Williamtown SAP, the following SAII are considered to have the potential to occur in the development areas:

Swift Parrot: development areas are within the Important Area Map for the species. Impacts to these areas require consideration of the potential for SAII.

Impacts to an additional three candidate species also have the potential to result in SAII, however, the species are not considered likely to occur and/or the species is a candidate species only with respect to its breeding habitat, which does not occur within the Williamtown SAP:

- Little Bentwing Bat and Eastern Bentwing Bat: recorded in the Williamtown SAP, however, these species are candidate species only with respect to their breeding habitat, which does not occur within the Williamtown SAP.
- Giant Dragonfly: low likelihood of occurrence.

ERM and DPE recognise that access constraints across the remainder of the SAP have limited the survey effort undertaken to date and confirm that additional survey over at least two separate survey periods will be undertaken across the precinct to support the Delivery Plan and preparation of a BDAR as the next phase of this project. This will be prepared in accordance with the Biodiversity Assessment Method (BAM 2020), including detailed assessments of potential SAII. As soon as access is available across the entire precinct, ERM will prepare a gaps analysis and develop a detailed survey plan. At this stage a meeting with BCD may be scheduled to discuss any remaining limitations, survey requirements or other considerations that will need to be addressed during the preparation of the BDAR.

11. MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE

The EPBC Act requires approval of the Commonwealth Minister for the Environment for actions that are likely to have a significant impact on Matters of National Environmental Significance (MNES) as assessed in accordance with the EPBC Significant Impact Guidelines 1.1. Any proposed action that is expected to have an impact on MNES must be referred to the Minister for assessment under the EPBC Act, or assessed under the existing bilateral agreement, or accredited process between the Commonwealth and the State of New South Wales (NSW). Based on our assessment to date, it is likely that the Masterplan will be referred and likely to be assessed under a bilateral agreement based on the following listed MNES:

- Wetlands of international importance
- Threatened species and ecological communities
- Migratory species
- Commonwealth Land

At this stage the Biodiversity Assessment has considered the direct impacts of habitat clearance and provides indicative credit obligations in accordance with the BAM. It is important to note that further assessment will be undertaken to inform the delivery plan and any SSD application and will be prepared based on the final flood mitigation and drainage design to consider:

- Any additional water that will flow into the retained habitats during major rainfall events may impact on the long term structure and diversity of these communities although it is noted that the swamp forest habitats are naturally adapted to being periodically inundated to some extent (see further discussion in Section 12)
- Drainage features that function as wetlands are incorporated into the Structure Plan which increases the surface area of water bodies in proximity to the airport, within the birdstrike zone area. The measures proposed for the management of the birdstrike risk will be included within the delivery plan and will include (as a minimum) steep batters to reduce foraging habitat and macrophyte planting designed to limit open water for large bird
- Indirect impacts on the nearby RAMSAR wetland and the important shorebird habitat within Fullerton Cove. This will also be addressed separately as part of a targeted MNES report and will be prepared following the completion of the final flood and hydrology modelling. This assessment will be based on the final flood mitigation and drainage design to consider any changes to the existing water quality, volume and flows entering the local drainage channels which ultimately lead into Fullerton Cove. Specifically, it is recommended that the impact of increased freshwater runoff and total nitrogen load on wetlands at Fullerton Cove be further assessed to support the delivery plan and EPBC referral.

Based on the current Structure Plan design, the Integrated Water Management Plan and Flood Assessment prepared by Aurecon (2022) indicates that the proposed water sensitive urban design measures and land use changes are predicted to have a low risk of changing downstream water quality loads and concentrations within Fullerton Cove. It is predicted these measures would ensure:

- No change in pollutant loads when compared with rural residential land use
- Mean annual pollutant loads for the post-development case match the pre-development case for total suspended solids (TSS), total phosphorus (TP) and total nitrogen (TN).
- TP and TN concentrations for the post-development case (including mitigation measures) must be equal to or better compared to the pre-development case for between the 50th and 98th percentilesover the five-year modelling period when runoff occurs.

Under this management approach, there is a low risk of impacts to the upstream Tomago sand bed aquifergiven the change in recharge volume is negligible, however the mean annual freshwater runoff dischargingto Fullerton Cove may increase by around 15 to 20%.

12. GROUNDWATER DEPENDENT ECOSYSTEMS

In terms of terrestrial GDE, a vegetation survey and mapping program of the Tomago and Tomaree Sandbeds was carried out by Driscoll and Bell (2006) to identify GDE. In summary all of the vegetation across the Tomago sandbeds was shown to have some degree of groundwater dependency, with 80% of the area having a depth to water of 3m or less.

There are no mapped high priority GDE's within the Williamtown SAP that are referenced by the Water Sharing Plan for the North Coast Coastal Sands Groundwater Sources (2016). The BoM GDE Atlas (accessed 7 December 2021) shows that there are several high potential terrestrial GDE's across the Williamtown SAP, including:

- Fern-leaf Banksia / Prickly-leaved Paperbark / Tantoon / Leptocarpus tenax wet heath on coastal sands
- Scribbly gum / Wallum banksia / Prickly-leaved Paperbark heathy coastal woodland on coastal lowlands ν Parramatta red gum / Fern-leaved banksia / Melaleuca sieberi swamp woodland of the Tomaree Peninsula
- Broad-leaved Paperbark / Swamp Mahogany / Swamp Oak / Saw Sedge swamp forest of the Central Coast.

These ecosystems are sensitive to changes in groundwater conditions and are consistent with the following ground-truthed PCTs:

- PCT1637: Scribbly gum - Wallum Banksia - Prickly-leaved Paperbark heathy coastal woodland on coastal lowlands.
- PCT1651 Parramatta red gum - Fern-leaved banksia - Melaleuca sieberi swamp woodland of the Tomaree Peninsula.
- PCT1724: Broad-leaved Paperbark - Swamp Oak - Saw Sedge swamp forest on coastal lowlands of the Central Coast and Lower North Coast.
- PCT1725: Swamp Mahogany - Broad-leaved Paperbark - Swamp Water Fern - Plume Rush swamp forest on coastal lowlands of the Central Coast and Lower North Coast.
- PCT1734: Wallum Bottlebrush – Leptocarpus tenax – Baloskion pallens Wallum sedge heath of the lower North Coast.
- PCT1742: Jointed Twig-rush sedgeland.

The future development will involve the clearing and filling of (8.31 ha) high potential GDEs located within the precinct. Williamtown SAP may also direct additional water into the retained habitats during major rainfall events and may impact on the long term structure and diversity of these communities. In summary (based on advice from Stephen Bell pers. comm):

- The retained environmental protect zones will be subject to increased inundation as a result of the proposed Structure Plan and resultant bulk filling. Batters will effectively create a basin to contain higher inundation levels, and this will likely accelerate tree death due to water levels extending higher up tree trunks and will retain water longer.
- Increased inundation of these forests also has the potential to restrict replacement through new recruitment (via drowning of seed germinants), potentially leading to a new ecosystem in 10 or 20 years (dependent on regularity and length of inundation periods, which will be driven by prevailing rainfall conditions year-to-year). Any wetland system surrounded largely by urban development will ultimately loose its ecological integrity and function over time, and elevating development around the wetland will exacerbate these impacts
- Of important note is that *Melaleuca quinquenervia* is highly invasive species of disturbed ground, and it would appear that mapped vegetation within the Williamtown SAP have taken over former estuarine tidal flats after they have been drained and cleared for grazing. The PCT 1724 is unlikely to be representative of the original vegetation and the *Melaleuca quinquenervia* dominated forests are almost certainly secondary in response to previous land modification

- All the land from Fullerton Cove extending to the north-east up to Tilligerry Creek, and sandwiched between the Inner and Outer sand barriers (i.e., Worimi Conservation Lands and Tomago Sandbeds) is former estuarine tidal flat, with some sources (Roy 1980; Matthei 1995) suggesting it was originally saltmarsh with some Swamp Oak forest (i.e. not Swamp Sclerophyll TEC). In one historical account, Hartley (1987) described the Fullerton Cove area as supporting 'swamp moors', which does suggest large areas of tidal mudflats and saltmarsh.
- *Melaleuca quinquenervia*, the dominant species in PCT1724 rapidly colonises in dense even-aged forests (Johnston et al. 2003). It is a species with a high tolerance of flooding and inundation (McJannet 2008), although extended periods will ultimately result in tree death (Winning and Clarke 1996). Seed germination may occur under water, but prolonged inundation is likely to kill young plants (Myers 1983; Turner et al. 1998).
- From the ecosystem/community perspective, Lee et al 2006 summarise the likely impacts: "coastal wetlands are characterized by a hydrological regime comprising concentrated flow to estuarine and coastal areas during flood events, and diffused discharge into groundwater and waterways during the non-flood periods. Urbanization, through increasing the amount of impervious areas in the catchment, results in a replacement of this regime by concentrating rain runoff. Quality of run-off is also modified in urban areas, as loadings of sediment, nutrients and pollutants are increased in urban areas."

Opportunities:

There may be avenues for a university research project to be established (via student scholarship) to track and report on the effects of increased inundation on these swamp forests; this is rarely reported in the literature but may be something that could be used as an offset/compensation mechanism.

13. CONSIDERATION OF THE EXISITING PFAS CONTAMINATION WITHIN THE ENVIRONMENTAL PROTECTION ZONE

It is well established that the RAAF Williamtown Base (the Base) and associated infrastructure immediately north of the Williamtown SAP are sources of PFAS (per- and poly-flouroalkyl substances) to groundwater, stormwater, surface water and to a lesser extent soil, sediment and vegetation. These are addressed separately within the Masterplan and associated technical studies.

This chapter addresses the findings of a literature review regarding the potential impacts of PFAS to the Williamtown SAP and specifically, the suitability of the environmental protection area. This has been addressed following public exhibition of the original Williamtown SAP Masterplan in February 2022 and concerns raised regarding the suitability of the environmental zone for conservation due to the existing PFAS contamination.

PFAS are a group of synthetic chemicals that do not occur naturally in the environment but have broad commercial applications worldwide and are commonly used in manufacturing and firefighting (Bolan, et al., 2021; Awad, et al., 2022). As water soluble compounds, the presence of PFAS in the environment has emerged as a significant threat to environmental and human health. A high tolerance of PFAS bioaccumulation has been observed in some riparian wetland vegetation with bioaccumulation rates increasing as plants grow closer to the water's edge. Physiological adaptations also appear to influence a species potential for PFAS tolerance with species possessing thicker taproots identified as possessing higher bioaccumulation rates. Recent research has investigated the potential of native vegetation as a passive, low-cost remediation strategy for wetland ecosystems impacted by PFAS contamination (Awad, et al., 2022).

13.1 Understanding of the Risk

The Williamtown Masterplan identifies areas of PFAS contamination in a variety of areas, including soil, sediment groundwater and surface water. As reported by Aerocon (2022), there is a low to negligible risk to human health for future SAP users and the risk to downgradient ecological receptors is not increased by the construction or operation of the SAP.

Water is the prime method of PFAS contamination transferal between a source and a receptor. Receptors are diverse and operate at various scales including a person, animal, plant, eco-system, property or a waterbody. As highly soluble compounds, PFAS contamination can be mobile throughout groundwater discharge and has been known to permeate porous media such as concrete. PFAS is also both chemically and biologically stable with a low vapour pressure that is resistant to breaking down in the environment or evaporation.

Despite the existing PFAS contamination, the Williamtown SAP is confirmed to include important areas of existing high biodiversity value for threatened species and ecological communities listed as threatened and critically endangered under state and federal legislation. There are also large areas of native vegetation that remain critical for connectivity with surrounding high-value biodiversity areas to the north and west. The protection and enhancement of these existing biodiversity values are important for ensuring that surrounding ecosystems are not impacted directly or indirectly by development and the location of the environmental protection area as displayed within the Masterplan is considered to play an important role in maintaining these values.

The existing areas of PFAS contamination do not diminish the importance of the environmental protection area,

13.2 Potential Opportunities

It is recognised that the current PFAS contamination levels throughout the SAP may constrain the potential for the environmental protection area to be set up as formal biodiversity stewardship site under the NSW Biodiversity Conservation Act 2016, however emerging research has identified strategies that can assist in meeting biodiversity needs while simultaneously exploring potential opportunities in remediating PFAS.

While adaptive management and mitigation methods are already in place within the Masterplan to avoid the mobilization of PFAS into surrounding ecosystems, additional passive remediation strategies can also be implemented that seek to further support and enhance biodiversity values

although it is important to note that the Masterplan is not aiming for the remediation of PFAS and it is understood that there are ongoing remedial efforts by Department of Defence.

As an example, the application of native plants in remediation strategies has been found to significantly lower PFAS contaminants from surface water (Awad, et al., 2022). Plants were applied using free floating artificial wetlands in open water and pre-established interchangeable baskets. Floating wetlands have already been attributed to improvements to ecosystem services such as water quality and biodiversity (Calheiros, Carecho, Tomasino, Almeida, & Mucha, 2020; Yeh, Yeh, & Chang, 2015), however have not been explicitly linked to the remediation of persistent pollutants. In the study three species of wetland plants were found to have significant capacity for PFAS remediation, *Phragmites australis, Baumea articulate* and *Juncus kraussii* (Figure 6). The SAP lies within the natural distribution of two of these species, *P. australis* and *J. kraussii,* which can be incorporated into restoration plantings within the constructed wetlands.

(left to right) Phragmates australis, Baumea articulata and Juncus krausii. Images from Seed Street, Colleen Miller and Katanning Landcare

Figure 6 Images of the three species found to significantly lower PFAS contamination levels.

In summary, the current PFAS contamination levels throughout the SAP may constrain the potential for the environmental protection area to be set up as formal biodiversity stewardship site under the NSW Biodiversity Conservation Act 2016, however it does not diminish the importance of the environmental protection area. There are also opportunities that can assist in meeting biodiversity needs including the careful selection of restoration plantings within the constructed wetlands.

14. INDIRECT IMPACTS

Indirect Impacts associated with the project are outlined in Table 14.1. Further assessment of indirect impacts associated with each stage of the project will be provided with the future BDAR.

Table 14.1 Indirect Impacts

Impact	Details	Frequency/Duration/Timing
Changes to hydrology	• Exposed soils have potential to cause sedimentation. • Pollutants including petrol/diesel, oil and lubricants may enter waterways in a spill event. • Analysis of impacts to Groundwater Ecosystems is provided in Section 12	During construction and ongoing. Impacts are already operational in some parts of the Structure Plan.
Soil disturbance	• Soil disturbance and presence of vehicles and equipment during construction may result in erosion.	During construction.
Weeds and Pests	• Introduction/spread of weeds and increased pest activity.	During construction and ongoing. Impacts are already operational in some parts of the Structure Plan.
Light and noise	• Light and noise spill from construction vehicles and equipment, and from developed areas during the operation phase.	During construction and ongoing. Impacts are already operational in some parts of the Structure Plan.

15. SUMMARY AND RECOMMENDATIONS

The majority of the vegetated areas within the Williamtown SAP comprise areas of high biodiversity value. A proportion of these values are within the DAREZ and/or the Environmental Protection Area. Areas within the DAREZ do not require further assessment. Areas within the Environment Protection Area would be subject to an assessment of indirect impacts. The high biodiversity values within the Williamtown SAP are summarised in Table 15.1.

Table 15.1 Summary of High Biodiversity Values

High Biodiversity Value	Location	Further Assessment Requirements
Important Mapped Area for the Swift Parrot	The majority is in the DAREZ and Environmental Protection Area. Impacts in the development area are a potential SAII	Direct impacts in the development area, and any associated indirect impacts, are a potential SAII and would be assessed in detail as part of a future BDAR.
Two (2) Threatened Ecological Communities (TEC): • Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions; and • Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions.	The majority is in the Environmental Protection Area. Also occurs in the DAREZ and development area. Occurs in the DAREZ only.	Impacts in the development area, and any associated indirect impacts, would be assessed in detail as part of a future BDAR. Further assessment is not required.
Extensive occurrence of Earps Gum	Occurs in the DAREZ only.	Further assessment is not required.
Extensive known habitat for a further three species credit species (Koala, Squirrel Glider and Wallum Froglet)	The majority of the known habitat is in the DAREZ and Environmental Protection Area. Small areas occur in the development area.	Impacts in the development area, and any associated indirect impacts, would be assessed in detail as part of a future BDAR.
Potential habitat for additional species credit species for which adequate survey could not be undertaken due to the survey timing and duration.	Potentially in the development area.	Impacts in the development area, and any associated indirect impacts, would be assessed in detail as part of a future BDAR.

The Structure Plan includes a large central corridor through the precinct that provides an important habitat linkage area leading to the adjacent Hunter Water land and Tilligerry State Conservation Area to the west. This Environmental Protection Area has been developed through a series of workshops and avoids large areas of these important habitat values. Based on the retention of this important central corridor, and assuming full clearing within the development precincts, the Williamtown SAP would require a total of:

- 51 ecosystem credits (indicative only)
- 87 species credits (indicative only)

15.1 Key Next Steps

At this stage the Biodiversity Assessment has considered the direct impacts of habitat clearance and provides indicative credit obligations in accordance with the BAM. These values are provided as indicative only as access to areas within the Williamtown SAP was limited to properties for which landowner permission was obtained. Detailed assessment across the entire SAP would be required to inform the delivery plan and any SSD application. This will require the preparation of a BDAR and an EPBC Referral.

Based on the current Structure Plan design, the Integrated Water Management and Flood Risk Assessment prepared by Aurecon (2022) indicates that moderate increases in freshwater runoff discharges to Fullerton Cove will occur as a result of the development. It is recommended that the impact of increased freshwater runoff and total nitrogen load on wetlands at Fullerton Cove be further assessed.

Any additional water that will flow into the retained habitats during major rainfall events may impact on the long term structure and diversity of existing swamp forest communities. This presents an opportunity for a university research project to be established (via student scholarship) to track and report on the effects of increased inundation on these swamp forests as critical information is rarely reported in the literature.

In summary, the following recommendations for additional assessment are:

- the impact of increased freshwater runoff and total nitrogen load on wetlands at Fullerton Cove be further assessed to support the delivery plan and EPBC referral.
- meet the BAM survey requirements for species with the potential to occur that have not been adequately surveyed. Once these species have been surveyed in accordance with the BAM requirements, and if they are not recorded, they can be removed from further assessment and will not require any credit obligations.

15.2 Avoidance

The BAM requires that the avoid, minimise, offset hierarchy is applied to development projects and therefore, any future BDAR will be required to outline measures taken to avoid impacts to biodiversity and provide justification where avoidance is not applied. This is clearly evidenced through the Enquiry by Design process, which tested the suitability of land based on biodiversity and other constraints, and the reduction in the Williamtown SAP from the original Investigation Area. The original Investigation Area comprised 11,408 ha of land within the Port Stephens LGA, which was subsequently reduced to three smaller scenarios, ranging in area from 3452 ha to 4409 ha, that were further investigated. Upon completion of field surveys, the impact area associated with the draft Structure Plan was further reduced to avoid areas of high biodiversity value within the Hunter Water Corporation land as it included TECs and known threatened species habitat in good condition.

The current Structure Plan includes a large central corridor through the precinct that provides an important habitat linkage area leading to the adjacent Tomaree National Park to the west. This Environmental Protection Area has been developed through a series of workshops and avoids large areas of habitat values. The Structure Plan also incorporates large areas of cleared land or land upon which development has already occurred, and areas of vegetation in poor condition. The information provided to date together with the avoidance of the identified high biodiversity values within the Environmental Protection Area provides a detailed baseline to support assessment of the Masterplan.

15.3 Minimisation

Habitat enhancement will be implemented throughout the internal flood mitigation areas, with constructed wetlands and adjacent plantings to comprise local native species. These areas will provide habitat and movement corridors through the Williamtown SAP for wetland species. These areas are connected to the Environment Protection Area, which will provide connectivity to the large areas of native vegetation to the north-west of the Williamtown SAP.

Detailed impact minimisation measures will be provided in further detail as part of a future BDAR, however, a number of performance criteria will be applied to the project and are provided in Table 15.2.

15.4 Meeting Offset Obligations

Under the BOS, there are three options available to meet an offset obligation:

- Purchase and retire credits from the market: If 'like for like' credits are available on the biodiversity credits market, the offset obligation can be met by purchasing and retiring these credits. The offset obligation is satisfied upon retirement of the credits. The price of the credits is negotiated with the credit owner. Availability of credits is limited and would need to be sourced from multiple properties. Where sourcing of credits is difficult, the offset variation rules can be applied, which broaden the 'like for like' rules.
- Establish a Biodiversity Stewardship Site: The BAM is used to identify the biodiversity values at a Stewardship Site and, where the credits generated at the property meet the 'like for like' requirements, the credits are retired to meet the offset obligations associated with development. Upon retirement of the credits, the offset obligation is satisfied, however, the landowner is required to manage the stewardship site in perpetuity in accordance with a Management Action Plan. Establishment of a Biodiversity Stewardship Site can be costly and time consuming and it is unlikely that the entire offset obligation can be met at a single Biodiversity Stewardship Site.
- Payment to the Biodiversity Conservation Fund: the cost of payment into the Biodiversity Conservation Fund is calculated using the offsets payment calculator. Upon payment into the Biodiversity Conservation Fund, the offset obligation is satisfied. The Biodiversity Conservation Fund is then responsible for identifying and securing the credits.

15.5 EPBC Act Offsets

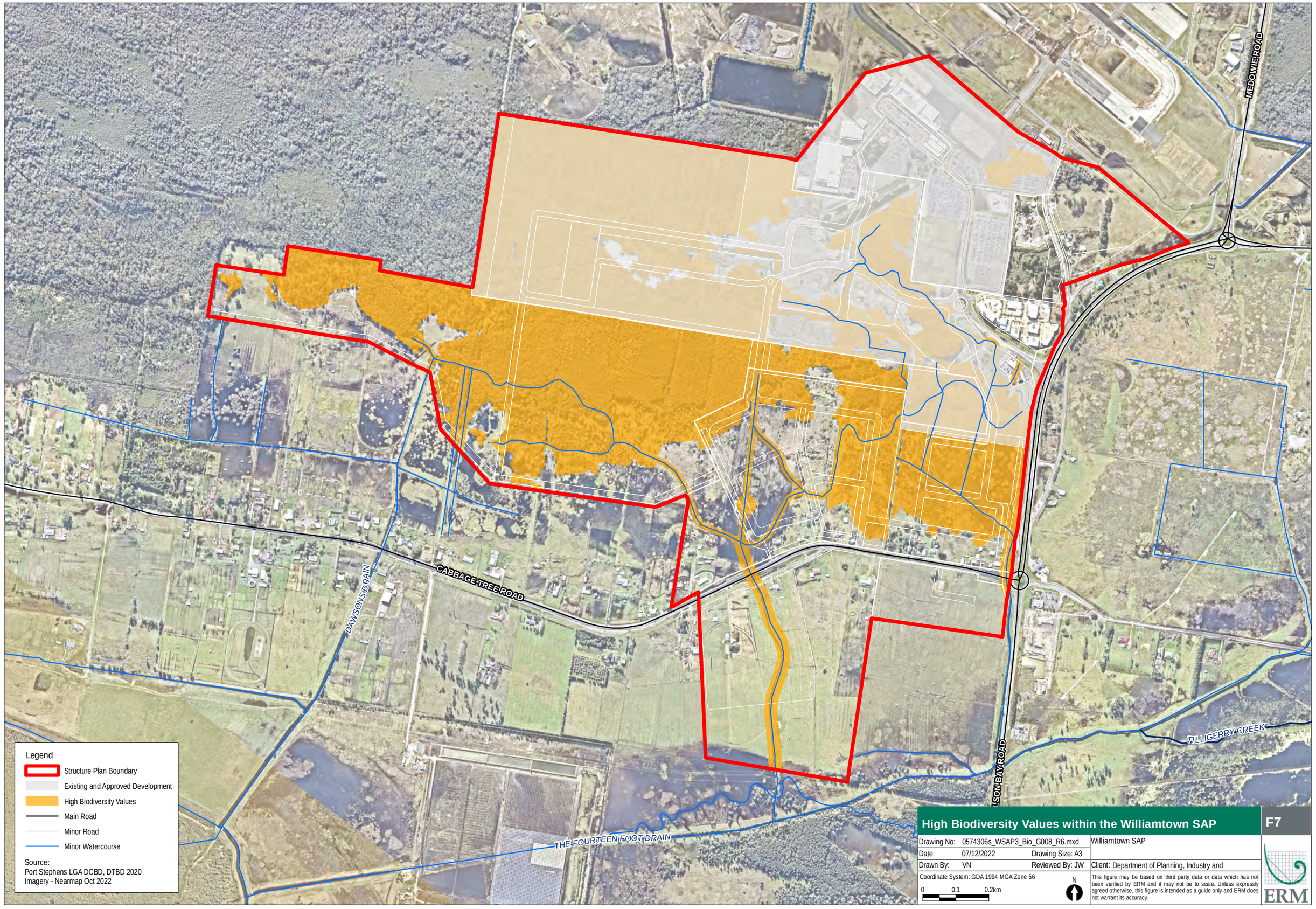
The BOS has been endorsed by the Australian Government in accordance with an Assessment Bilateral Agreement between the NSW and Australian governments. Major projects with an offset obligation in relation to MNES can use the BOS to meet the offset obligations and the BAM to calculate the credit requirement.

15.6 Proposed Performance Criteria – Biodiversity

Key specifications and requirements to assist in the development of the Masterplan are provided in Table 15.2. Areas of high biodiversity value are identified in Figure 7.

Table 15.2 Proposed Performance Criteria – Biodiversity

Performance Criteria No.	Performance Criteria Description
1	Apply the avoid, minimise and offset hierarchy: 1. Avoid areas of high biodiversity value. In particular: a) Matters of National Environmental Significance b) Threatened Ecological Communities c) Threatened species populations/habitat d) Vegetation and habitat linkages e) Native vegetation f) 1st and 2nd order streams 2. Minimise direct and indirect impacts to biodiversity values 3. Offset any remaining impacts to biodiversity values in accordance with the BOS
2	Maximise retention of existing biodiversity values where possible by incorporating key features into development design e.g. retain existing vegetation and habitat in landscaped and drainage areas.
3	Enhance the biodiversity value of cleared/developed areas by: 1. Using local native species for landscaping and constructed wetlands. 2. Species used in landscaping are to include those that are important to threatened native species, e.g. Swamp Mahogany. 3. Creation of microhabitat for native species using items removed during development such as tree hollows, logs and rocks.
4	Establish long term objectives and protection mechanisms for the Environment Protection Area and neighbouring sensitive areas (i.e. Hunter Water land) including: 1. Ongoing monitoring and management of biodiversity values within the Environment Protection Area 2. Establish control measures to prevent impacts, such as release of pollutants and spread of weeds, during the construction and operation phases. 3. Establish control measures to increase the sensitivity of development to the Environment Protection Area and neighboring sensitive areas. Control measures may include use of wildlife safe fencing, retention of vegetated buffers along boundaries and directing artificial lighting and noise away from these areas.



High Biodiversity Values within the Williamtown SAP

F7

Drawing No:	0574306s_WSAP3_Bio_G008_R6.mxd		Williamtown SAP
Date:	07/12/2022	Drawing Size: A3	
Drawn By:	VN	Reviewed By: JW	Client: Department of Planning, Industry and

Coordinate System: GDA 1994 MGA Zone 56

0 0.1 0.2km

N

This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

ERM

16. REFERENCES

ALA (2021) Atlas of Living Australia. search https://www.ala.org.au/

Aurecon (2022) Williamtown SAP Integrated Water Management Plan and Flood Risk Assessment. Report prepared for DPE.

Bell (2006) Status, distribution and habitat of Eucalyptus parramattensis subsp. decadens.

Bell and Driscoll (2010) Worimi Conservation Lands vegetation classification and mapping. https://worimiconservationlands.com/wp-content/uploads/2016/02/Vegetation-of-the-Worimi-Conservation-Lands-Bell-2010-2-1-1-1.compressed.pdf Bureau of Meteorology (2021) Groundwater Dependent Ecosystems Atlas. Retrieved from http://www.bom.gov.au/water/groundwater/gde/map.shtml

Bell, S.A.J. & Driscoll, C. (2006) Vegetation of the Tomago and Tomaree Sandbeds, Port Stephens, New South Wales: Management of Groundwater Dependent Ecosystems. Part 1 – Vegetation Classification. Unpublished Report to Hunter Water. Eastcoast Flora Survey. September 2006.

DEC (2004). Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities. Working Draft. Department of Environment and Conservation (NSW).

DECC. (2009). Lower Hunter Regional Conservation Plan. Sydney South: Department of Environment, Climate Change and Water NSW.

Department of Customer Service. (2020). Biodiversity Values Map and Threshold Tool. Retrieved from https://www.lmbc.nsw.gov.au/Maps/index.html?viewer=BOSETMap

DPIE (2019) Soil Landscapes of the Port Stephens 1:100,000 map sheet: Tea Gardens. https://www.environment.nsw.gov.au/Salis5app/resources/spade/reports/9232tna.pdf

DPIE (2020a) Surveying Threatened Plants and Their Habitats. https://www.environment.nsw.gov.au/research-and-publications/publications-search/surveying-threatened-plants-and-their-habitats-survey-guide-for-the-biodiversity-assessment-method

DPIE (2020b) NSW Survey Guide for Threatened Frogs: A guide for the survey of threatened frogs and their habitats for the Biodiversity Assessment Method. https://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Animals-and-plants/Threatened-species/nsw-survey-guide-for-threatened-frogs-200440.pdf

DPIE (2020c) Biodiversity Assessment Method https://www.environment.nsw.gov.au/topics/animals-and-plants/biodiversity-offsets-scheme/accredited-assessors/biodiversity-assessment-method-2020

Driscoll, C. & Bell, S.A.J. (2006) Vegetation of the Tomago and Tomaree Sandbeds, Port Stephens, New South Wales: Management of Groundwater Dependent Ecosystems. Part 2 – Groundwater Dependency. Unpublished Report to Hunter Water. Eastcoast Flora Survey. September 2006.

ERM (2020) Williamtown Special Activation Precinct: Biodiversity Baseline Report. Unpublished report prepared for DPIE.

ERM (2021) Williamtown Special Activation Precinct: Biodiversity Scenario Analysis. Unpublished report prepared for DPIE.

GHD (2007). Airport/Defence Related Employment Zone (Williamtown): Ecology Report. Report prepared for Dept of Planning, February 2007.

Jacobs (2016) Tomago Biodiversity Assessment Report. Unpublished report prepared for Hunter Water Corporation.

LHCCREMS (2003) Lower Hunter and Central Coast Regional Biodiversity Conservation Strategy Technical Report, Callaghan NSW.

Murray, M. (2006). Targeted Threatened Fauna Survey, Salt Ash Air Weapons Range, Port Stephens. Report prepared for Department of Defence (Project CNN 774) by Forest Fauna Surveys Pty Ltd.

OEH (2018) Species credit' threatened bats and their habitats: NSW survey guide for the Biodiversity Assessment Method. https://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Animals-and-plants/Threatened-species/species-credit-threatened-bats-survey-guide-180466.pdf

OEH (2021). BioNet Atlas Database Search. 20 May 2021.

OEH. (2020, November). Threatened Species found in Karuah Manning IBRA sub-region. Retrieved from NSW Environment, Energy and Science: https://www.environment.nsw.gov.au/threatenedspeciesapp/cmaSearchResults.aspx?SubCmaId=341

Port Stephens Council. (2002). Comprehensive Koala Plan of Management. Retrieved from http://www.portstephens.nsw.gov.au/trim/other?RecordNumber=18%2F200915

Resource Planning (1993). Plan of Management, Lot 2 (Part Portion 3), Parish of Stowell, Stockton – Fern Bay, Newcastle Bight. Report prepared for Boral Resources (Country) Pty Ltd by Resource Planning Pty Ltd, December 1993.

Williams, D (Ed.) (2020). Hunter Region of New South Wales Annual Bird Report Number 27 (2019). Produced by Hunter Bird Observers Club Inc, New Lambton, Australia.

APPENDIX A PCT DESCRIPTIONS

PCT1646: Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast

General Description

PCT1646 occurs in elevated areas of the Williamtown SAP and comprises an open forest with a canopy dominated by *Angophora costata* (Smooth-barked Apple) and *Corymbia gummifera* (Red Bloodwood). The mid-stratum is characterized by *Monotoca elliptica* (Tree Broom-heath), *Acacia ulicifolia* (Prickly Moses), and *Banksia aemula* (Wallum Banksia), with *Eucalyptus robusta* (Swamp Mahogany) and *Glochidion ferdinandi* (Cheese Tree) also occurring. The ground stratum is largely dominated by *Pteridium esculentum* (Bracken Fern), with *Dianella caerulea* (Blue Flax-lily), *Pomax umbellata* and *Lomandra longifolia* (Spiny-headed Mat-rush) also occurring. (A full species list for the PCT is provided in 0).

Key features associated with the PCT.

Feature	PCT1646
Vegetation Class	Coastal Dune Dry Sclerophyll Forests
Percent Cleared Value of PCT	45
Equivalence with mapping units of previous vegetation maps	Coastal Sand Apple Blackbutt Forest (LHCCREMS (2003)
Vegetation Zones	The PCT occurs in three broad condition types and therefore has been assigned to three separate vegetation zones: good, canopy only and regrowth. The area in good condition comprises a diverse native canopy, mid-stratum and understorey with a sparse weed cover. The canopy only vegetation zone comprises mature canopy trees with an exotic grass understorey. Native shrubs and groundcover do not occur or are very sparse as the area is used for grazing. The regrowth area largely lacks a canopy due to previous clearing, with only juvenile canopy plants occurring. The native species assemblage is diverse, however, there are more weed species with a higher percent cover than areas in good condition.
TEC	PCT is not associated with any TECs in the BAM Calculator.
Area in development zone (ha)	Good: 0.06 Canopy only: 0.0 Regrowth: 0.54 Total: 0.6
Area in environment zone (ha)	Good: 2.88 Canopy only: 0.5 Regrowth: 1.68 Total: 5.06
Area in flood mitigation area (ha)	0.0

PCT1646 from start of midline of Plot SAP12

Justification for PCT Selection

PCT1646 was considered to be the best-fit PCT as the community profile description and the vegetation at the Williamtown SAP share the following features and associations.

Diagnostic Feature	BioNet Vegetation Classification Community Profile for PCT 1646	PCT1646 at Williamtown SAP
Associated IBRA region / subregion	New South Wales North Coast/ South Eastern Queensland / Mummel Escarpment (and others)	New South Wales North Coast
Description	Open forest or woodland	Open forest (fire affected in some parts).
Landscape Position	On Quaternary dune sands at elevations up to 100m	The Williamtown SAP is within the Tea Gardens soil landscape, which includes broad, irregular sandy rises (DPIE 2019). PCT1646 occurs on sandy rises.
Diagnostic Species	Twelve diagnostic species including: three canopy species, four mid-stratum species and five groundcover species.	Seven of the twelve diagnostic species were recorded at the Williamtown SAP including: two canopy species, two mid-stratum species and three groundcover species. In particular, the following species were observed throughout the PCT and used in the selection of PCT1646: **Canopy:** Smooth-barked Apple: recorded in four plots. Red Bloodwood: recorded in three plots **Mid-stratum**: Tree Broom Heath: recorded in five plots. Prickly Moses*:* recorded in three plots. **Groundcover species**: Bracken Fern: recorded in four plots. Blue Flax-lily: recorded in five plots. *Lomandra longifolia:* recorded in one plot.

PCT1637 Scribbly gum - Wallum Banksia - Prickly-leaved Paperbark heathy coastal woodland on coastal lowlands

General Description

PCT1637 at the Williamtown SAP comprises a healthy woodland with a canopy dominated by *Eucalyptus saligna* (Scribbly Gum) with Angophora costata (Smooth-barked Apple) also occurring throughout. Mid-storey species include *Banksia aemula* (Wallum Banksia), *Bossiaea heterophylla, Acacia longifolia* (Sydney Golden Wattle), *Banksia spp*, *Callistemon spp* and *Dillwynia retorta*. The ground stratum is largely dominated by *Pteridium esculentum* (Bracken Fern), with G*eranium spp*., *Leptocarpus tenax* (Slender Twine-rush), *Leptospermum polygalifolium* (Jelly Bush), and *Melaleuca nodosa* (Prickly-leaved Paperbark) also occurring. (A full species list for the PCT is provided in Appendix B).

Key features associated with PCT1637.

Feature	PCT1637
Vegetation Class	Coastal Dune Dry Sclerophyll Forests
Percent Cleared Value of PCT	42
Equivalence with mapping units of previous vegetation maps	Scribbly Gum Apple Bloodwood Forest (LHCCREMS (2003)
Vegetation Zones	The PCT occurs in one broad condition type: good. The area in good condition comprises a diverse native canopy, mid-stratum and understorey with a sparse weed cover.
TEC	The PCT is not associated with any TECs in the BAM Calculator.
Area in development zone (ha)	N/A occurs in DAREZ only
Area in environment zone (ha)	N/A occurs in DAREZ only
Area in flood mitigation (ha)	N/A occurs in DAREZ only

PCT1637 (external to Williamtown SAP)

Justification for PCT Selection

PCT1637 was considered to be the best-fit PCT as the community profile description and the vegetation at the Williamtown SAP share the following features and associations.

Diagnostic Feature	BioNet Vegetation Classification Community Profile for PCT 1637	PCT1637 at Williamtown SAP
Associated IBRA region / subregion	New South Wales North Coast/ Macleay Hastings (and others)	New South Wales North Coast/ Macleay Hastings
Description	Heathy Woodlands	Heathy Woodlands
Landscape Position	Swamps; coastal	Occurs between the irregular sandy rises and poorly drained swales and deflation basins of the Tea Gardens soil landscape.
Diagnostic Species	Fourteen diagnostic species including: one canopy species, eight mid-stratum species and five groundcover species.	Five of the fourteen diagnostic species were recorded at the Williamtown SAP including: one canopy species and four mid-storey stratum species. In particular, the following species were observed throughout the PCT and used in the selection of PCT1637: Canopy: Scribbly Gum: recorded in two plots. Mid-stratum: Wallum Banksia: recorded in one plot. Jelly Bush: recorded in two plots. Prickly-leaved Paperbark: recorded in one plot. *Bossiaea heterophylla*: recorded in one plot

PCT1725: Swamp Mahogany - Broad-leaved Paperbark - Swamp Water Fern - Plume Rush swamp forest on coastal lowlands of the Central Coast and Lower North

General Description

PCT1725 at the Williamtown SAP comprises a swampy open forest with a canopy dominated by *Eucalyptus robusta* (Swamp Mahogany) with *Melaleuca quinquenervia* (Broad-leaved paperbark) also occurring frequently. Commonly occurring mid-storey species include *Banksia aemula* (Wallam Banksia), *Callstemon citrinus* (Crimson Bottlebrush)*, Melaleuca thymifolia* (Thyme-leaf Honey-myrtle) and *Leptospermum spp.*. The ground stratum is dominated by grass species including *Leptocarpus tenax* (Slender Twine-rush) and *Schoenus spp.* with *Blechnum indicum* (Swamp Water Fern)*, Imperata cylindrical* (Blady Grass*),* and *Dianella caearulae* (Blue Flax-lily), also occurring. (A full species list for the PCT is provided in Appendix B). Occurs in low-lying, wetter areas.

Key features associated with the PCT

Feature	PCT1725
Vegetation Class	Coastal Swamp Forests
Percent Cleared Value of PCT	35
Equivalence with mapping units of previous vegetation maps	Swamp Mahogany Forest (LHCCREMS (2003)
Vegetation Zones	The PCT occurs in two broad condition types: good and regrowth. The area in good condition comprises a diverse native canopy, mid-stratum and understorey with a sparse weed cover. The regrowth area is dominated by Broad-leaved Paperbark, with very sparse Swamp Mahogany.
TEC	PCT 1725 is associated with the Endangered BC Act listed TEC: *Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions.*
Area in development zone (ha)	Good: 0.0 Regrowth: N/A occurs in DAREZ only Total: 0.0
Area in environment zone (ha)	Good: 2.56 Regrowth: N/A occurs in DAREZ only Total: 2.56
Area in flood mitigation (ha)	Good: 0.0 Regrowth: N/A occurs in DAREZ only Total: 0.0

PCT1725 (external to Williamtown SAP)

Justification for PCT Selection

PCT1725 was considered to be the best-fit PCT as the community profile description and the vegetation at the Williamtown SAP share the following features and associations.

Diagnostic Feature	BioNet Vegetation Classification Community Profile for PCT 1725	PCT1725 at Williamtown SAP
Associated IBRA region / subregion	New South Wales North Coast/ Macleay Hastings (and others)	New South Wales North Coast/ Macleay Hastings
Description	Swamp Open Forest	Swamp Open Forest
Landscape Position	Sublittoral swamps; lake margins | Footslopes. This community occurs on alluvial sands and muds at poorly drained sites. Elevations usually less than 40m	Occurs in the poorly drained swales and deflation basins of the Tea Gardens soil landscape. Not as poorly drained as areas of PCT1724.
Diagnostic Species	Eleven diagnostic species including: two canopy species, three mid-stratum species and six groundcover species.	Five of the eleven diagnostic species were recorded at the Williamtown SAP including: two canopy species and three groundcover species. In particular, the following species were observed throughout the PCT and used in the selection of PCT1725: **Canopy:** Swamp Mahogany: recorded in one plot. Broad-leaved Paperbark: recorded in one plot **Groundcover species**: Swamp Water Fern: recorded in one plot. Blue Flax-lily: recorded in one plot. Blady Grass: recorded in one plot.

PCT1651: Parramatta red gum - Fern-leaved banksia - Melaleuca sieberi swamp woodland of the Tomaree Peninsula

General Description

PCT1651 at the Williamtown SAP comprises of swampy woodlands with a canopy dominated by *Eucalyptus parramattensis subsp. Decadens* (Parramatta Red Gum) with *Eucalyptus robusta* (Swamp Mahogany) also occurring frequently. Commonly occurring mid-storey species include *Melaleuca sieberi, Banksia oblongif*olia (Fern-leaved Banksia), *Hakea teretifolia* (Dagger Hakea), *Persoonia lanceolata* (Lance Leaf Geebung), *Callistemon pachyphyllus* (Wallum Bottlebrush), *Acacia longifolia* (Sydney Golden Wattle) and *Leptospermum polygalifolium* (Tantoon). The ground stratum is dominated by grass species including *Typha orientalis* (Bulrush), *Leptocarpus tenax* (Slender Twine-rush) and *Schoenus spp.* with *Melaleuca thymifolia* (Thyme-leaf Honey-myrtle) and *Pteridium esculentum* (Bracken Fern) also occurring. (A full species list for the PCT is provided in 0).

Key features associated with the PCT

Feature	PCT1651
Vegetation Class	Coastal Floodplains Wetlands
Percent Cleared Value of PCT	75
Equivalence with mapping units of previous vegetation maps	Earps Gum Sedge Woodland (LHCCREMS 2003)
Vegetation Zones	The PCT occurs in one broad condition type: good. The area in good condition comprises a diverse native canopy, mid-stratum and understorey with a sparse weed cover.
TEC	PCT is not associated with any TECs in the BAM Calculator.
Area in development zone (ha)	N/A occurs in DAREZ only
Area in environment zone (ha)	N/A occurs in DAREZ only
Area in flood mitigation (ha)	N/A occurs in DAREZ only

PCT1651 from start of midline of Plot SAP8

Justification for PCT Selection

PCT1651 was considered to be the best-fit PCT as the community profile description and the vegetation at the Williamtown SAP share the following features and associations.

Diagnostic Feature	BioNet Vegetation Classification Community Profile for PCT 1651	PCT1651 at Williamtown SAP
Associated IBRA region / subregion	New South Wales North Coast/ Karuah Manning (and others)	New South Wales North Coast/ Karuah Manning
Description	Swamp Woodlands	Swamp Woodlands
Landscape Position	Sublittoral swamps; Confined to the Tomaree sandbeds with elevations usually below 10m	Occurs in the poorly drained swales and deflation basins of the Tea Gardens soil landscape.
Diagnostic Species	Fifteen diagnostic species including: one canopy species, nine mid-stratum species and five groundcover species.	Nine of the fifteen diagnostic species were recorded at the Williamtown SAP including: one canopy species and eight mid-stratum species. In particular, the following species were observed throughout the PCT and used in the selection of PCT1651: **Canopy:** Parramatta Red Gum: recorded in two plots. **Mid-stratum**: Thyme Honey-myrtle: located in one plot *Melaleuca sieberi*: located in one plot Fern-leaved Banksia: located in one plot Tantoon: located in two plots Lance Leaf Geebung: located in two plots Needlebush: located in one plot Wallum Bottlebrush: located in one plot *Acacia longifolia*: located in one plot

PCT1734: Wallum Bottlebrush - Leptocarpus tenax - Baloskion pallens Wallum sedge heath of the lower North Coast

General Description

PCT1734 at the Williamtown SAP comprises a swampy tall shrubland with a mixed mid-storey consisting predominately of *Banksia oblongif*olia (Fern-leaved Banksia), *Callistemon pachyphyllus* (Wallum Bottlebrush), and *Hakea teretifolio* (Needlebush) species with *Melaleuca sieberi* also occurring. The ground stratum is dominated by sedges including *Leptocarpus tenax* (Slender Twine-rush) and *Schoenus brevifolius* with *Xyris operculata* (Tall yellow-eye) also occurring. (A full species list for the PCT is provided in Appendix B).

Key features associated with the PCT.

Feature	PCT1734
Vegetation Class	Coastal Heath Swamps
Percent Cleared Value of PCT	44
Equivalence with mapping units of previous vegetation maps	Clay Wallum Scrub (LHCCREMS 2003)
Vegetation Zones	The PCT occurs in one broad condition type: good. The area in good condition comprises diverse and dense shrub and ground layers with a sparse weed cover.
TEC	PCT is not associated with any TECs in the BAM Calculator.
Area in development zone (ha)	N/A occurs in DAREZ only
Area in environment zone (ha)	N/A occurs in DAREZ only
Area in flood mitigation (ha)	N/A occurs in DAREZ only

PCT1734 (external to Williamtown SAP)

Justification for PCT Selection

PCT1734 was considered to be the best-fit PCT as the community profile description and the vegetation at the Williamtown SAP share the following features and associations.

Diagnostic Feature	BioNet Vegetation Classification Community Profile for PCT 1734	PCT1734 at Williamtown SAP
Associated IBRA region / subregion	New South Wales North Coast/ Karuah Manning (and others)	New South Wales North Coast/ Karuah Manning
Description	Swampy tall shrublands	Swampy tall shrublands
Landscape Position	Flat (swamps)	Occurs in the poorly drained swales and deflation basins of the Tea Gardens soil landscape.
Diagnostic Species	Fourteen diagnostic species including: six mid-stratum species and eight groundcover species.	Six of the fourteen diagnostic species were recorded at the Williamtown SAP including: three mid-stratum species and three ground layer species. In particular, the following species were observed throughout the PCT and used in the selection of PCT1374: **Mid-Stratum:** Fern-leaved Banksia: located in one plot Needlebush: located in one plot *Melaleuca sieberi*: located in one plot **Groundlayer**: Thyme Honey-myrtle: located in one plot Slender Twine-rush: located in one plot *Schoenus brevifolus*: located in one plot *Xyris operculata*: located in one plot

PCT1724: Broad-leaved Paperbark - Swamp Oak - Saw Sedge swamp forest on coastal lowlands of the Central Coast and Lower North Coast

General Description

PCT1724 at the Williamtown SAP comprises a swampy open forest with a canopy dominated by *Melaleuca quinquenervia* (Broad-leaved Paperbark).*Casuarina Glauca* (Swamp Oak) occurred on occasion within the mid-storey. *Gahnia clarkei* (Tall Saw-sedge) occurred commonly within the ground stratum which also consisted of *Philydrum lanuginosum* (Woolly Waterlily), *Telmatoblechnum indicum* (Swamp Water Fern), and *Centella asiatica* (Gotu kola). (A full species list for the PCT is provided in Appendix B).

Key features associated with the PCT

Feature	PCT1724
Vegetation Class	Coastal Swamp forests
Percent Cleared Value of PCT	31
Equivalence with mapping units of previous vegetation maps	Freshwater Wetland Complex (LHCCREMS 2003)
Vegetation Zones	The PCT occurs in two broad condition types: inundated and low. The inundated area comprises a native canopy dominated by Broad-leaved Paperbark and a sparse native mid-stratum and understorey. Weed cover is sparse. The area in low condition has largely been cleared of Broad-leaved Paperbark and the remaining groundlayer is a mix of native and exotic species.
TEC	PCT is associated with the Endangered BC Act TEC: *Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions*
Area in development zone (ha)	Inundated: 3.84 Low: 4.47 Total: 8.31
Area in environment zone (ha)	Good: 25.86 Low: 10.4 Total: 36.26
Area in flood mitigation (ha)	Good: 0.01 Low: 1.66 Total: 1.67

PCT1724 from start of midline of Plot SAP13

Justification for PCT Selection

PCT1724 was considered to be the best-fit PCT as the community profile description and the vegetation at the Williamtown SAP share the following features and associations

Diagnostic Feature	BioNet Vegetation Classification Community Profile for PCT 1724	PCT1724 at Williamtown SAP
Associated IBRA region / subregion	New South Wales North Coast/ Macleay Hastings (and others)	New South Wales North Coast/ Macleay Hastings
Description	Swamp Open Forest	Swamp Open Forest
Landscape Position	Lagoon and Lake margins; sub-littoral swamps and footslopes	Occurs in the poorly drained swales and deflation basins of the Tea Gardens soil landscape.
Diagnostic Species	Twelve diagnostic species including: three canopy species, three mid-stratum species and six groundcover species.	Four of the twelve diagnostic species were recorded at the Williamtown SAP including: one canopy species, one mid-stratum species and two groundcover species. In particular, the following species were observed throughout the PCT and used in the selection of PCT1724: **Canopy:** Broad-leaved Paperbark: recorded in five plots. **Mid-stratum**: Swamp Oak: recorded in one plot. **Groundcover species**: Tall Saw-sedge: recorded in five plots. Swamp Water Fern: recorded in two plots.

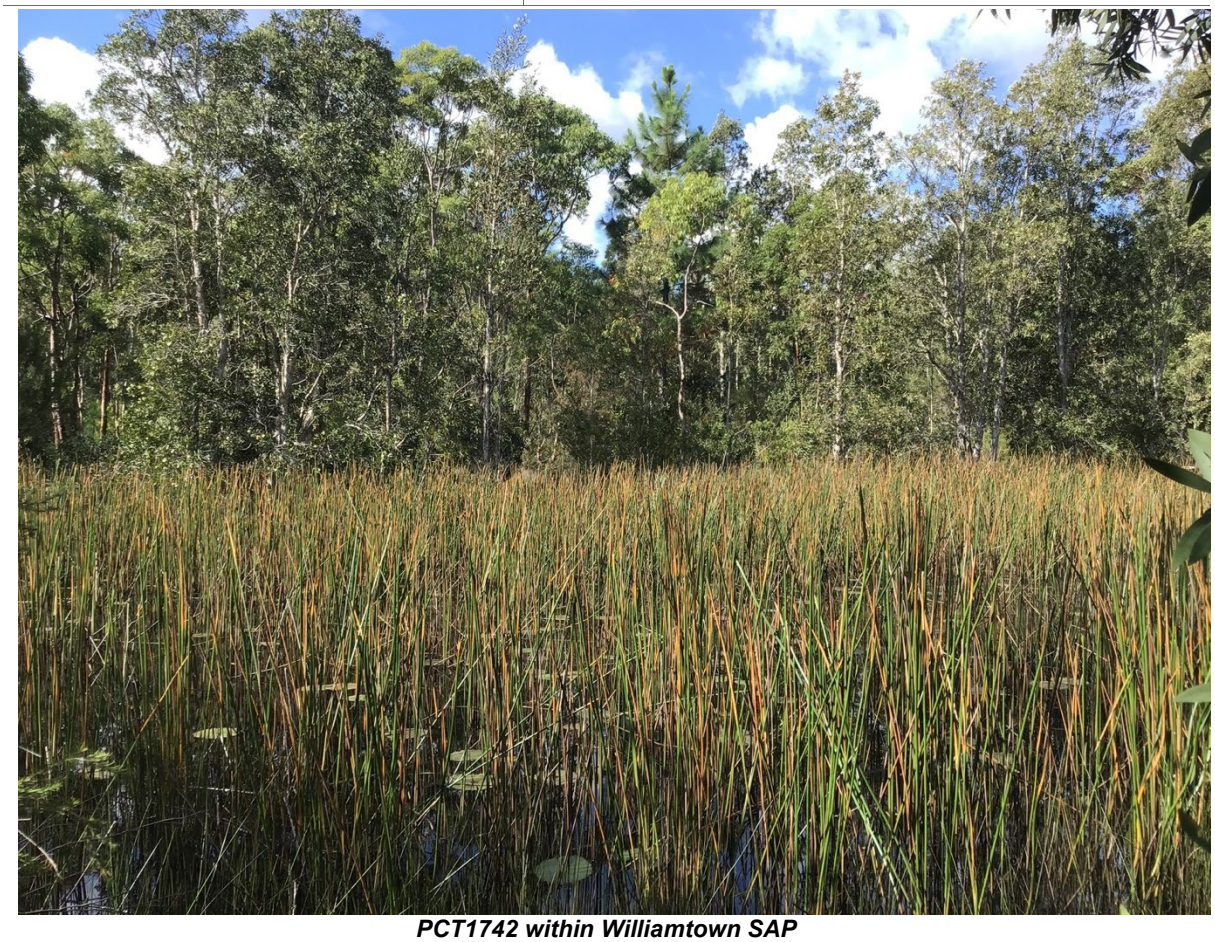
PCT1742: Jointed Twig-rush sedgeland

General Description

PCT1742 comprises a freshwater wetland with a variety of rushes and aquatic species such as *Baumea articulata* (Jointed Twig-rush), *Baumea juncea* and *Eleocharis sphacelata* (Tall Spike-rush). Scattered Broad-leaved Paperbark also occur.

Key features associated with the PCT

Feature	PCT61724
Vegetation Class	Coastal Freshwater Lagoons
Percent Cleared Value of PCT	70
Equivalence with mapping units of previous vegetation maps	Freshwater Wetland Complex (LHCCREMS 2003)
Vegetation Zones	The PCT occurs in one broad condition types: good.
TEC	PCT is associated with the Endangered BC Act TEC: *Freshwater wetlands on coastal floodplains of the NSW North Coast| Sydney Basin and South East Corner bioregions*
Area in development zone (ha)	N/A occurs in DAREZ only
Area in environment zone (ha)	N/A occurs in DAREZ only
Area in flood mitigation (ha)	N/A occurs in DAREZ only



PCT1742 within Williamtown SAP

Justification for PCT Selection

PCT1742 was considered to be the best-fit PCT as the community profile description and the vegetation at the Williamtown SAP share the following features and associations

Diagnostic Feature	BioNet Vegetation Classification Community Profile for PCT 1742	PCT1742 at Williamtown SAP
Associated IBRA region / subregion	New South Wales North Coast/ Macleay Hastings (and others)	New South Wales North Coast/ Macleay Hastings
Description	Baumea dominated Sedgelands occasionally with Melaleuca emergents. A number of wetland species co-occur depending on local.	Sedgeland with Melaleuca emergent and a variety of wetland species.
Landscape Position	This community occurs on poorly drained to inundated coastal sands and muds from Wyong to Failford at elevations of less than 20m.	Occurs in the poorly drained areas scattered through the Williamtown SAP.
Diagnostic Species	Eight diagnostic species including: one canopy species and seven aquatic ground species.	BAM plots have not been undertaken for the PCT, however, observations of the PCT indicate that at least four diagnostic species occur. In particular, the following species were observed: **Canopy:** Broad-leaved Paperbark. **Groundcover species**: Jointed Twig-rush. Tall Spike-rush *Phylidrum lanuginosum* (Frogsmouth)

APPENDIX B FLORA SPECIES LIST

Appendix B: Flora Species List

Plant Species	Growth Form	SA P1	SA P2	SA P3	SA P4	SA P5	SA P6	SA P7	SA P8	SA P9	SA P10	SA P11	SA P12	SA P13	SA P14	SA P15	SA P16	SA P17	SA P18	SA P19	SA P20
Acacia elongata	Shrub		✓															✓		✓	✓
Acacia longifolia	Shrub	✓	✓		✓				✓		✓	✓	✓					✓	✓		✓
Acacia ulicifolia	Shrub	✓	✓								✓	✓									
Acianthus spp.	Forb										✓	✓	✓								
Alternanthera philoxeroides	HTW														✓	✓	✓				
Andropogon virginicus	HTW										✓										
Angophora costata	Tree	✓	✓								✓	✓	✓							✓	✓
Baloskion tetraphyllum subsp. meiostachyum	Grass		✓						✓												
Banksia aemula	Tree	✓	✓		✓						✓	✓	✓								
Banksia oblongifolia	Shrub								✓									✓	✓	✓	✓
Banksia robur	Shrub																				✓
Banksia spinulosa	Shrub																			✓	✓
Baumea articulata	Grass																	✓			
Billardiera scandens	Other																		✓	✓	
Bolboschoenus caldwellii	Grass															✓	✓				
Boronia parviflora	Forb																				✓
Bossiaea heterophylla	Shrub	✓																			
Bossiaea obcordata	Shrub												✓								
Breynia oblongifolia	Shrub		✓		✓																

Plant Species	Growth Form	SA P1	SA P2	SA P3	SA P4	SA P5	SA P6	SA P7	SA P8	SA P9	SA P10	SA P11	SA P12	SA P13	SA P14	SA P15	SA P16	SA P17	SA P18	SA P19	SA P20
Callistemon citrinus	Shrub																	✓	✓	✓	✓
Callistemon pachyphyllus	Shrub								✓										✓		
Cassytha glabella	Other								✓									✓	✓	✓	✓
Casuarina glauca	Tree			✓											✓	✓	✓				
Centella asiatica	Forb									✓											✓
Cirsium vulgare (Spear thistle)	Exotic															✓	✓				
Conyza species (Fleabane)	Exotic				✓						✓				✓	✓	✓				
Corymbia gummifera	Tree										✓	✓	✓								
Cyperus eragrostis	HTW															✓	✓				
Damasonium minus	Forb			✓						✓											✓
Dampiera stricta	Forb	✓																			
Daucus glochidiatus	Frob																✓				
Desmodium rhytidophyllum	Forb											✓									
Dianella caerulea	Forb	✓	✓		✓						✓	✓	✓							✓	✓
Dillwynia retorta	Shrub	✓																			
Dillwynia spp.	Shrub																		✓		
Empodisma minus																				✓	✓
Entolasia marginata	Grass																				✓
Entolasia stricta	Grass								✓												
Eragrostis brownii	Grass				✓																

Plant Species	Growth Form	SA P1	SA P2	SA P3	SA P4	SA P5	SA P6	SA P7	SA P8	SA P9	SA P10	SA P11	SA P12	SA P13	SA P14	SA P15	SA P16	SA P17	SA P18	SA P19	SA P20
Eragrostis curvula	HTW				✓																
Eragrostis spp.	Grass										✓										
Eucalyptus parramattensis subsp. Decadens	Tree								✓											✓	
Eucalyptus robusta	Tree		✓						✓											✓	✓
Eucalyptus signata	Tree	✓																	✓		
Gahnia clarkei	Grass		✓	✓		✓	✓		✓	✓				✓					✓	✓	✓
Gahnia spp.	Grass																	✓			
Geranium spp.	Forb																		✓	✓	
Glochidion ferdinandi	Tree											✓	✓								✓
Gompholobium pinnatum	Shrub																		✓	✓	
Gompholobium virgatum	Shrub	✓																			
Gonocarpus teucrioides	Forb												✓								✓
Haemodorum planifolium	Forb																		✓		
Hakea sericea	Shrub																			✓	
Hakea teretifolia	Shrub								✓									✓			
Hibbertia linearis	Shrub				✓						✓	✓									
Hibbertia salicifolia	Shrub	✓																			
Homalanthus populifolius	Shrub				✓					✓											
Imperata cylindrica	Grass																				✓
Ipomoea indica	HTW							✓													
Isachne globosa	Grass						✓														

Plant Species	Growth Form	SA P1	SA P2	SA P3	SA P4	SA P5	SA P6	SA P7	SA P8	SA P9	SA P10	SA P11	SA P12	SA P13	SA P14	SA P15	SA P16	SA P17	SA P18	SA P19	SA P20
Kennedia rubicunda	Other		✓																		
Lantana camara	HTW				✓																
Leptocarpus tenax	Grass																	✓	✓	✓	✓
Leptospermum juniperinum	Shrub								✓	✓								✓			✓
Leptospermum polygalifolium	Shrub	✓							✓										✓	✓	✓
Leptospermum spp.	Shrub																		✓		
Lepyrodia scariosa	Grass																	✓		✓	✓
Leucopogon lanceolatus	Shrub		✓																		
Leucopogon spp.	Shrub	✓							✓											✓	
Livistona australis	Other																✓				
Lomandra longifolia	Grass												✓								
Lomandra spp.	Grass	✓	✓								✓	✓	✓								
Marsilea mutica	Fern																✓				
Melaleuca nodosa	Shrub																		✓		
Melaleuca linariifolia	Shrub								✓												
Melaleuca quinquenervia	Tree			✓	✓	✓	✓			✓				✓							✓
Melaleuca sieberi	Shrub								✓									✓			
Melaleuca thymifolia	Shrub																		✓	✓	✓
Melinis repens	Exotic				✓																
Mirbelia rubiifolia	Shrub																			✓	
Monotoca elliptica	Shrub	✓	✓		✓						✓	✓	✓							✓	

Plant Species	Growth Form	SA P1	SA P2	SA P3	SA P4	SA P5	SA P6	SA P7	SA P8	SA P9	SA P10	SA P11	SA P12	SA P13	SA P14	SA P15	SA P16	SA P17	SA P18	SA P19	SA P20
Oxalis radicosa	Forb				✓																
Pandorea pandorana	Other		✓		✓						✓	✓	✓								
Panicum simile	Grass								✓												
Panicum sp.	Grass										✓										
Parsonsia straminea	Other			✓						✓				✓							
Paspalum dilatatum	HTW																✓				
Paspalum spp.	Exotic														✓						
Persicaria spp.	Forb									✓											
Persicaria strigosa	Forb						✓			✓											
Persoonia lanceolata	Shrub		✓						✓										✓	✓	
Persoonia levis	Shrub								✓											✓	
Philydrum lanuginosum	Forb			✓		✓	✓			✓											
Phragmites australis	Grass														✓						
Pimelea linifolia	Shrub	✓			✓						✓	✓						✓		✓	
Pimelea spp.	Shrub																				
Platysace lanceolata	Shrub		✓																✓		✓
Pomax umbellata	Forb		✓								✓	✓	✓								
Pteridium esculentum	Fern	✓	✓					✓	✓		✓	✓	✓						✓	✓	
Pultenaea retusa	Shrub	✓																			✓
Richardia stellaris	Exotic				✓																
Ricinocarpos pinifolius	Shrub										✓	✓	✓								

Plant Species	Growth Form	SA P1	SA P2	SA P3	SA P4	SA P5	SA P6	SA P7	SA P8	SA P9	SA P10	SA P11	SA P12	SA P13	SA P14	SA P15	SA P16	SA P17	SA P18	SA P19	SA P20
Rumex obtusifolia	Exotic				✓										✓	✓	✓				
Scaevola spp.	Forb																				
Schoenus brevifolius	Grass								✓									✓		✓	✓
Schoenus spp.	Grass																		✓		
Selaginella uliginosa	Fern																	✓	✓		
Senecio madagascarensis	HTW										✓										
Setaria pumila	Exotic															✓					
Solanum americanum	Forb																✓				
Sonchus oleraceus	Exotic															✓					
Stellaria media	Exotic														✓						
Stenotaphrum secundatum	HTW														✓	✓					
Telmatoblechnum indicum	Fern		✓			✓								✓							✓
Tradescantia fluminensis	HTW				✓												✓				
Triglochin microtuberosa	Forb						✓														
Typha orientalis	Grass							✓	✓												
Verbena bonariensis	Exotic															✓	✓				
Wahlenbergia spp.	Forb										✓										
Xanthorrhoea spp.	Other								✓												
Xanthosia pilosa	Forb																		✓		
Xyris operculata	Grass																	✓			

APPENDIX C FAUNA SPECIES LIST

Fauna Recorded within the Williamtown SAP

FAMILY / Common Name	Scientific Name	EPBC	BC Act	Williamtown SAP May 21	Williamtown SAP Nov 21	OEH Locality Records
CASUARIIDAE						
Emu	*Dromalus novaehollandiae*					+
PHASIANIDAE						
Stubble Quail	*Coturnix pectoralis*					+
Brown Quail	*Coturnix ypsilophora*			observed (5), heard	Observed, heard	+
ANATIDAE						
Blue-billed Duck	***Oxyura australis***		V			+
Musk Duck	*Biziura lobata*					+
Freckled Duck	***Strictonetta naevosa***		V			+
Black Swan	*Cyngus atratus*				Overhead	+
Australian Shelduck	*Tadorna tadornoides*					+
Australian Wood Duck	*Chenonetta jubata*			20+ observed	Observed, heard	+
* Northern Mallard	* *Anas platyrhychos*					+
Pacific Black Duck	*Anas superciliosa*			10+ observed	Observed	+
Grey Teal	*Anas gracilis*			10+ observed	Observed	+
Chestnut Teal	*Anas castanea*					+
PODICIPEDIDAE						
Australasian Grebe	*Tachybaptus novaehollandiae*			4 observed	Observed	+
ANHINGIDAE						
Australian Darter	*Anhinga melanogaster*			1 heard	Observed	+
PHALACROCORACIDAE						
Little Pied Cormorant	*Microcarbo melanoleucos*				Observed	+
Pied Cormorant	*Phalacrocorax varius*				overhead	+
Little Black Cormorant	*Phalacrocorax sulcirostris*					+
PELECANIDAE						

FAMILY / Common Name	Scientific Name	EPBC	BC Act	Williamtown SAP May 21	Williamtown SAP Nov 21	OEH Locality Records
Australian Pelican	*Pelecanus conspicillatus*			10+ overhead	Overhead	+
ARDEIDAE						
White-faced Heron	*Egretta novaehollandiae*			10+ observed, heard	Observed	+
Little Egret	*Egretta garzetta*					+
White-necked Heron	*Ardea pacifica*			4 observed	Observed	
Eastern Great Egret	*Casmerodius modesta*					
Intermediate Egret	*Ardea intermedia*			1 observed		
Cattle Egret	*Bubulcus ibis*	M				+
Striated Heron	*Butorides striata*					+
Nankeen Night Heron	*Nycticorax caledonicus*					+
Black Bittern	***Ixobrychus flavicollis***		V			+
PLATALEIDAE						
Glossy Ibis	*Plegadis falcinellus*	M				+
Australian White Ibis	*Threskiornis molucca*			100+ observed		+
Straw-necked Ibis	*Threskiornis spinicollis*			100+ observed	Observed	+
Royal Spoonbill	*Platalea regia*			2 observed	Observed	+
CICONIIDAE						
Black-necked Stork (Jabiru)	***Ephippiorhynchus asiaticus***		E			+
ACCIPITRIDAE						
Eastern Osprey	***Pandion cristatus***	M	V			+
Pacific Baza	*Aviceda subcristata*					+
Black-shouldered Kite	*Elanus axillaris*				Observed	+
Square-tailed Kite	***Lophoictinia isura***		V			+
Black Kite	*Milvus migrans*					+
Whistling Kite	*Haliastur sphenurus*			5+ observed	Heard call	+
White-bellied Sea-eagle	***Haliaeetus leucogaster***	M	V		Overhead	+
Swamp Harrier	*Circus approximans*			1 observed		+
Brown Goshawk	*Accipiter fasciatus*				Observed	+

FAMILY / Common Name	Scientific Name	EPBC	BC Act	Williamtown SAP May 21	Williamtown SAP Nov 21	OEH Locality Records
Grey Goshawk	*Accipiter novaehollandiae*			1 observed	Observed, photo	+
Collared Sparrowhawk	*Accipiter cirrhocephalus*					+
Wedge-tailed Eagle	*Aquila audax*			2 observed		+
FALCONIDAE						
Brown Falcon	*Falco berigora*					+
Australian Hobby	*Falco longipennis*					+
Peregrine Falcon	*Falco peregrinus*				Observed	+
Nankeen Kestrel	*Falco cenchroides*			2 observed	Observed	+
RALLIDAE						
Buff-banded Rail	*Gallirallus philippensis*					+
Baillon's Crake	*Porzana pusilla*					+
Purple Swamphen	*Porphyrio porphyrio*			10+ observed, heard	Observed	+
Dusky Moorhen	*Gallinula tenebrosa*					+
Eurasian Coot	*Fulica atra*					+
SCOLOPACIDAE						
Latham's Snipe	*Gallinago hardwickii*	M		1 observed		+
Bar-tailed Godwit	*Limosa lapponica*	M				+
Whimbrel	*Numenius phaeopus*	M				+
Eastern Curlew	***Numenius madagascariensis***	CE	E			+
Marsh Sandpiper	*Tringa stagnatilis*	M				+
Common Greenshank	*Tringa nebularia*	M				+
Grey-tailed Tattler	*Tringa brevipes*	M				+
Red-necked Stint	*Calidris ruficollis*	M				+
Pectoral Sandpiper	*Calidris melanotos*	M				+
Sharp-tailed Sandpiper	*Calidris acuminata*	M				+
Curlew Sandpiper	*Calidris ferruginea*	M				+
HAEMATOPODIDAE						
Australian Pied Oystercatcher	***Haematopus longirostris***		E			+

FAMILY / Common Name	Scientific Name	EPBC	BC Act	Williamtown SAP May 21	Williamtown SAP Nov 21	OEH Locality Records
RECURVIROSTRIDAE						
Black-winged Stilt	*Himantopus leucocephalus*					+
Red-necked Avocet	*Recurvirostra novaehollandiae*					+
CHARADRIIDAE						
Pacific Golden Plover	*Pluvialis fulva*	M				+
Masked Lapwing	*Vanellus miles*				Observed	+
LARIDAE						
Silver Gull	*Chroicocephalus novaehollandiae*					+
Caspian Tern	*Hydroprogne caspia*	M				+
Little Tern	***Sternula albifrons***	M	E			+
COLUMBIDAE						
* Rock Dove	* *Columba livia*			100+ observed	Observed	
*Spotted Turtle-Dove	* *Streptopelia chinensis*			10+ observed		+
Brown Cuckoo-dove	*Macropygia amboinenses*					+
Common Bronzewing	*Phaps chalcoptera*				Observed, heard	+
Brush Bronzewing	*Phaps elegans*					+
Crested Pigeon	*Ocyphaps lophotes*			10+ observed	Observed	+
Peaceful Dove	*Geopelia striata*					+
Bar-shouldered Dove	*Geopelia humeralis*				Observed, heard	+
Topknot Pigeon	*Lopholaimus antarcticus*					+
CACATUIDAE						
Glossy Black-Cockatoo	***Calyptorhynchus lathami***		V			+
Yellow-tailed Black Cockatoo	*Calyptorhynchus funereus*			50+ observed, heard	Observed, heard	+
Galah	*Eolophus roseicapillus*			10+ heard	Observed	+
Sulphur-crested Cockatoo	*Cacatua galerita*			10+ observed, heard	Observed	
PSITTACIDAE						
Rainbow Lorikeet	*Trichoglossus haematodus*			100+ observed, heard	Observed	+

FAMILY / Common Name	Scientific Name	EPBC	BC Act	Williamtown SAP May 21	Williamtown SAP Nov 21	OEH Locality Records
Scaly-breasted Lorikeet	*Trichoglossus chlorolepidotus*			100+ observed, heard		+
Musk Lorikeet	*Glossopsitta concinna*			100+ observed, heard		+
Little Lorikeet	***Glossopsitta pusilla***		**V**	100+ observed, heard		+
Australian King Parrot	*Alisterus scapularis*			observed, heard	Observed, heard	+
Eastern Rosella	*Platycercus eximius*			observed, heard	Observed, heard	+
Crimson Rosella	*Platycercus elegans*				Observed, heard	
Swift Parrot	***Lathamus discolor***	E	E			+
Red-rumped Parrot	*Psephotus haematonotus*			10+ observed, heard	Observed, heard	+
CUCULIDAE						
Pallid Cuckoo	*Heteroscenes pallidus*					+
Brush Cuckoo	*Cacomantis variolosus*			heard	Observed, heard	+
Fan-tailed Cuckoo	*Cacomantis flabelliformis*			heard	Observed, heard	+
Shining Bronze-Cuckoo	*Chalcites lucidus*					+
Eastern Koel	*Eudynamys orientalis*				Observed, heard	+
Channel-billed Cuckoo	*Scythrops novaehollandiae*				Observed, heard	+
Pheasant Coucal	*Centropus phasianinus*				Observed, heard	+
STRIGIDAE						
Powerful Owl	***Ninox strenua***		V			+
Southern Boobook	*Ninox novaeseelandiae*			2 heard	heard	+
TYTONIDAE						
Masked Owl	***Tyto novaehollandiae***		V			+
Eastern Barn Owl	*Tyto javanica*					+
Eastern Grass Owl	***Tyto longimembris***		V			
PODARGIDAE						
Tawny Frogmouth	*Podargus strigoides*			1 spot	Observed, heard	+
CAPRIMULGIDAE						
White-throated Nightjar	*Eurostopodus mystacalis*				Recorded audio	
AEGOTHELIDAE						

FAMILY / Common Name	Scientific Name	EPBC	BC Act	Williamtown SAP May 21	Williamtown SAP Nov 21	OEH Locality Records
Australian Owlet-Nightjar	*Aegotheles cristatus*			2 heard	photo, heard	+
APODIDAE						
White-throated Needletail	*Hirundapus caudacutus*				overhead	
HALCYONIDAE						
Laughing Kookaburra	*Dacelo novaeguineae*			10+ heard, observed	Observed, heard	+
Sacred Kingfisher	*Todiramphus sanctus*				Observed, heard	+
MEROPIDAE						
Rainbow Bee-eater	*Merops ornatus*	M			Observed, heard	+
CORACIIDAE						
Dollarbird	*Eurystomus orientalis*				Observed, heard	+
CLIMACTERIDAE						
White-throated Treecreeper	*Cormobates leucophaea*			5+ observed, heard	Observed, heard	+
MALURIDAE						
Superb Fairy-wren	*Malurus cyaneus*			20+ observed, heard	Observed, heard	+
Variegated Fairy-wren	*Malurus lamberti*				Observed, heard	+
Southern Emu-wren	*Stipiturus malachurus*					+
PARDALOTIDAE						
Spotted Pardalote	*Pardalotus punctatus*			100+ heard	Observed, heard	+
Striated Pardalote	*Pardalotus striatus*			2 heard		+
ACANTHIZIDAE						
White-browed Scrubwren	*Sericornis frontalis*			10+ heard	Observed, heard	
Weebill	*Smicrornis brevirostris*				Observed, heard	+
Brown Gerygone	*Gerygone mouki*					+
Mangrove Gerygone	*Gerygone laevigaster*					+
White-throated Gerygone	*Gerygone olivacea*				Observed, heard	+
Brown Thornbill	*Acanthiza pusilla*			10+ observed, heard	Observed, heard	+
Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*					+
Yellow Thornbill	*Acanthiza nana*				Observed, heard	+

FAMILY / Common Name	Scientific Name	EPBC	BC Act	Williamtown SAP May 21	Williamtown SAP Nov 21	OEH Locality Records
Striated Thornbill	*Acanthiza lineata*					+
MELIPHAGIDAE						
Red Wattlebird	*Anthochaera carunculata*			heard	Observed, heard	+
Little Wattlebird	*Anthochaera chrysoptera*					+
Striped Honeyeater	*Plectorhyncha lanceolata*			2 heard	Observed, heard	
Noisy Friarbird	*Philemon corniculatus*			observed, heard	Observed, heard	+
Regent Honeyeater	***Anthochaera phrygia***	CE M	CE			+
Blue-faced Honeyeater	*Entomyzon cyanotis*			10+ heard	Observed, heard	
Bell Miner	*Manorina melanophrys*					+
Noisy Miner	*Manorina melanocephala*			10+ observed	Observed, heard	+
Lewin's Honeyeater	*Meliphaga lewinii*			10+ observed, heard	Observed, heard	+
Yellow-faced Honeyeater	*Caligavis chrysops*			100+ observed	Observed, heard	+
White-eared Honeyeater	*Nesoptilotis leucotis*					+
Brown-headed Honeyeater	*Melithreptus brevirostris*				Observed, heard	+
White-naped Honeyeater	*Melithreptus lunatus*			100+ heard, observed		
Brown Honeyeater	*Lichmera indistincta*					+
New Holland Honeyeater	*Phylidonyris novaehollandiae*					+
White-cheeked Honeyeater	*Phylidonyris nigra*			100+ observed, heard	Observed, heard	+
Eastern Spinebill	*Acanthorhynchus tenuirostris*				Observed, heard	+
Scarlet Honeyeater	*Myzomela sanguinolenta*			100+ observed, heard	Observed, heard	+
White-fronted Chat	***Ephthianura albifrons***		**V**			+
PETROICIDAE						
Rose Robin	*Petroica rosea*			2 heard		
Eastern Yellow Robin	*Eopsaltria australis*			10+ observed, heard	Observed, heard	+
CINCLOSOMATIDAE						
Eastern Whipbird	*Psophodes olivaceus*			2 heard	Observed, heard	+
NEOSITTIDAE						
Varied Sitella	***Daphoenositta chrysoptera***		**V**			+

FAMILY / Common Name	Scientific Name	EPBC	BC Act	Williamtown SAP May 21	Williamtown SAP Nov 21	OEH Locality Records
PACHYCEPHALIDAE						
Eastern Shrike-tit	*Falcunculus frontatus*				Observed, heard	
Golden Whistler	*Pachycephala pectoralis*			2 observed	Observed, heard	+
Rufous Whistler	*Pachycephala rufiventris*					+
Grey Shrike-thrush	*Colluricincla harmonica*				Observed, heard	+
MONARCHIDAE						
Black-faced Monarch	*Monarcha melanopsis*	M				+
Leaden Flycatcher	*Myiagra rubecula*			2 heard	Observed, heard	+
Magpie-Lark	*Grallina cyanoleuca*			10+ heard	Observed, heard	+
RHIPIDURIDAE						
Rufous Fantail	*Rhipidura rufifrons*	M				+
Grey Fantail	*Rhipidura albiscapa*			observed, heard	Observed, heard	+
Willie Wagtail	*Rhipidura leucophrys*				Observed, heard	+
DICRURIDAE						
Spangled Drongo	*Dicrurus bracteatus*					+
CAMPEPHAGIDAE						
Black-faced Cuckoo-shrike	*Coracina novaehollandiae*			10+ observed, heard	Observed, heard	+
White-bellied Cuckoo-shrike	*Coracina papuensis*			2 observed		
Cicadabird	*Edolisoma tenuirostris*				Heard call	
ORIOLIDAE						
Olive-backed Oriole	*Oriolus sagittatus*			10+ heard	Observed, heard	+
Australasian Figbird	*Sphecotheres vieilloti*					+
ARTAMIDAE						
Dusky Woodswallow	***Artamus cyanopterus cyanopterus***		V			+
Grey Butcherbird	*Cracticus torquatus*			5+ heard	Observed, heard	+
Pied Butcherbird	*Cracticus nigrogularis*			2 observed	Observed, heard	+
Australian Magpie	*Cracticus tibicen*			50+ observed, heard	Observed, heard	+

FAMILY / Common Name	Scientific Name	EPBC	BC Act	Williamtown SAP May 21	Williamtown SAP Nov 21	OEH Locality Records
Pied Currawong	*Strepera graculina*				Observed, heard	+
CORVIDAE						
Australian Raven	*Corvus coronoides*			10+ observed, heard	Observed, heard	+
Little Raven	*Corvus mellori*					+
Torresian Crow	*Corvus orru*			2 heard		+
PTILONORHYNCHIDAE						
Satin Bowerbird	*Ptilinorhynchus violaceus*			5+ heard	Observed, heard	+
MOTACILLIDAE						
Australian Pipit	*Anthus novaeseelandiae*			2 observed	Observed	+
PASSERIDAE						
* House Sparrow	* *Passer domesticus*				observed	
ESTRILDIDAE						
Double-barred Finch	*Stizoptera bichenovii*			10+ heard	Observed, heard	+
Red-browed Firetail	*Neochmia temporalis*			100+ observed	Observed, heard	+
Chestnut-breasted Mannikin	*Lonchura castaneothorax*			100+ observed		
DICAEIDAE						
Mistletoebird	*Dicaeum hirundinaceum*			5+ heard	Observed, heard	+
HIRUNDINIDAE						
Welcome Swallow	*Hirundo neoxena*			10+ observed	Observed, heard	+
Fairy Martin	*Petrochelidon ariel*				Observed	
ACROCEPHALIDAE						
Australian Reed-Warbler	*Acrocephalus australis*	M		10+ heard	Heard call	+
LOCUSTELLIDAE						
Tawny Grassbird	*Megalurus timoriensis*					+
Little Grassbird	*Megalurus gramineus*					+
CISTICOLIDAE						
Golden-headed Cisticola	*Cisticola exilis*			10+ heard	Heard call	+
ZOSTEROPIDAE						

FAMILY / Common Name	Scientific Name	EPBC	BC Act	Williamtown SAP May 21	Williamtown SAP Nov 21	OEH Locality Records
Silvereye	*Zosterops lateralis*			100+ observed, heard	Observed, heard	+
STURNIDAE						
* Common Starling	* *Sturnus vulgaris*				Observed, heard	+
* Common Myna	* *Sturnus tristis*			10+ heard	Observed, heard	+
MAMMALS						
ORNITHORHYNCHIDAE						
Platypus	*Ornithorhynchus anatinus*					+
TACHYGLOSSIDAE						
Short-beaked Echidna	*Tachyglossus aculeatus*				Photo	+
DASYURIDAE						
Brown Antechinus	*Antechinus stuartii*			10 captures	4 captures	+
Spotted-tailed Quoll	***Dasyurus maculatus***	V	V			+
Brush-tailed Phascogale	***Phascogale tapoatafa***		V			+
Common Dunnart	*Smithopsis murina*					+
PERAMELIDAE						
Northern Brown Bandicoot	*Isoodon macrourus*			? diggings present	Photo, diggings	+
Long-nosed Bandicoot	*Perameles nasuta*					+
PHASCOLARCTIDAE						
Koala	***Phascolarctos cinereus***	E	E	1 spotlight, 1 adult + cub observed		+
VOMBATIDAE						
Bare-nosed Wombat	*Vombatus ursinus*					+
PETAURIDAE						
Sugar Glider	*Petaurus breviceps*					+
Squirrel Glider	***Petaurus norfolcensis***		V	6 nestbox		+
PSEUDOCHEIRIDAE						
Common Ringtail Possum	*Pseudocheirus peregrinus*			1 spotlight	spotlight	+
ACROBATIDAE						

FAMILY / Common Name	Scientific Name	EPBC	BC Act	Williamtown SAP May 21	Williamtown SAP Nov 21	OEH Locality Records
Feather-tail Glider	*Acrobates pygmaeus*					+
PHALANGERIDAE						
Common Brushtail Possum	*Trichosurus vulpecula*			3 spot + 6 nestbox	Spotlight, photo	+
POTOROIDAE						
Long-nosed Potoroo	***Potorous tridactylus***	V	V			+
MACROPODIDAE						
Eastern Grey Kangaroo	*Macropus giganteus*			10+ camera	Photo	+
Red-necked Wallaby	*Macropus rufogriseus*			10+ observed, IR camera	Photo	+
Swamp Wallaby	*Wallabia bicolor*			1 observed, IR camera	Photo	+
PTEROPODIDAE						
Grey-headed Flying-fox	***Pteropus poliocephalus***	V	V	100+ spot	Spotlight, Heard call	+
Little Red Flying-fox	*Pteropus scapulatus*			10+ spot		+
Black Flying-fox	*Pteropus alecto*					+
EMBALLONURIDAE						
Yellow-bellied Sheathtail-bat	***Saccolaimus flaviventris***		V			+
MOLOSSIDAE						
Eastern Coastal Freetailed-bat	***Micronomus norfolkensis***		V	2 calls	55 calls	+
Eastern Free-tailed Bat	*Ozimops ridei*					+
Southern Freetail-bat	*Mormopterus sp.4*					+
White-striped Freetail-bat	*Austronomus australis*			3 calls	12 calls	+
VESPERTILIONIDAE						
Little Bent-wing Bat	***Miniopterus australis***		V	143 calls	1 capture, 190 calls	+
Eastern Bent-wing Bat	***Miniopterus schreibersii oceanensis***		V	7 calls	17 calls	+
Lesser Long-eared Bat	*Nyctophilus geoffroyi*				3 captures	+
Gould's Long-eared Bat	*Nyctophilus gouldi*					+
Long-eared Bat	*Nyctophilus sp.*			4 calls	9 calls	

FAMILY / Common Name	Scientific Name	EPBC	BC Act	Williamtown SAP May 21	Williamtown SAP Nov 21	OEH Locality Records
Gould's Wattled Bat	*Chalinolobus gouldii*			65 calls	293 calls	+
Chocolate Wattled Bat	*Chalinolobus morio*			9 calls	101 calls	+
Eastern Falsistrelle	***Falsistrellus tasmaniensis***		V			+
Southern Myotis	***Myotis macropus***		V			+
Greater Broad-nosed Bat / Inland Broad-nosed Bat	***Scoteanax rueppellii*** / *Scotorepens balstoni*		V		62 calls	+
Eastern Broad-nosed Bat	*Scotorepens orion*					+
Large Forest Bat	*Vespadelus darlingtoni*			4 calls	4 calls	+
Eastern Forest Bat	*Vespadelus pumilus*					+
Little Forest Bat	*Vespadelus vulturnus*			9 calls	2 captures, 181 calls	+
MURIDAE						
New Holland Mouse	***Pseudomys novaehollandiae***	V				+
Water Rat	*Hydromys chrysogaster*					+
* House Mouse	* *Mus musculus*					+
Bush Rat	*Rattus fuscipes*			1 capture		+
Swamp Rat	*Rattus lutreolus*				Found dead	+
* Black Rat	* *Rattus rattus*			3 captures		+
CANIDAE						
* Dog	* *Canis familiaris*			Footprints	photo	+
Dingo	*Canis lupus dingo*				Photo	+
* Fox	* *Vulpes vulpes*			IR camera	Photo	+
FELIDAE						
* Cat (feral)	* *Felis catus*					+
LEPORIDAE						
* Brown Hare	* *Lepus capensis*			Observed	Observed	+
* Rabbit	* *Oryctolagus cuniculus*			Droppings	Droppings, observed	+
EQUIDAE						
* Horse	* *Equus caballus*			Observed	Droppings	+

FAMILY / Common Name	Scientific Name	EPBC	BC Act	Williamtown SAP May 21	Williamtown SAP Nov 21	OEH Locality Records
SUIDAE						
* Pig	** Sus scrofa*					+
BOVIDAE						
* Cattle	*Bos taurus*			observed		+
CERVIDAE						
* Fallow Deer	*Dama dama*					+
REPTILES						
CHELIDAE						
Broad-shelled Snake-necked Turtle	*Chelodina expansa*					+
PYGOPODIDAE						
Burton's Snake-lizard	*Lialis burtonis*					+
AGAMIDAE						
Jacky Lizard	*Amphibolurus muricatus*				1 observed	+
Bearded Dragon	*Pogona barbata*				2 observed	+
VARANIDAE						
Lace Monitor	*Varanus varius*				Photo, 3 observed	+
SCINCIDAE						
Punctate Worm Skink	*Anomalopus swansoni*					+
Southern Rainbow -skink	*Carlia tetradactyla*					+
Bar-sided Forest-skink	*Concinnia tenuis*					+
Fence Skink	*Cryptoblepharus virgatus*					+
Striped Skink	*Ctenotus robustus*			2 observed		+
Copper-tailed Skink	*Ctenotus taeniolatus*				1 observed	+
Land Mullet	*Egernia major*					+
Eastern Water Skink	*Eulamprus quoyii*				2 observed	+
Garden Skink	*Lampropholis delicata*			10+ observed	10+ observed	+
Garden Skink	*Lampropholis guichenoti*					+
Eastern Blue-tongue	*Tiliqua scincoides*				1 observed	+

FAMILY / Common Name	Scientific Name	EPBC	BC Act	Williamtown SAP May 21	Williamtown SAP Nov 21	OEH Locality Records
BOIDAE						
Diamond Python	*Morelia spilota ssp. spilota*			1 spot		+
COLUBRIDAE						
Common Tree Snake	*Dendrelaphis punctulata*					+
ELAPIDAE						
Yellow-faced Whip Snake	*Demansia psammophis*			1 observed		
Black-bellied Snake	*Hemiaspis signata*			1 observed		+
Red-bellied Black Snake	*Pseudechis porphyriacus*					+
Eastern Brown Snake	*Pseudonaja textilis*			1 observed		+
AMPHIBIANS						
MYOBATRACHIDAE						
Tusked Frog	*Adelotus brevis*					+
Common Eastern Froglet	*Crinia signifera*			100+ heard	10+ heard	+
Wallum Froglet	***Crinia tinnula***		V	10+ heard	10+ heard	+
Eastern Banjo Frog	*Limnodynastes dumerilii*					+
Brown-striped Frog	*Limnodynastes peronii*			1 spot	10+ heard	+
Spotted Grass Frog	*Limnodynastes tasmaniensis*			10+ calling	10+ heard	+
Haswell's Frog	*Paracrinia haswelli*					+
Ornate Burrowing Frog	*Platyplectrum ornatum*			100+ observed	10+ observed	+
Brown Toadlet	*Pseudophryne bibronii*					+
Red-backed Toadlet	*Pseudophryne coriacea*					+
Dusky Toadlet	*Uperoleia fusca*					+
Smooth Toadlet	*Uperoleia laevigata*					+
Mahony's Toadlet	***Uperoleia mahonyi***		V			+
HYLIDAE						
Green Tree Frog	*Litoria caerulea*					+
Bleating Tree Frog	*Litoria dentata*				10+ heard	+
Eastern Dwarf Tree Frog	*Litoria fallax*			10+ heard	100+ heard	+

FAMILY / Common Name	Scientific Name	EPBC	BC Act	Williamtown SAP May 21	Williamtown SAP Nov 21	OEH Locality Records
Freycinet's Frog	*Litoria freycineti*					+
Dainty Green Tree Frog	*Litoria gracilenta*					+
Jervis Bay Tree Frog	*Litoria jervisiensis*			10+ calling		+
Broad Palmed Frog	*Litoria latopalmata*			10+ observed	10+ heard	+
Rocket Frog	*Litoria nasuta*					+
Peron's Tree Frog	*Litoria peronii*				10+ heard	+
Tyler's Tree Frog	*Litoria tyleri*				100+ heard	+
Whistling Tree Frog	*Litoria verreauxii*				10+ heard	+

Threatened Species Recorded in Locality, Williamtown SAP.

Common Name	No. Records	Recorded, or Likelihood of Occurrence in Williamtown SAP	Species Designation
Emu	4	High, observed in open grassland south of Nelson Bay Road / Lavis Lane intersection (M. Murray personal observation, March 2021). However, it must be recognised that the Port Stephens endangered population is noted as not comprising wild birds (Williams, 2020). This population has likely become established after escaping, or being released from a local zoo or wildlife carer.	Ecosystem Credit
Black-necked Stork	6	Low to moderate potential for occurrence during localised flooding, may forage along network of drains in Williamtown SAP. Known from nearby Hunter Estuary, breeding at Hexham Swamp and Tomago	Ecosystem Credit
Black Bittern	1	Suitable habitat along Dawson's Drain and several small freshwater dams with dense emergent aquatic habitat.	Candidate Species
White-bellied Sea Eagle	69	Recorded flying over Williamtown SAP, no nests located in Williamtown SAP, although potential to occur in taller forests on sand dunes in Williamtown SAP	Ecosystem Credit
Eastern Osprey	1	Unlikely, no suitable foraging habitat for species, and no nests located in Williamtown SAP.	No occurrence
Glossy Black Cockatoo	1	No suitable foraging habitat within Williamtown SAP, absence of preferred feed trees (i.e. *Allocasuarina torulosa*). Potential nesting sites in larger hollows in Williamtown SAP.	Ecosystem Credit
Little Lorikeet	3	Recorded in Williamtown SAP, present during flowering, regular visitor	Ecosystem Credit
Swift Parrot	3	Moderate, wide ranging species may occur anywhere in Lower Hunter, high quality foraging habitat present (i.e. flowering Swamp Mahogany and Spotted Gum), lerps in eucalypt trees	Ecosystem Credit
Powerful Owl	6	Indirect evidence of species found in Williamtown SAP, suitable foraging and roost habitat, with suitable nest trees.	Ecosystem Credit
Masked Owl	5	High, suitable foraging and roost habitat, potential nest trees in Williamtown SAP, suitable large hollows present in SAP, particularly Scribbly Gum woodland	Ecosystem Credit
Eastern Grass Owl		High, areas of suitable habitat including Wet Heath and long grasses	Ecosystem Credit
Regent Honeyeater	1	Low, wide ranging species may occur anywhere in Lower Hunter, high quality foraging habitat present (i.e. flowering Swamp Mahogany and Spotted Gum)	No records
White-fronted Chat	3	High, suitable habitat present in Williamtown SAP, known from several locations in immediate locality	Ecosystem Credit
Dusky Woodswallow	1	High, summer migrant (Williams, 2020), more commonly associated with drier forests and woodlands of the Hunter Valley, wide ranging, suitable foraging habitat present. Noted as nesting in Blackbutt Angophora woodland on sand at Fern Bay (Resource Planning, 1993)	Ecosystem Credit
Spotted-tail Quoll	2	Moderate likelihood of occurrence, small number of local records in area, may occur as part of very large foraging range	Ecosystem Credit

Common Name	No. Records	Recorded, or Likelihood of Occurrence in Williamtown SAP	Species Designation
Brush-tailed Phascogale	5	Potential to occur in taller dry forest types in Williamtown SAP, suitable den locations in mature trees with hollows, not detected in installed nest boxes for species	Candidate Species
Koala	818	Recorded on site, high quality habitat present	Ecosystem Credit
Squirrel Glider	30	Recorded on site, high quality habitat present, habitat trees as den sites	Yes
Grey-headed Flying-fox	30	Recorded on site, foraging habitat present, no camps or roost sites in Williamtown SAP	Ecosystem Credit
Eastern Coastal Freetail-bat	3	Recorded on site, aerial space provides foraging habitat, roost / sheltering habitat in mature trees with hollows in Williamtown SAP	Ecosystem Credit
Little Bentwing-bat	18	Recorded on site, aerial space provides foraging habitat, no roost sheltering habitat in Williamtown SAP	Ecosystem Credit
Eastern Bentwing-bat	8	Recorded on site, aerial space provides foraging habitat, no roost sheltering habitat in Williamtown SAP	Ecosystem Credit
Greater Broad-nosed Bat	11	Tentatively recorded on site, roost habitat suitable in Williamtown SAP, aerial space provides potential foraging habitat, recorded in immediate locality	Ecosystem Credit
New Holland Mouse		Limited potential for occurrence, may occur in drier Open Forest on sand dunes, known from locality at Cox's Lane, Fern Bay (Resource Planning, 1993)	Ecosystem Credit
Eastern Chestnut Mouse		Limited potential for occurrence, may occur in Wet Heath / Open Forest complex just outside of Williamtown SAP, not known from locality records but recorded in similar habitats in broader region (Myall Lakes N.P)	Ecosystem Credit
Southern Myotis	3	High, roost habitat in mature trees in Williamtown SAP, aerial space above waterbodies provides foraging habitat, associated with riparian areas such as Dawson's Drain	Likely to occur
Wallum Froglet	56	Recorded in Williamtown SAP, expansive areas of habitat including open grasslands which inundate following heavy rainfall	Ecosystem Credit
Mahony's Toadlet	12	Likelihood of occurrence in areas of wet heath and low lying swamp forests, not detected in Williamtown SAP	Possible occurrence

Williamtown SAP Nest Box Observations, 2021

Box ID	Box Style	Latitude	Longitude	x_proj	y_proj	date inspected	Evidence of Use	Fauna Present	Number
Nb01	Parrot	-32.809	151.8305	390509.4	6369285	11/05/2021	Leaf nest		0
Nb02	Possum	-32.8091	151.8304	390499.5	6369266	11/05/2021	no evidence		0
Nb03	Glider	-32.8091	151.8302	390484.8	6369267	11/05/2021	spider webs		0
Nb04	Glider	-32.809	151.8302	390480.3	6369285	11/05/2021	Leaf nest	Squirrel Glider	2
Nb05	Glider	-32.8088	151.8299	390457.6	6369307	11/05/2021	Leaf nest		0
Nb07	Glider	-32.8087	151.8298	390442.1	6369319	11/05/2021	Leaf nest		0
Nb08	Possum	-32.8088	151.8304	390499	6369305	11/05/2021	Leaf nest	Common Brushtail Possum	1
Nb09	Microbat	-32.8088	151.8307	390533.2	6369305	11/05/2021	no evidence		0
Nb10	Glider	-32.8087	151.8305	390507.4	6369317	11/05/2021	Leaf nest		0
Nb12	Parrot	-32.8086	151.8291	390379.7	6369321	12/05/2021	Leaf nest		0
Nb16	Glider	-32.8068	151.8294	390403.8	6369529	11/05/2021			
Nb17	Possum	-32.8088	151.8284	390317.3	6369304	12/05/2021	no evidence	Common Brushtail Possum	1
Nb18	Glider	-32.8066	151.8293	390394.5	6369543	11/05/2021	fresh leaf nest		0
Nb19	Microbat	-32.8085	151.829	390371.2	6369337	12/05/2021	no evidence		0
Nb20	Treecreeper	-32.8067	151.8293	390397.3	6369534	11/05/2021	Leaf nest		0
Nb21	Possum	-32.8067	151.8295	390418.3	6369531	11/05/2021	Leaf nest		0
Nb22	Possum	-32.8087	151.8292	390390.5	6369316	12/05/2021		Common Brushtail Possum	1
Nb25	Glider	-32.8089	151.8292	390391.4	6369294	12/05/2021	Leaf nest	Squirrel Glider	2
Nb33	Glider	-32.8077	151.8291	390383.5	6369429	12/05/2021	Leaf nest	Squirrel Glider	2

Nb34	Possum	-32.8089	151.8276	390238.3	6369288	12/05/2021	no evidence	Common Brushtail Possum	1
Nb35	Kookaburra	-32.8089	151.8277	390248.1	6369285	12/05/2021	no evidence	Common Brushtail Possum	1
Nb36	Possum	-32.8074	151.8292	390385.5	6369463	11/05/2021	no evidence		0
Nb37	Glider	-32.8073	151.8292	390388.4	6369468	12/05/2021	Leaf nest		0
Nb38	Kookaburra	-32.807	151.8303	390490.7	6369502	11/05/2021	Leaf nest	Common Brushtail Possum	1
Nb39	Parrot	-32.8069	151.8296	390421	6369516	11/05/2021	Leaf nest		0
Nb40	Possum	-32.8067	151.8298	390441.8	6369534	11/05/2021	Leaf nest		0
Nb41	Possum	-32.8068	151.8297	390438	6369526	11/05/2021	Leaf nest		0
Nb42	Glider	-32.807	151.8303	390490.7	6369502	11/05/2021	spider webs		0
Nb43	Microbat	-32.8071	151.8303	390492.1	6369497	11/05/2021	no evidence		0
Nb44	Possum	-32.8071	151.8308	390538.5	6369488	11/05/2021	Leaf nest		0
Nb45	Glider	-32.8072	151.8311	390562.4	6369476	11/05/2021	Leaf nest		0
Nb46	Glider	-32.8073	151.8313	390580.8	6369470	10/05/2021	Leaf nest		0

APPENDIX D WEATHER CONDITIONS DURING FAUNA SURVEYS

Weather conditions during the fauna survey was fine with clear skies and light to moderate winds. Diurnal temperatures were mild in the early mornings, leading to fine days and clear nights. Nocturnal temperatures were mild to cold. Rainfall was experienced on one day during the survey, but was only light over the course of the evening. Parts of the Williamtown SAP, particularly low lying areas, were inundated with water to a depth of 0.5m, with more elevated areas dry. Access to some locations could only be made on foot, with limited access tracks.

Weather conditions in November were mild, with several cool nights and warm days. Rainfall was experienced on Thursday 11 November, with 20.2 mm rain. A large electrical storm with heavy rain was experienced just on dusk, which dissipated quickly and steady rainfall was experienced till 10pm when the nocturnal survey was completed. The second week of survey in November started with extremely windy weather, a maximum wind gust of 44km/h recorded early in day, remaining similar in strength all day.

A summary of weather conditions is presented below.

Weather conditions during fauna survey, Williamtown SAP.

Date	Min. Temp °C	Max. Temp °C	Rel. Hum. 9am	Rel. Hum 3pm	Wind Speed (km/hr) and Direction		Cloud Cover	Rainfall (mm) 24 hrs
					9 am	3 pm		
10 May 2021	13.3	24.4	82%	45%	WNW 19	WNW 26	0/8	0.4
11 May 2021	12.6	22.5	79%	93%	NW 17	WNW 24	0/8	0.0
12 May 2021	12.6	20.9	83%	77%	WNW 19	S 17	1/8	7.2
13 May 2021	13.1	22.6	94%	59%	WNW 15	WNW 20	1/8	0.0
14 May 2021	11.9	20.7	61%	29%	WNW 31	WSW 22	2/8	0.0
9 Nov 2021	16.2	24.2	83%	69%	SW 11	SE 26	7/8	0.0
10 Nov 2021	16.0	23.7	94%	89%	W 13	S 24	8/8	0.4
11 Nov 2021	18.5	21.9	88%	90%	S 30	SSE 17	8/8	20.2
15 Nov 2021	11.6	24.4	37%	26%	WNW 44	WNW 41	2/8	0.0
16 Nov 2021	10.8	21.0	47%	43%	WNW 20	SE 26	4/8	0.2
17 Nov 2021	15.2	21.5	56%	52%	SE 17	ESE 24	6/8	0.0
18 Nov 2021	14.7	26.6	67%	54%	NNW 13	ESE 20	4/8	0.6

Data Courtesy of Bureau of Meteorology – Williamtown Airport (Daily Weather Observations (bom.gov.au)

APPENDIX E FIELD EFFORT AND SURVEY GUIDELINES

"Prevailing climatic conditions at time of survey

May: fine with clear skies and light to moderate winds. Diurnal temperatures were mild in the early mornings, leading to fine days and clear nights. Nocturnal temperatures were mild to cold. Rainfall was experienced on one day during the survey in May, but was only light over the course of the evening. Parts of the study area, particularly low lying areas, were inundated with water to a depth of 0.5m, with more elevated areas dry.

September: fine, cloudy at times. Low lying areas inundated and wet underfoot in swamp forest areas.

November: Weather conditions in November were mild, with several cool nights and warm days. Rainfall was experienced on Thursday 11 November, with 20.2 mm rain. A large electrical storm with heavy rain was experienced just on dusk, which dissipated quickly and steady rainfall was experienced till 10pm when the nocturnal survey was completed. The second week of survey in November started with extremely windy weather, a maximum wind gust of 44km/h recorded early in day, remaining similar in strength all day. Parts of the study area, particularly low lying areas, were inundated with water to a depth of 1m. Swamp forests were drier than during the September survey."

Scientific Name	Common Name	Vegetation Types/Habitats Targeted	Timing	Recommended methods	Methods used	2021Survey Effort	How the survey effort meets guidelines or other recognised best practice methods
Flora							
Angophora inopina	Charmhaven Apple	PCT1646 good and regrowth PCT1637_good PCT1725_good	All year	Parallel field traverse 5 - 10 m apart in areas of suitable habitat. 4km/hour in open vegetation, 1.5km/hour in dense vegetation Map species polygon if found	Parallel field traverse 5 - 10 m apart in areas of suitable habitat. 4km/hour in open vegetation, 1.5km/hour in dense vegetation	2 people over 3 days in September 2 people over 5 days in November	Survey timing, method and requirements met in areas where access was available
Callistemon linearifolius	Netted Bottle Brush	PCT1646 good and regrowth PCT1637_good PCT1725 good and regrowth	Oct-Jan	Parallel field traverse 5 - 10 m apart in areas of suitable habitat. 4km/hour in open vegetation, 1.5km/hour in dense vegetation Count individual plants if found	Parallel field traverse 5 - 10 m apart in areas of suitable habitat. 4km/hour in open vegetation, 1.5km/hour in dense vegetation	2 people over 3 days in September 2 people over 5 days in November	Survey timing, method and requirements met in areas where access was available
Commersonia prostrata	Dwarf Kerrawang	PCT1646 good and regrowth PCT1637_good PCT1725 good	All year	Parallel field traverse 5 - 10 m apart in areas of suitable habitat. 4km/hour in open vegetation, 1.5km/hour in dense vegetation Map species polygon if found	Parallel field traverse 5 - 10 m apart in areas of suitable habitat. 4km/hour in open vegetation, 1.5km/hour in dense vegetation	2 people over 3 days in September 2 people over 5 days in November	Survey timing, method and requirements met in areas where access was available
Cryptostylis hunteriana	Leafless Tongue Orchid	PCT1646 good and regrowth PCT1637_good	Nov-Jan and check flowering of reference population	Parallel field traverse 5 - 10 m apart in areas of suitable habitat. 4km/hour in open vegetation, 1.5km/hour in dense vegetation Map species polygon if found	Parallel field traverse 5 - 10 m apart in areas of suitable habitat. 4km/hour in open vegetation, 1.5km/hour in dense vegetation Reference population checked 17/11/2021 in Tomaree and observed to be in flower	2 people over 5 days in November	Survey timing, method and requirements met in areas where access was available
Cynanchum elegans		PCT1646 good and regrowth PCT1637_good	All year	Parallel field traverse 5 - 10 m apart in areas of suitable habitat. 4km/hour in open vegetation, 1.5km/hour in dense vegetation Map species polygon if found	Parallel field traverse 5 - 10 m apart in areas of suitable habitat. 4km/hour in open vegetation, 1.5km/hour in dense vegetation	2 people over 3 days in September 2 people over 5 days in November	Survey timing, method and requirements met in areas where access was available
Diuris arenaria	Sand Doubletail	PCT1646 good and regrowth PCT1637_good	September and check flowering of reference population	Parallel field traverse 5 - 10 m apart in areas of suitable habitat. 4km/hour in open vegetation, 1.5km/hour in dense vegetation Map species polygon if found	Parallel field traverse 5 - 10 m apart in areas of suitable habitat. 4km/hour in open vegetation, 1.5km/hour in dense vegetation Reference population in Bobs Farm checked 28/09/21 and observed to be in flower.	2 people over 3 days in September	Survey timing, method and requirements met in areas where access was available
Diuris praecox	Rough Doubletail	N/A	August and check flowering of reference population	Parallel field traverse 5 - 10 m apart in areas of suitable habitat. 4km/hour in open vegetation, 1.5km/hour in dense vegetation Map species polygon if found	N/A	Not surveyed	Survey timing requirements not met

Scientific Name	Common Name	Vegetation Types/Habitats Targeted	Timing	Recommended methods	Methods used	2021Survey Effort	How the survey effort meets guidelines or other recognised best practice methods
Eucalyptus camfieldii	Camfield's Stringybark	PCT1646_good PCT1637_good	All year	Parallel field traverse 5 - 10 m apart in areas of suitable habitat. 4km/hour in open vegetation, 1.5km/hour in dense vegetation Map species polygon if found	Parallel field traverse 5 - 10 m apart in areas of suitable habitat. 4km/hour in open vegetation, 1.5km/hour in dense vegetation	2 people over 3 days in September 2 people over 5 days in November	Survey timing, method and requirements met in areas where access was available
Eucalyptus parramattensis subsp. decadens		PCT1637_good PCT1725_good PCT1651_good	All year	Parallel field traverse 5 - 10 m apart in areas of suitable habitat. 4km/hour in open vegetation, 1.5km/hour in dense vegetation Count individual plants if found	Parallel field traverse 5 - 10 m apart in areas of suitable habitat. 4km/hour in open vegetation, 1.5km/hour in dense vegetation Individuals counted and marked with hand held GPS	2 people over 3 days in September 2 people over 5 days in November	Survey timing, method and requirements met in areas where access was available
Galium australe		PCT1646_good and regrowth PCT1637_good PCT1725_good PCT1651_good	Oct-Feb	Parallel field traverse 5 - 10 m apart in areas of suitable habitat. 4km/hour in open vegetation, 1.5km/hour in dense vegetation Map species polygon if found	Parallel field traverse 5 - 10 m apart in areas of suitable habitat. 4km/hour in open vegetation, 1.5km/hour in dense vegetation	2 people over 5 days in November	Survey timing, method and requirements met in areas where access was available
Genoplesium baueri			Feb-Mar 6 weeks after heavy rain	Parallel field traverse 5 - 10 m apart in areas of suitable habitat. 4km/hour in open vegetation, 1.5km/hour in dense vegetation Map species polygon if found	N/A	Not surveyed	Survey timing requirements not met
Grevillea parviflora subsp. parviflora	Small-flower Grevillea	PCT1646 good and regrowth PCT1637_good PCT1725 good	Aug-Nov	Parallel field traverse 5 - 10 m apart in areas of suitable habitat. 4km/hour in open vegetation, 1.5km/hour in dense vegetation Map species polygon if found	Parallel field traverse 5 - 10 m apart in areas of suitable habitat. 4km/hour in open vegetation, 1.5km/hour in dense vegetation	2 people over 3 days in September 2 people over 5 days in November	Survey timing, method and requirements met in areas where access was available
Lindernia alsinoides	Noah's False Chickweed	PCT1725 good and regrowth PCT1651_good PCT1724_low PCT1742	Nov-Feb	Parallel field traverse 5 - 10 m apart in areas of suitable habitat. 4km/hour in open vegetation, 1.5km/hour in dense vegetation Map species polygon if found	Parallel field traverse 5 - 10 m apart in areas of suitable habitat. 4km/hour in open vegetation, 1.5km/hour in dense vegetation	2 people over 5 days in November	Survey timing, method and requirements met in areas where access was available
Maundia triglochinoides		PCT1724_low PCT1742	Nov-Mar	Parallel field traverse 5 - 10 m apart in areas of suitable habitat. 4km/hour in open vegetation, 1.5km/hour in dense vegetation Map species polygon if found	Parallel field traverse 5 - 10 m apart in areas of suitable habitat. 4km/hour in open vegetation, 1.5km/hour in dense vegetation	2 people over 5 days in November	Survey timing, method and requirements met in areas where access was available Some areas of potential habitat not surveyed
Persicaria elatior	Tall Knotweed	PCT1724_low PCT1742	Dec-May	Parallel field traverse 5 - 10 m apart in areas of suitable habitat. 4km/hour in open vegetation, 1.5km/hour in dense vegetation Map species polygon if found	N/A	Not surveyed	Survey timing requirements not met
Syzygium paniculatum		PCT1725_good PCT1651_good	Apr-Jun	Parallel field traverse 5 - 10 m apart in areas of suitable habitat. 4km/hour in open vegetation, 1.5km/hour in dense vegetation Count individual plants if found	Parallel field traverse 5 - 10 m apart in areas of suitable habitat. 4km/hour in open vegetation, 1.5km/hour in dense vegetation	2 people over 3 days in September 2 people over 5 days in November	Survey method and requirements met in areas where access was available. Survey was not within recommended timeframe, however, no Lilly Pilly plants were observed during surveys for other plants.

Scientific Name	Common Name	Vegetation Types/Habitats Targeted	Timing	Recommended methods	Methods used	2021Survey Effort	How the survey effort meets guidelines or other recognised best practice methods
Tetratheca juncea	Black-eyed Susan	PCT1646 good and regrowth PCT1637_good	Sep-Oct and check flowering of reference population	Parallel field traverse 5 - 10 m apart in areas of suitable habitat. 4km/hour in open vegetation, 1.5km/hour in dense vegetation Map species polygon if found	Parallel field traverse 5 - 10 m apart in areas of suitable habitat. 4km/hour in open vegetation, 1.5km/hour in dense vegetation Reference population checked 28/09/21, Blackbutt Reserve, numerous plants observed in flower.	2 people over 3 days in September	Survey timing, method and requirements met in areas where access was available
Fauna							
Calyptorhynchus lathami (breeding)	Glossy Black-Cockatoo	Hollow bearing trees in: PCT1646_good PCT1637_good PCT1725_good	Apr-Aug	Search for potential nest hollows. Habitat assessment for preferred food trees along 100m linear transect.	Diurnal census: conducted each morning for a period of 20 minutes, recording all bird species heard or observed within a 1ha area (100 x 100m) area. Visual inspection of hollows from the ground. Two Titley-Scientific Chorus audio recorders were installed for 7 consecutive nights over the period 9 to 16 November, targeting nocturnal birds, but also programmed to document dawn and dusk bird chorus. Opportunistic observations.	Dawn and dusk 20 min census over nine days, autumn and spring	Survey considered adequate to detect if the species is breeding at the Williamtown SAP (in areas that were accessed for survey). Autumn survey within the recommended survey timing.
Cercartetus nanus	Eastern Pygmy-possum	PCT1646_good PCT1637_good PCT1725_good PCT1651_good	Oct-Mar	Arboreal Elliott traps: 24 trap nights over 3-4 consecutive nights	Inspection of 32 nest boxes with pole mounted camera.	Inspection of 32 nest boxes with pole mounted camera.	Nest boxes appear to have been in place long term (installation date is unknown) and considered to be one of the most effective methods of detecting the species.
				Spotlighting on foot: 2 x 1 hour and 1km, walking at approximately 1 km/hr over 2 separate nights	Spotlight searches were undertaken on foot across the subject site and larger study area with a 1,000 lumen spotlight for a period of 100 - 120 minutes per evening.	Spotlight on foot: 13.8 hours over 7 nights, autumn and spring	Survey requirement met
				Spotlighting from vehicle: 2 x 1 km of track, maximum speed of 5 km/hr over 2 separate nights	Not suitable for the Williamtown SAP	Not suitable for the Williamtown SAP	Not suitable for the Williamtown SAP
				Terrestrial trapping using Elliott A traps	4 transects measuring 250m in length with 25 traps spaced ~10m apart. Traps set for 4 continuous nights in both May and November 2021.	800 terrestrial trap nights in total	Traps located in areas of potential habitat, i.e. Banksia spinulosa / Banksia serrata woodland
Crinia tinnula	Wallum Froglet	PCT1742_good PCT1734_good PCT1724 (inundated and low condition) PCT1725_regrowth	All year after flooding rains	Aural-visual surveys, 480 mins, 4 repeat surveys	Quiet listening for frog calls Spotlight in and around areas of suitable habitat	Spotlight: 14 hours over seven nights, autumn and spring	Survey requirement met Spring survey was within the recommended survey timing and during and after rainfall. Species was detected at the Williamtown SAP.

Scientific Name	Common Name	Vegetation Types/Habitats Targeted	Timing	Recommended methods	Methods used	2021Survey Effort	How the survey effort meets guidelines or other recognised best practice methods
				Acoustic recorder, 14 recorder days, 1x14 days.	One Wildlife Acoustics Mini Songmeter was installed on 11 May 2021 at the edge of a small dam supporting emergent aquatic vegetation to record nocturnal frog calls. The songmeter was programmed to switch on at dusk (17:00 hours) and switch off at dawn (06:00 hours). The songmeter was left in-situ for 17 continuous nights and removed on 28 May 2021. One Titley-Scientific Chorus acoustic recorder was set at the same dam over 7 continuous nights from 9 to 16 November 2021. Recordings were downloaded and analysed by Kaleidoscope Audio software.	Songmeter: 34 nights at two sites during autumn Acoustic recorder: 14 nights at two sites during spring	Survey requirement not met, however, other methods were also used and the species was detected on site during optimal survey conditions.
Haliaeetus leucogaster (Breeding)	White-bellied Sea-Eagle	PCT1646_good PCT1637_good PCT1725_good	July - December (if stick nests occur)	Searches for large stick nests within 1km of a rivers, lakes, large dams or creeks, wetlands and coastlines.	Searches for stick nests during other surveys.	Dawn and dusk 20 min census over nine days, autumn and spring	Survey considered adequate and no stick nests were observed at the Williamtown SAP (in areas that were accessed for survey). No courtship behaviour noted and no consistent activity around any particular area of the Williamtown SAP study area to suggest nesting behaviour.
Hieraaetus morphnoides (breeding)	Little Eagle	PCT1646_good PCT1637_good PCT1725_good	August - October (if stick nests occur)	Searches for large stick nests.	Searches for stick nests during other surveys.	Dawn and dusk 20 min census over nine days, autumn and spring	Survey considered adequate as stick nests were not observed at the Williamtown SAP (in areas that were accessed for survey)
Lathamus discolor (breeding)	Swift Parrot	PCT1646_good PCT1637_good PCT1725_good PCT1651_good	N/A	None due to Important Area Maps, however, habitat survey required to refine mapping.	Vegetation mapping to refine areas of suitable habitat.	N/A	N/A
Miniopterus australis (breeding)	Little Bentwing-bat	Flyways in proximity to waterbodies	December - February	Harp trap placed close to exits of caves, mines or tunnels, i.e. potential breeding habitat.	Harp traps were set in areas of suitable habitat (flyways) where there is a higher chance of captures. Individual microbats captured are identified, measured and released the following evening after dusk.	Three sites were sampled by harp trap over 2 nights each in May 2021, and 3 sites in November 2021, for a total of 12 harp trap nights.	Survey requirements are not applicable due to lack of breeding habitat.
Miniopterus orianae oceanensis (breeding)	Eastern Bentwing-bat	Flyways in proximity to waterbodies	December - February	Harp trap placed close to exits of caves, mines or tunnels, i.e. potential breeding habitat.	Harp traps were set in areas of suitable habitat (flyways) where there is a higher chance of captures. Individual microbats captured are identified, measured and released the following evening after dusk.	Three sites were sampled by harp trap over 2 nights each in May 2021, and 3 sites in November 2021, for a total of 12 harp trap nights.	Survey requirements are not applicable due to lack of breeding habitat.

Scientific Name	Common Name	Vegetation Types/Habitats Targeted	Timing	Recommended methods	Methods used	2021Survey Effort	How the survey effort meets guidelines or other recognised best practice methods
Myotis macropus	Southern Myotis	Flyways in proximity to waterbodies. Potential habitat is <2.5km riparian length.	Oct-Mar	Harp trap or mist net, 16 trap nights over min 4 nights	Harp traps were set in areas of suitable habitat (flyways) where there is a higher chance of captures. Individual microbats captured are identified, measured and released the following evening after dusk.	Three sites were sampled by harp trap over 2 nights each in May 2021, and 3 sites in November 2021, for a total of 12 harp trap nights for the study area.	Survey effort by harp trapping short by two nights. However, the guidelines are only indicative of survey effort, and do not always reflect availability of survey sites suitable for a particular species. For instance, setting harp traps for 5 continuous nights per site would meet survey guidelines for survey effort, but exceed survey duration with regard to Ethics approval guidelines.
				Roost search (buildings, bridges etc, 1 search per structure, 30min per structure.	NA	NA	Roosting habitat does not occur
				Acoustic detection, 16 nights over min 4 nights	Echolocation calls of microchiropteran bats were recorded at each bat monitoring site. Calls are recorded by an Anabat Express, Anabat II detectors and Titley Scientific Chorus detectors and stored onto a digital storage card. This technique enables sampling of bat activity for the duration of the night, providing a more comprehensive recording of bat species utilising the study area. All recorded calls were down loaded to a computer for analysis by Anabat Insight (Titley Scientific) software.	Seven sites were sampled over the period 10 to 14 May 2021, and three sites in November 2021.	Survey considered adequate as roosting habitat does not occur and foraging habitat is limited as waterbodies are either overgrown (i.e. Dawson's Drain) or very open exposed waterbodies (culvert drains and stormwater detention ponds).
Ninox connivens (breeding)	Barking Owl	Trees with large hollows in: PCT1646_good PCT1637_good PCT1725_good	May-Dec	1. Look for SIGNS OF BREEDING on site as follows; suitable habitat AND (a) presence of male and female OR (b) calling to each other (duetting) OR (c) find nest.	Diurnal searches on foot of all potential nest trees searching for roosting adults and or characteristic whitewash	10 continuous days in both May and November 2021	No signs of breeding on site, survey requirements met
				2. Where signs of breeding on site are present, POTENTIAL NEST TREES should be identified. Potential nest trees are living or dead trees with hollows greater than 20 cm diameter and greater than 4 m above the ground.	Potential nest trees identified from ground searches	10 continuous days in both May and November 2021	No signs of breeding on site, survey requirements met
				3. Where potential nest trees are identified on site then, night monitoring at the identified potential nest locations for a minimum of 2 nights should be undertaken to detect the presence of any owl of this species using a potential nest tree or demonstrating behaviour focussed on a potential nest tree (e.g. investigating the hollow or roosting within 10 m). DPE is currently developing survey guidance for threatened bird species. In the interim, assessors must undertake species surveys using best practice methods that can be replicated for repeat surveys (as per the BAM threatened species survey requirements).	The nocturnal census comprised quiet listening for characteristic calls following dusk for a period of 30 minutes following dusk. Broad-cast of pre-recorded calls of threatened large forest owls (Powerful Owl, Sooty Owl, Masked Owl, Barking Owl) was conducted later in the evening following completion of spotlight surveys. Calls were broadcast for a period of 2 minutes per species, with a 5 minute quiet interval between each call to listen for responses from each species. Two Wildlife Acoustics Mini Songmeters were installed on 11 May 2021 and programmed to switch on at	Spotlight: 13.8 hours over 7 nights Sound recorders deployed for 48 nights Stagwatch: 120 minutes over four nights	Survey requirement met

Scientific Name	Common Name	Vegetation Types/Habitats Targeted	Timing	Recommended methods	Methods used	2021Survey Effort	How the survey effort meets guidelines or other recognised best practice methods
					dusk (17:00 hours) and switch off at dawn (06:00 hours). Each songmeter was left in-situ for 17 continuous nights and removed on 28 May 2021. Recordings were downloaded and analysed by Kaleidoscope Audio software. Two Titley-Scientific Chorus audio recorders were installed for 7 consecutive nights over the period 9 to 16 November, targeting nocturnal birds, but also programmed to document dawn and dusk bird chorus. Spotlight searches were undertaken on foot across the Williamtown SAP with a 1,000 lumen spotlight for a period of 100 - 120 minutes per evening.		
				4. If monitoring of potential nest trees detects this owl species using, or demonstrating behaviour focussed on the trees (e.g. investigation of the hollow or roosting within 10 m) on site, the species polygons should be drawn around those trees (i.e the identified potential nest trees where any owl of this species is observed using or focussing behaviour around the tree).	NA	NA	No owls found
				Patch: Species is likely to breed and forage within very small patches of vegetation (< 5 ha), especially when the patch is riparian vegetation or where the small patch is within 400 m of another larger patch of vegetation. They are unlikely to nest in the hollows of a paddock tree if the tree is separated from a larger patch of vegetation by more than 400 m of cleared habitat.	NA	NA	No owls found
Ninox strenua (breeding)	Powerful Owl	Trees with large hollows in: PCT1646_good PCT1637_good PCT1725_good	May-Aug	1. Look for SIGNS OF BREEDING on site as follows; suitable habitat AND (a) presence of male and female OR (b) calling to each other (duetting) OR (c) find nest. Note that this species does not respond as well to call-play-back and could require stagwatching and other evidence of nesting.	The nocturnal census comprised quiet listening for characteristic calls following dusk for a period of 30 minutes following dusk. Broad-cast of pre-recorded calls of threatened large forest owls (Powerful Owl, Sooty Owl, Masked Owl, Barking Owl) was conducted later in the evening following completion of spotlight surveys. Calls were broadcast for a period of 2 minutes per species, with a 5 minute quiet interval between each call to listen for responses from each species. Two Wildlife Acoustics Mini Songmeters were installed on 11 May 2021 and programmed to switch on at dusk (17:00 hours) and switch off at dawn (06:00 hours). Each songmeter was left in-situ for 17 continuous nights and removed on 28 May 2021. Recordings were downloaded and analysed by Kaleidoscope Audio software. Two Titley-Scientific Chorus	Spotlight: 13.8 hours over 7 nights Sound recorders deployed for 48 nights Stagwatch: 120 minutes over four nights	Survey requirement met as signs of breeding were not detected.

Scientific Name	Common Name	Vegetation Types/Habitats Targeted	Timing	Recommended methods	Methods used	2021Survey Effort	How the survey effort meets guidelines or other recognised best practice methods
					audio recorders were installed for 7 consecutive nights over the period 9 to 16 November, targeting nocturnal birds, but also programmed to document dawn and dusk bird chorus. Spotlight searches were undertaken on foot across the Williamtown SAP with a 1,000 lumen spotlight for a period of 100 - 120 minutes per evening.		
				2. Where signs of breeding on site are present, POTENTIAL NEST TREES should be identified. Potential nest trees are living or dead trees with hollows greater than 20 cm diameter.	Diurnal searches on foot of all potential nest trees searching for roosting adults and or characteristic whitewash	10 continuous days in both May and November 2021	Survey requirement met
				3. Where potential nest trees are identified on site, night monitoring at the identified potential nest locations for a minimum of 2 nights should be undertaken to detect the presence of any owl of this species using a potential nest tree or demonstrating behaviour focussed on a potential nest tree (e.g. investigating the hollow or roosting within 10 m). DPE is currently developing survey guidance for threatened bird species. In the interim, assessors must undertake species surveys using best practice methods that can be replicated for repeat surveys (as per the BAM threatened species survey requirements).	Potential nest trees identified from ground searches	10 continuous days in both May and November 2021	No signs of breeding on site, survey requirements met
				4. If monitoring of potential nest trees detects this owl species using, or demonstrating behaviour focussed on the trees (e.g. investigation of the hollow or roosting within 10 m) on site, the species polygons should be drawn around those trees (i.e the identified potential nest trees where any owl of this species is observed using, or focussing behaviour around the tree).	Acoustic monitoring	17 nights in May and 7 nights in November 2021	Survey requirement met
Petaurus norfolcensis	Squirrel Glider	PCT1646_good PCT1637_good PCT1725_good PCT1651_good	All year	Arboreal Elliott traps: 24 trap nights over 3-4 consecutive nights	Inspection of 32 nest boxes with pole mounted camera.	Inspection of 32 nest boxes with pole mounted camera.	Some survey methods were not applied, however, effort is considered adequate as the species was detected at the Williamtown SAP.
				Arboreal hair tubes: three tubes in each of 10 habitat trees for 4 days and 4 nights	No survey	No survey	Some survey methods were not applied, however, effort is considered adequate as the species was detected at the Williamtown SAP.
				Spotlighting on foot: 2 x 1 hour and 1km, walking at approximately 1 km/hr over 2 separate nights	Spotlight searches were undertaken on foot across the subject site and larger study area with a 1,000 lumen spotlight for a period of 100 - 120 minutes per evening.	Spotlight: 13.8 hours over 7 nights	Survey requirements met

Scientific Name	Common Name	Vegetation Types/Habitats Targeted	Timing	Recommended methods	Methods used	2021Survey Effort	How the survey effort meets guidelines or other recognised best practice methods
				Spotlighting from vehicle: 2 x 1 km of track, maximum speed of 5 km/hr over 2 separate nights	Note: this recommended technique is not suitable for Squirrel Glider	Note: this recommended technique is not suitable for Squirrel Glider	Recommended survey does not meet best practice methodology for Squirrel Glider. Should be removed from Survey Guidelines (DEC, 2004)
				Call playback: 2 sites/stratification unit up to 200 ha, over 2 separate nights at each site	Note: this recommended technique is not suitable for Squirrel Glider	Note: this recommended technique is not suitable for Squirrel Glider	Recommended survey does not meet best practice methodology for Squirrel Glider. Should be removed from Survey Guidelines (DEC, 2004)
				Stagwatch: observe potential roost hollows for 30 minutes prior to sunset and 60 min after sunset	Stagwatch surveys are conducted where habitat trees (mature trees with hollows) occur within the study area. The technique relies on visual detection of arboreal fauna emerging from tree hollows, or becoming active following dusk.	Stagwatch: 120 minutes over four nights	Survey requirements met
Phascogale tapoatafa	Brush-tailed Phascogale	PCT1646_good PCT1637_good PCT1725_good PCT1651_good	December - June	Survey must be undertaken using baited cameras. The bait type used must remain as an effective attractant until replaced. Cameras must remain in place for a minimum of 4 weeks with cameras checked and baits replaced after 2 weeks. A minimum of 4 cameras, independent of the size of the subject land, must be used for sites up to 1 ha, then an additional 2 cameras for every ha of potential habitat thereafter. Where potential habitat is disconnected by gaps of 50 m or more, each habitat patch should have a minimum of 4 cameras for the first ha, and 2 cameras for every ha thereafter.	Inspection of 32 nest boxes with pole mounted camera. Stagwatch surveys are conducted where habitat trees (mature trees with hollows) occur within the study area. The technique relies on visual detection of arboreal fauna emerging from tree hollows, or becoming active following dusk. Spotlight searches were undertaken on foot across the subject site and larger study area with a 1,000 lumen spotlight for a period of 100 - 120 minutes per evening.	Spotlight: 13.8 hours over 7 nights Stagwatch: 120 minutes over four nights	Cameras were not used, however, nest boxes appear to have been in place long term (installation date is unknown) and can be an effective method of detecting the species.
Phascolarctos cinereus (breeding)	Koala	PCT1646_good PCT1637_good PCT1725_good PCT1651_good	All year	Feed tree survey and then SAT in areas that meet criteria for potential habitat as per SEPP 44.	Spotlight searches were undertaken on foot across the subject site and larger study area with a 1,000 lumen spotlight for a period of 100 - 120 minutes per evening. The following data is recorded during each transect; • time at commencement and completion of transects, and • the identity and number of animal's observed and environmental conditions, i.e. presence of flowering trees. Diurnal searches.	Spotlight: 13.8 hours over 7 nights Sound recorders deployed for 48 nights	Survey guidelines met through diurnal and nocturnal searches and audio recordings. Use of SAT technique not employed as mapping of preferred habitat and presence of preferred feed trees was determine to be more accurate at this site.
Pteropus poliocephalus (breeding)	Grey-headed Flying-fox	PCT1646_good PCT1637_good PCT1725_good	October - December (if breeding camp is detected)	Search for camps and roosting habitat. Daytime camp survey of Flying-fox camp.	Spotlight searches were undertaken on foot across the subject site and larger study area with a 1,000 lumen spotlight for a period of 100 - 120 minutes per evening. The following data is recorded during each transect; • time at commencement and completion of transects, and • the identity and number of animal's observed and environmental	Spotlight: 13.8 hours over 7 nights	Survey requirements only apply if a camp is located on the site.

Scientific Name	Common Name	Vegetation Types/Habitats Targeted	Timing	Recommended methods	Methods used	2021Survey Effort	How the survey effort meets guidelines or other recognised best practice methods
					conditions, i.e. presence of flowering trees. Diurnal searches.		
Tyto novaehollandiae	Masked Owl	Trees with large hollows PCT1646_good PCT1637_good PCT1725_good	May-Aug	As per 2004 guidelines	The nocturnal census comprised quiet listening for characteristic calls following dusk for a period of 30 minutes following dusk. Broad-cast of pre-recorded calls of threatened large forest owls (Powerful Owl, Sooty Owl, Masked Owl, Barking Owl) was conducted later in the evening following completion of spotlight surveys. Calls were broadcast for a period of 2 minutes per species, with a 5 minute quiet interval between each call to listen for responses from each species. Two Wildlife Acoustics Mini Songmeters were installed on 11 May 2021 and programmed to switch on at dusk (17:00 hours) and switch off at dawn (06:00 hours). Each songmeter was left in-situ for 17 continuous nights and removed on 28 May 2021. Recordings were downloaded and analysed by Kaleidoscope Audio software. Two Titley-Scientific Chorus audio recorders were installed for 7 consecutive nights over the period 9 to 16 November, targeting nocturnal birds, but also programmed to document dawn and dusk bird chorus. Spotlight searches were undertaken on foot across the sWilliamtown SAP with a 1,000 lumen spotlight for a period of 100 - 120 minutes per evening.	Spotlight: 13.8 hours over 7 nights Sound recorders deployed for 48 nights Stagwatch: 120 minutes over four nights	Survey requirements met. May survey within recommended survey timing.
Uperoleia mahonyi	Mahony's Toadlet	PCT1742_good PCT1734_good PCT1724 (inundated and low condition) PCT1725_regrowth	Oct-Mar	500 m transect of suitable breeding habitat	Aquatic habitat within the study area was sampled by combination of quiet listening for frog calls, and use of songmeter and Titley Scientific Chorus acoustic detectors placed at specific habitat (i.e. a small dam to record evening calls of frogs).	Spotlight: 14 hours over seven nights, autumn and spring Songmeter: 34 nights at two sites, autumn Acoustic recorder: 14 nights at two sites, spring	Survey requirement met Spring survey within the recommended survey timing and during and after rainfall. Species was not detected at the Williamtown SAP, absence of suitable habitat
Non-target terrestrial species such as Bandicoots, Quolls and Dogs	N/A	N/A	N/A	N/A	Five infra-red motion detection digital cameras were installed within the study area in May 2021, and an additional 4 cameras over the period late September to November, to photograph terrestrial fauna, such as bandicoots, dogs and quolls. The cameras were set at a height of 1.0 – 2.0m above ground.	300 camera trap nights at two sites, autumn and spring 290 nights, 9 sites, autumn and spring	N/A

Scientific Name	Common Name	Vegetation Types/Habitats Targeted	Timing	Recommended methods	Methods used	2021Survey Effort	How the survey effort meets guidelines or other recognised best practice methods
Non-target terrestrial species such as Bandicoots, Quolls and Dogs	N/A	N/A	N/A	N/A	Cameras were installed over two periods: Monday 10 May and retrieved on Friday 28 May, a total of 18 continuous nights per camera, or 90 camera trap nights when combined using 5 cameras. Tuesday 28 September to Thursday 18 November 2021, 50 continuous nights per camera, or 200 camera trap nights when combined using 4 cameras.	290 camera trap nights	Use of cameras detected target species
Non- target reptiles	N/A	N/A	N/A	N/A	Reptiles were searched for under natural (ground logs, rocks, leaf litter) across the study area. Searches for reptiles were conducted from early morning to late afternoon as well as nocturnal spotlight searches, as well as opportunistic sightings whilst conducting other phases of the field survey. The nocturnal survey for reptiles was conducted at the same time as the other fauna groups.	240 minutes over nine days, autumn and spring	N/A

APPENDIX F CANDIDATE SPECIES LIST

Table F.16.1 Ecosystem Credit Species

Scientific name	Common name	EPBC Act	BC Act	Description	Recorded Within SAP	Further Consideration
Anthochaera phrygia	Regent Honeyeater	CE	CE	The Regent Honeyeater is a flagship threatened woodland bird whose conservation will benefit a large suite of other threatened and declining woodland fauna. The species inhabits dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River Sheoak. Regent Honeyeaters inhabit woodlands that support a significantly high abundance and species richness of bird species. These woodlands have significantly large numbers of mature trees, high canopy cover and abundance of mistletoes. Every few years non-breeding flocks are seen foraging in flowering coastal Swamp Mahogany and Spotted Gum forests, particularly on the central coast and occasionally on the upper north coast. Birds are occasionally seen on the south coast. The Regent Honeyeater is a generalist forager, although it feeds mainly on the nectar from a relatively small number of eucalypts that produce high volumes of nectar. Key eucalypt species include Mugga Ironbark, Yellow Box, White Box and Swamp Mahogany. Other tree species may be regionally important.	No	The species has been retained in the BAM-C as suitable habitat occurs within the Williamtown SAP.
Callocephalon fimbriatum	Gang-gang Cockatoo	-	V	In spring and summer, generally found in tall mountain forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. In autumn and winter, the species often moves to lower altitudes in drier more open eucalypt forests and woodlands,particularly box-gum and box-ironbark assemblages, or in dry forest in coastal areas and often found in urban areas. May also occur in sub-alpine Snow Gum (Eucalyptus pauciflora) woodland and occasionally in temperate rainforests. Favours old growth forest and woodland attributes for nesting and roosting. Nests are located in hollows that are 10 cm in diameter or larger and at least 9 m above the ground in eucalypts.	No	The species has been removed from the BAM-C as suitable habitat does not occur within the Williamtown SAP.
Calyptorhynchus lathami	Glossy Black-Cockatoo	-	V	The Glossy Black-cockatoo has not been recorded within the Williamtown SAP since 1998. The species is uncommon although widespread throughout suitable forest and woodland habitats, from the central Queensland coast to East Gippsland in Victoria. Feeds almost	No	The species has been retained in the BAM-C as it has been previously recorded and suitable habitat occurs within the Williamtown SAP.

Scientific name	Common name	EPBC Act	BC Act	Description	Recorded Within SAP	Further Consideration
				exclusively on the seeds of several species of she-oak (Casuarina and Allocasuarina species), shredding the cones with the massive bill. Dependent on large hollow-bearing eucalypts for nest sites.		
Chthonicola sagittata	Speckled Warbler	-	V	The Speckled Warbler lives in a wide range of Eucalyptus dominated communities that have a grassy understorey, often on rocky ridges or in gullies. Typical habitat would include scattered native tussock grasses, a sparse shrub layer, some eucalypt regrowth and an open canopy. Large, relatively undisturbed remnants are required for the species to persist in an area. The diet consists of seeds and insects, with most foraging taking place on the ground around tussocks and under bushes and trees.	No	The species has been removed from the BAM-C as suitable habitat does not occur within the Williamtown SAP.
Daphoenositta chrysoptera	Varied Sittella	-	V	Varied Sitellas are found in eucalypt woodlands and forests throughout their range. They prefer rough-barked trees like stringybarks and ironbarks or mature trees with hollows or dead branches.	No	The species has been retained in the BAM-C as suitable habitat occurs within the Williamtown SAP.
Dasyurus maculatus	Spotted-tailed Quoll	E	V	The range of the Spotted-tailed Quoll has contracted considerably since European settlement. It is now found in eastern NSW, eastern Victoria, south-east and north-eastern Queensland, and Tasmania. Females occupy home ranges of 200-500 hectares, while males occupy very large home ranges from 500 to over 4000 hectares. Are known to traverse their home ranges along densely vegetated creeklines.	No	The species has been retained in the BAM-C as it was previously recorded and suitable habitat occurs within the Williamtown SAP.
Ephippiorhynchus asiaticus	Black-necked Stork	-	E	The Black-necked Stork is the only species of stork found in Australia. In NSW, the species becomes increasingly uncommon south of the Clarence Valley, and rarely occurs south of Sydney. Since 1995, breeding has been recorded as far south as Tomago and Hexham Swamp Nature Reserve. Floodplain wetlands (swamps, billabongs, watercourses and dams) of the major coastal rivers are the key habitat in NSW for the Black-necked Stork. Secondary habitat includes minor floodplains, coastal sandplain wetlands and estuaries.	No	The species has been retained in the BAM-C as suitable habitat occurs within the Williamtown SAP.
Falsistrellus tasmaniensis	Eastern False Pipistrelle	-	V	Utilise hollows for roosting, but will also roost under bark or in man-made structures. They forage in most habitats across their range, with and without trees. Eastern False Pipistrelle are likely to likely to utilise mangroves in Williamtown SAP.	No	The species has been retained in the BAM-C as suitable habitat occurs within the Williamtown SAP.

Scientific name	Common name	EPBC Act	BC Act	Description	Recorded Within SAP	Further Consideration
Glossopsitta pusilla	Little Lorikeet	-	V	Forages primarily in the canopy of open Eucalypt forest and woodland, yet also finds food in Angophora, Melaleuca and other tree species. Riparian habitats are particularly used, due to higher soil fertility and hence greater productivity. Isolated flowering trees in open country, e.g. paddocks, roadside remnants and urban trees also help sustain viable populations of the species. Feeds mostly on nectar and pollen, occasionally on native fruits such as mistletoe, and only rarely in orchards Gregarious, travelling and feeding in small flocks (<10), though often with other lorikeets. Flocks numbering hundreds are still occasionally observed and may have been the norm in past centuries. Roosts in treetops, often distant from feeding areas. Nests in proximity to feeding areas if possible, most typically selecting hollows in the limb or trunk of smooth-barked Eucalypts. Entrance is small (3 cm) and usually high above the ground (2–15 m).	Yes - survey	The species has been retained in the BAM-C as it was recorded during survey and suitable habitat occurs within the Williamtown SAP.
Haliaeetus leucogaster	White-bellied Sea-Eagle	-	V	The White-bellied Sea-Eagle is commonly observed within the Williamtown SAP and broader region. In New South Wales it is widespread along the east coast, and along all major inland rivers and waterways. Habitats are characterised by the presence of large areas of open water including larger rivers, swamps, lakes, and the sea. Terrestrial habitats include coastal dunes, tidal flats, grassland, heathland, woodland, and forest (including rainforest).	Yes (Bionet record)	The species has been retained in the BAM-C as it was previously recorded and suitable habitat occurs within the Williamtown SAP.
Hieraaetus morphnoides	Little Eagle	-	V	This species occupies open eucalypt forest, woodland or open woodland. Sheoak or Acacia woodlands and riparian woodlands of interior NSW are also used.	No	The species has been retained in the BAM-C as suitable habitat occurs within the Williamtown SAP.
Hirundapus caudacutus	White-throated Needletail	V	-	In Australia, the White-throated Needletail is almost exclusively aerial, from heights of less than 1 m up to more than 1000 m above the ground.	No	The species has been retained in the BAM-C as suitable habitat occurs within the Williamtown SAP.
Ixobrychus flavicollis	Black Bittern	-	V	Inhabits both terrestrial and estuarine wetlands, generally in areas of permanent water and dense vegetation. Where permanent water is present, the species may occur in flooded grassland, forest, woodland, rainforest and mangroves.	No	The species has been retained in the BAM-C as suitable habitat occurs within the Williamtown SAP.

Scientific name	Common name	EPBC Act	BC Act	Description	Recorded Within SAP	Further Consideration
				Feeds on frogs, reptiles, fish and invertebrates, including snails, dragonflies, shrimps and crayfish, with most feeding done at dusk and at night. During the day, roosts in trees or on the ground amongst dense reeds. When disturbed, freezes in a characteristic bittern posture (stretched tall, bill pointing up, so that shape and streaked pattern blend with upright stems of reeds), or will fly up to a branch or flush for cover where it will freeze again.		
Lathamus discolor	Swift Parrot	CE	E	The Swift Parrot is endemic to south-eastern Australia, breeding only in Tasmania during spring and summer. It migrates to mainland Australia in the autumn and winter months. Within the Hunter and Mid Coast regions, Swift Parrots have been found to forage regularly in Spotted Gum and Swamp Mahogany forests. Swift Parrots migrate the longest distance of any parrot in the world. The Swift Parrot is listed as endangered in NSW and critically endangered under Commonwealth legislation. In 2015, it was listed under the International Union for Conservation of Nature (IUCN) as critically endangered as research suggested it could become extinct by 2031.	No	The species has been retained in the BAM-C as suitable habitat occurs within the Williamtown SAP.
Lophoictinia isura	Square-tailed Kite	-	V	Found in a variety of timbered habitats including dry woodlands and open forests. Shows a particular preference for timbered watercourses. In arid north-western NSW, has been observed in stony country with a ground cover of chenopods and grasses, open acacia scrub and patches of low open eucalypt woodland. Is a specialist hunter of passerines, especially honeyeaters, and most particularly nestlings, and insects in the tree canopy, picking most prey items from the outer foliage. Appears to occupy large hunting ranges of more than 100km^2. Breeding is from July to February, with nest sites generally located along or near watercourses, in a fork or on large horizontal limbs.	No	The species has been removed from the BAM-C as suitable habitat does not occur within the Williamtown SAP.
Melithreptus gularis gularis	Black-chinned Honeyeater (eastern subspecies)	-	V	Occupies mostly upper levels of drier open forests or woodlands dominated by box and ironbark eucalypts, especially Mugga Ironbark *(Eucalyptus sideroxylon*), White Box (*E. albens*), Inland Grey Box (*E. microcarpa*), Yellow Box (E. *melliodora*), Blakely's Red Gum (*E. blakelyi*) and Forest Red Gum (E. *tereticornis*). Also inhabits open forests of smooth-barked gums, stringybarks, ironbarks, river sheoaks (nesting habitat) and tea-trees. A gregarious species usually seen in pairs and small groups of up to 12 birds.	No	The species has been removed from the BAM-C as suitable habitat does not occur within the Williamtown SAP.

Scientific name	Common name	EPBC Act	BC Act	Description	Recorded Within SAP	Further Consideration
				Feeding territories are large making the species locally nomadic. Recent studies have found that the Black-chinned Honeyeater tends to occur in the largest woodland patches in the landscape as birds forage over large home ranges of at least 5 hectares.		
Micronomus norfolkensis	Eastern Coastal Free-tailed Bat	-	V	Utilise hollows for roosting, but will also roost under bark or in man-made structures. They forage in most habitats across their range, with and without trees. Eastern Coastal Freetail-bat are likely to likely to utilise mangroves in Williamtown SAP.	Yes - survey	The species has been retained in the BAM-C as it was recorded during recent surveys and suitable habitat occurs within the Williamtown SAP.
Miniopterus australis	Little Bent-winged Bat	-	V	Moist eucalypt forest, rainforest, vine thicket, wet and dry sclerophyll forest, Melaleuca swamps, dense coastal forests and banksia scrub. Generally found in well-timbered areas. Little Bentwing-bats roost in caves, tunnels, tree hollows, abandoned mines, stormwater drains, culverts, bridges and sometimes buildings during the day, and at night forage for small insects beneath the canopy of densely vegetated habitats. They often share roosting sites with the Common Bentwing-bat and, in winter, the two species may form mixed clusters.	Yes - survey	The species has been retained in the BAM-C as it was recorded during the recent surveys and suitable habitat occurs within the Williamtown SAP.
Miniopterus orianae oceanensis	Large Bent-winged Bat	-	V	Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other man-made structures. Form discrete populations centred on a maternity cave that is used annually in spring and summer for the birth and rearing of young. Maternity caves have very specific temperature and humidity regimes. At other times of the year, populations disperse within about 300 km range of maternity caves. Cold caves are used for hibernation in southern Australia. Breeding or roosting colonies can number from 100 to 150,000 individuals. Hunt in forested areas, catching moths and other flying insects above the tree tops.	Yes - survey	The species has been retained in the BAM-C as it was recorded during the recent surveys and suitable habitat occurs within the Williamtown SAP.
Neophema pulchella	Turquoise Parrot	-	V	Lives on the edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland. Usually seen in pairs or small, possibly family, groups and have also been reported in flocks of up to thirty individuals. Prefers to feed in the shade of a tree and spends most of the day on the ground searching for the seeds or grasses and herbaceous plants, or browsing on vegetable matter.	No	The species has been retained in the BAM-C as suitable habitat occurs within the Williamtown SAP.

Scientific name	Common name	EPBC Act	BC Act	Description	Recorded Within SAP	Further Consideration
				Forages quietly and may be quite tolerant of disturbance. However, if flushed it will fly to a nearby tree and then return to the ground to browse as soon as the danger has passed. Nests in tree hollows, logs or posts, from August to December. It lays four or five white, rounded eggs on a nest of decayed wood dust.		
Ninox connivens	Barking Owl	-	V	Inhabits woodland and open forest, including fragmented remnants and partly cleared farmland. It is flexible in its habitat use, and hunting can extend in to closed forest and more open areas. Sometimes able to successfully breed along timbered watercourses in heavily cleared habitats (e.g. western NSW) due to the higher density of prey found on these fertile riparian soils. Roost in shaded portions of tree canopies, including tall midstorey trees with dense foliage such as Acacia and Casuarina species. During nesting season, the male perches in a nearby tree overlooking the hollow entrance. Breeding occurs in the hollows of large, old trees. Living eucalypts are preferred though dead trees are also used. Nest sites are used repeatedly over years by a pair, but they may switch sites if disturbed by predators.	No	The species has been retained in the BAM-C as suitable habitat occurs within the Williamtown SAP.
Ninox strenua	Powerful Owl	-	V	The Powerful Owl requires large tracts of forest or woodland habitat but can occur in fragmented landscapes as well. The species breeds and hunts in open or closed sclerophyll forest or woodlands and occasionally hunts in open habitats. It roosts by day in dense vegetation.	Yes - survey	The species has been retained in the BAM-C as it was previously recorded and suitable habitat occurs within the Williamtown SAP.
Pandion cristatus	Eastern Osprey	-	V	This is only one record of the Osprey within the Williamtown SAP from 2000. The species favours coastal areas, especially the mouths of large rivers, lagoons and lakes. They feed on fish over clear, open water. Nests are made high up in dead trees or in dead crowns of live trees, usually within one kilometre of the sea	No	The species has been removed from the BAM-C as suitable habitat does not occur within the Williamtown SAP.
Petaurus australis	Yellow-bellied Glider	-	V	Occur in tall mature eucalypt forest generally in areas with high rainfall and nutrient rich soils. Forest type preferences vary with latitude and elevation; mixed coastal forests to dry escarpment forests in the north; moist coastal gullies and creek flats to tall montane forests in the south. Feed primarily on plant and insect exudates, including nectar, sap, honeydew and manna with pollen and insects providing protein. Extract sap by incising (or biting into) the trunks and branches of favoured food trees, often leaving a distinctive 'V'-shaped scar.	No	The species has been retained in the BAM-C as suitable habitat occurs within the Williamtown SAP.

Scientific name	Common name	EPBC Act	BC Act	Description	Recorded Within SAP	Further Consideration
				Live in small family groups of two - six individuals and are nocturnal. Den, often in family groups, in hollows of large trees. Very mobile and occupy large home ranges between 20 to 85 ha to encompass dispersed and seasonally variable food resources.		
Phoniscus papuensis	Golden-tipped Bat	-	V	Found in rainforest and adjacent wet and dry sclerophyll forest up to 1000m. Also recorded in tall open forest, Casuarina-dominated riparian forest and coastal Melaleuca forests. Bats will fly up to two kilometres from roosts to forage in rainforest and sclerophyll forest on mid and upper-slopes. Roost mainly in rainforest gullies on small first- and second-order streams in usually abandoned hanging Yellow-throated Scrubwren and Brown Gerygone nests modified with an access hole on the underside. Bats may also roost under thick moss on tree trunks, in tree hollows, dense foliage and epiphytes. Bats will use multiple roost and change roosts regularly. Bats roost individually or in small colonies which can contain up to approximately 20 bats of both males and females or just a single sex. Maternity roots may occur away from water sources with one maternity roost found 450m upslope of the nearest water course in a broken bough.	No	The species has been removed from the BAM-C as suitable habitat does not occur within the Williamtown SAP.
Pomatostomus temporalis temporalis	Grey-crowned Babbler (eastern subspecies)	-	V	Inhabits open Box-Gum Woodlands on the slopes, and Box-Cypress-pine and open Box Woodlands on alluvial plains. Woodlands on fertile soils in coastal regions. Flight is laborious so birds prefer to hop to the top of a tree and glide down to the next one. Birds are generally unable to cross large open areas. Live in family groups that consist of a breeding pair and young from previous breeding seasons. A group may consist of up to fifteen birds. All members of the family group remain close to each other when foraging. A soft 'chuck' call is made by all birds as a way of keeping in contact with other group members. Feed on invertebrates, either by foraging on the trunks and branches of eucalypts and other woodland trees or on the ground, digging and probing amongst litter and tussock grasses.	No	The species has been removed from the BAM-C as suitable habitat does not occur within the Williamtown SAP.
Pseudomys gracilicaudatus	Eastern Chestnut Mouse	-	V	In NSW the Eastern Chestnut Mouse is mostly found, in low numbers, in heathland and is most common in dense, wet heath and swamps. In the tropics it is more an animal of grassy woodlands. Optimal habitat appears to be in vigorously regenerating heathland burnt from 18 months to four years previously. By the time the heath is	No	The species has been retained in the BAM-C as suitable habitat occurs within the Williamtown SAP.

Scientific name	Common name	EPBC Act	BC Act	Description	Recorded Within SAP	Further Consideration
				mature, the larger Swamp Rat becomes dominant, and Eastern Chestnut Mouse numbers drop again. Feeds at night via runways through the grassy and sedge understorey, within an area of less than half a hectare. It has a broad diet of grass stems, invertebrates, fungi and seeds, with the relative significance of each component varying seasonally.		
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	Occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are generally located within 20 km of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy. Individual camps may have tens of thousands of animals and are used for mating, and for giving birth and rearing young. The closest recorded camp is located at Raymond Terrace, 2.5km to the north west of the Williamtown SAP.	Yes	The species has been retained in the BAM-C as it was recorded during field surveys and suitable habitat occurs within the Williamtown SAP.
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	-	V	Roosts singly or in groups of up to six, in tree hollows and buildings; in treeless areas they are known to utilise mammal burrows. When foraging for insects, flies high and fast over the forest canopy, but lower in more open country. Forages in most habitats across its very wide range, with and without trees; appears to defend an aerial territory. Breeding has been recorded from December to mid-March, when a single young is born. Seasonal movements are unknown; there is speculation about a migration to southern Australia in late summer and autumn.	No	The species has been retained in the BAM-C as it was previously recorded and suitable habitat occurs within the Williamtown SAP.
Scoteanax rueppellii	Greater Broad-nosed Bat	-	V	Utilise hollows for roosting, but will also roost under bark or in man-made structures. They forage in most habitats across their range, with and without trees. There have been high capture rates for the Greater Broad-nosed Bat in Swamp Forest at Fern Bay	Yes - survey	The species has been retained in the BAM-C as it has been recorded and suitable habitat occurs within the Williamtown SAP.
Syconycteris australis	Common Blossombat	-	V	Common Blossom-bats often roost in littoral rainforest and feed on nectar and pollen from flowers in adjacent heathland and paperbark swamps. They have also been recorded in a range of other vegetation communities, such as subtropical rainforest, wet sclerophyll forest and other coastal forests.	No	The species has been removed from the BAM-C as suitable habitat does not occur within the Williamtown SAP.

Scientific name	Common name	EPBC Act	BC Act	Description	Recorded Within SAP	Further Consideration
				They generally roost individually in dense foliage and vine thickets of the sub-canopy, staying in the same general area for a season. They change roost sites daily, but each roost site is generally only 50m or so away from other recent roosts. Favoured feeding sites are repeatedly visited on consecutive nights within a flowering season and revisted over several years. They require a year round supply of nectar and pollen which is gathered from a mosaic of coastal complex vegetation types. When these vegetation types are in short supply of nectar and pollen (Nov/Dec in northern NSW) Common Blossom-bats have been known to utilise riverine areas containing Black Bean, Silky Oak and Weeping Bottlebrush.		
Tyto novaehollandiae	Masked Owl	-	V	Lives in dry eucalypt forests and woodlands from sea level to 1100 m. A forest owl, but often hunts along the edges of forests, including roadsides. The typical diet consists of tree-dwelling and ground mammals, especially rats. Pairs have a large home-range of 500 to 1000 hectares. Roosts and breeds in moist eucalypt forested gullies, using large tree hollows or sometimes caves for nesting.	No	The species has been retained in the BAM-C as it was previously recorded and suitable habitat occurs within the Williamtown SAP.

Table F.16.2 Species Credit Species

Scientific name	Common name	EPBC Act	BC Act	Description	Likelihood of Occurrence at subject land	Recorded Within Williamtown SAP	Further Consideration
Allocasuarina simulans	Nabiac Casuarina	V	V	Straggling shrub of the sheoak family, 1 to 3 m in height. Ridged branchlets grow to 20 cm long and at each joint there is a whorl of six tiny teeth. Male and female flowers are inconspicuous and occur on separate plants. Oblong woody cones to 3cm long contain the small winged seeds. The Nabiac Casuarina grows in heathland on coastal sands.	Potential	No	No - species was not detected during targeted survey.
Angophora inopina	Charmhaven Apple	V	V	A small to large tree, up to 8 m high, often multi-stemmed, and with persistent shortly fibrous bark throughout. Adult leaves are moderately glossy, leathery and opposite, 4 – 11 cm long. Inflorescences (groups of buds, flowers or fruits) are compound and terminal; the stalk of each group is bristly. Fruits are also bristly, vaguely ribbed, cup- or pear-shaped, usually 3-celled, 11 – 15 mm long, and 9 – 2 mm in diameter.	Potential	No	No - species was not detected during targeted survey.
Asperula asthenes	Trailing Woodruff	V	V	Trailing Woodruff is a low, trailing perennial herb with leaves in whorls of four around the stem. It has tiny fragrant white star-shaped flowers followed by tiny two-lobed fruit, only 1 mm long. Occurs in damp sites, often along river banks.	Potential	No	No - species was not detected during targeted survey.
Burhinus grallarius	Bush Stone-curlew	-	E	Inhabits open forests and woodlands with a sparse grassy groundlayer and fallen timber. Largely nocturnal, being especially active on moonlit nights. Feed on insects and small vertebrates, such as frogs, lizards and snakes. Nest on the ground in a scrape or small bare patch. Two eggs are laid in spring and early summer.	Low	No	No - species was not detected during targeted survey.

Scientific name	Common name	EPBC Act	BC Act	Description	Likelihood of Occurrence at subject land	Recorded Within Williamtown SAP	Further Consideration
Callistemon linearifolius	Netted Bottle Brush	-	V	This shrub is up to 3-4 m tall, with linear (long and narrow) to linear-lanceolate (lance shaped) leaves 8-10 cm long, and 5-7 mm wide with a sharp tip, thickened margins, and distinct lateral veins. Flowers are clustered into the typical "bottlebrushes" of Callistemon species. The brushes are red and usually 9-10 cm long and approximately 50 mm in diameter. The stem upon which the filaments occur are covered in a soft downy hair at flowering. The seed capsules are approximately 7 mm in diameter. Grows in dry sclerophyll forest on the coast and adjacent ranges.	Potential	TBC – sample to be formally identified by Royal Botanic Gardens Plant ID Service	No - species was not detected during targeted survey.
Callocephalon fimbriatum	Gang-gang Cockatoo	-	V	In spring and summer, generally found in tall mountain forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. In autumn and winter, the species often moves to lower altitudes in drier more open eucalypt forests and woodlands, particularly box-gum and box-ironbark assemblages, or in dry forest in coastal areas and often found in urban areas. May also occur in sub-alpine Snow Gum (Eucalyptus pauciflora) woodland and occasionally in temperate rainforests. Favours old growth forest and woodland attributes for nesting and roosting. Nests are located in hollows that are 10 cm in diameter or larger and at least 9 m above the ground in eucalypts.	Low	No	No - species was not detected during targeted survey.
Calyptorhynchus lathami	Glossy Black-Cockatoo	-	V	The Glossy Black-cockatoo has not been recorded within the Williamtown SAP since 1998. The species is uncommon although widespread throughout suitable forest and woodland habitats, from the central Queensland coast to East Gippsland in Victoria. Feeds almost exclusively on the seeds of several species of she-oak (Casuarina and Allocasuarina species), shredding the cones with the massive bill.	Potential	No	No – species was not detected during targeted survey.

Scientific name	Common name	EPBC Act	BC Act	Description	Likelihood of Occurrence at subject land	Recorded Within Williamtown SAP	Further Consideration
				Dependent on large hollow-bearing eucalypts for nest sites.			
Cercartetus nanus	Eastern Pygmy-possum	-	V	Found in a broad range of habitats from rainforest through sclerophyll (including Box-Ironbark) forest and woodland to heath, but in most areas woodlands and heath appear to be preferred, except in north-eastern NSW where they are most frequently encountered in rainforest. Feeds largely on nectar and pollen collected from banksias, eucalypts and bottlebrushes; an important pollinator of heathland plants such as banksias; soft fruits are eaten when flowers are unavailable. Also feeds on insects throughout the year; this feed source may be more important in habitats where flowers are less abundant such as wet forests. Shelters in tree hollows, rotten stumps, holes in the ground, abandoned bird-nests, Ringtail Possum (*Pseudocheirus peregrinus*) dreys or thickets of vegetation, (e.g. grass-tree skirts); nest-building appears to be restricted to breeding females; tree hollows are favoured but spherical nests have been found under the bark of eucalypts and in shredded bark in tree forks.	Potential	No	No – species was not detected during targeted survey.
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	Roosts in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin (*Petrochelidon ariel*), frequenting low to mid-elevation dry open forest and woodland close to these features. Females have been recorded raising young in maternity roosts (c. 20-40 females) from November through to January in roof domes in sandstone caves and overhangs. They remain loyal to the same cave over many years. Found in well-timbered areas containing gullies.	Low	No	No

Scientific name	Common name	EPBC Act	BC Act	Description	Likelihood of Occurrence at subject land	Recorded Within Williamtown SAP	Further Consideration
Corybas dowlingii	Red Helmet Orchid	-	E	The orchid has a solitary dark green heart-shaped to circular leaf 15-35 mm long and 15-35 mm wide ending in a sharp point. The solitary, erect flower grows close to the ground and is dark purplish red with whitish areas in the labellum. Sheltered areas such as gullies and southerly slopes in tall open forest on well-drained gravelly soil at elevations of 10-200 m	Low	No	No
Crinia tinnula	Wallum Froglet	-	V	Wallum Froglets are found in a wide range of habitats, usually associated with acidic swamps on coastal sand plains. They typically occur in sedgelands and wet heathlands. They can also be found along drainage lines within other vegetation communities and disturbed areas, and occasionally in swamp sclerophyll forests.	Known	Yes	Yes – species polygon has been prepared and will be required for a BDAR
Cryptostylis hunteriana	Leafless Tongue Orchid	V	V	Leafless Tongue Orchid produces an upright flower-stem to 45 cm tall, bearing five to 10 flowers. It has small narrow green sepals and petals to 22 mm long, but is dominated by an erect narrow very hairy 'tongue'. Does not appear to have well defined habitat preferences and is known from a range of communities, including swamp-heath and woodland. Little is known about the ecology of the species; being leafless it is expected to have limited photosynthetic capability and probably depends upon a fungal associate to meet its nutritional requirements from either living or dead organic material.	Potential	No	No – species was not detected during targeted survey.
Cynanchum elegans	White-flowered Wax Plant	E	E	The species is a climber or twiner with a highly variable form. Mature stems have a fissured corky bark and can grow to 10 m long and 3.5 cm thick. The leaves are paired (or rarely in threes), ovate to broadly ovate in shape and the flowers are white and tubular. The species usually occurs on the edge of dry rainforest vegetation. Other associated vegetation types include littoral rainforest; Coastal Tea-tree *Leptospermum laevigatum* – Coastal Banksia *Banksia integrifolia*	Potential	No	No – species was not detected during targeted survey.

Scientific name	Common name	EPBC Act	BC Act	Description	Likelihood of Occurrence at subject land	Recorded Within Williamtown SAP	Further Consideration
				subsp. *integrifolia* coastal scrub; Forest Red Gum *Eucalyptus tereticornis* aligned open forest and woodland; Spotted Gum *Corymbia 127aculate* aligned open forest and woodland; and Bracelet Honeymyrtle *Melaleuca armillaris* scrub to open scrub.			
Diuris arenaria	Sand Doubletail	-	E	Occur in the Williamtown area within open coastal forest and along slashed utility corridors and road easements on coastal sand deposits (Jones, 1999; Yare et al., 2020). Flourishes under the increased light conditions afforded by partial clearing of overstorey and understorey, although they do persist in open forest but flower rarely there.	Potential	No	No – species was not detected during targeted survey.
Diuris praecox	Rough Doubletail	V	V	Grows on hills and slopes of near-coastal districts in open forests which have a grassy to fairly dense understorey.	Potential	No	Targeted survey/expert report/assumed presence is required in accordance with BAM requirements to inform the Masterplan and any BDAR
Dromaius rueppell - *endangered population*	Emu population in the New South Wales North Coast Bioregion and Port Stephens local government area	-	E	The population of Emus in the NSW North Coast Bioregion and Port Stephens LGA is of significant conservation value as the last known population in northern coastal NSW, and for the role that birds play in dispersing large seeds of native plant species, and over long distances. The species was formerly widespread in north-eastern NSW, but is now restricted to coastal and near-coastal areas between Evans Head and Red Rock and a small isolated population further west in the Bungawalbin area. It is not known whether a natural population continues to persist in the Port Stephens area although there are some confirmed records within farmland along Nelson Bay Road.	Potential	Yes	No – species was not detected during targeted survey.
Eucalyptus camfieldii	Camfield's Stringybark	V	V	Mostly mallee to 4 m tall though can grow to a straggly tree to 9 m high. Bark is rough, fibrous and stringy, red or dark grey-brown. Juvenile leaves round to heart	Potential	No	No - species was not detected during targeted survey.

Scientific name	Common name	EPBC Act	BC Act	Description	Likelihood of Occurrence at subject land	Recorded Within Williamtown SAP	Further Consideration
				shaped and roughly hairy. Adult leaves broadly lance-shaped, to 10 by 3 cm, glossy green. Flowers creamy-white. Buds egg-shaped, stalkless, to 8 mm long in clusters of 11 or more; bud caps conical. Fruit flattened, globe-shaped, to 9 mm across, with valves enclosed or with tips protruding. This species is historically known only from skeletal soils on elevated sandstone habitats south from the Gosford district, but populations on coastal sand deposits have surfaced in recent years and require investigation. Tomago populations are not typical of the more southern plants, and it is possible that these plants form part of the more widespread Eucalyptus capitellata complex, and a taxonomic review is required.			
Eucalyptus parramattensis subsp. decadens	Eucalyptus parramattensis subsp. decadens	V	V	A woodland tree, up to 15 m, but usually to about 8 – 10m in height. Bark sheds in large plates to leave a smooth, granular and mottled white or grey surface. Juvenile and adult leaves are disjunct. Juvenile leaves are narrow-lanceolate to lanceolate, dull green both sides. Adult leaves are usually lance-shaped to about 15 cm long and 2 cm wide. Inflorescences are 7–flowered. Buds are ovoid 4 – 10mm long, 4 – 6 mm in diameter with a scar present. Fruit is hemispherical or globose 4 – 9 mm long, 5 – 9 mm in diameter, with the disc flat or slightly raised, usually with four exserted valves. This Hunter Valley endemic is known only from the region between Cessnock and Port Stephens, where it occurs in two clear meta-populations separated by the Hunter River (Bell, 2006). One of these occupies the majority of the Tomago Sandbeds and includes the Williamtown SAP, where it occurs in three main vegetation communities. Populations within these habitats should be retained to preserve this taxon into the future	Known	Yes	No - individual trees were counted, however, all occur in the DAREZ.

Scientific name	Common name	EPBC Act	BC Act	Description	Likelihood of Occurrence at subject land	Recorded Within Williamtown SAP	Further Consideration
Galium australe	Tangled Bedstraw	E	-	Tangled Bedstraw is a straggling and inter-twining herb with weak, hairy stems to 60 cm long. The leaves are in whorls of four; each is up to 12 mm long by 4 mm wide. One to seven small (about 2 mm long) white flowers occur on stalks to 12 mm long. Fruits are about 1.5 mm long with numerous hooked hairs. Tangled Bedstraw has been recorded in Turpentine forest and coastal Acacia shrubland.	Potential	No	No – species was not detected during targeted survey.
Genoplesium baueri	Bauer's Midge Orchid	E	E	A terrestrial orchid 6-15 cm high, fleshy, brittle, yellowish-green or reddish. Inflorescence sparse, 1-3 cm long, 1-6-flowered. Flowers approximately 15 mm across, green and red or wholly reddish. Grows in dry sclerophyll forest and moss gardens over sandstone.	Potential	No	Targeted survey/expert report/assumed presence is required in accordance with BAM requirements to inform the Masterplan and any BDAR
Grevillea parviflora subsp. parviflora	Small-flower Grevillea	V	V	A low spreading to erect shrub, usually less than a metre high. It has erect narrow leaves are 2-3.5 mm long and less than 1.3mm wide, with silky hairs on the underside and a short pointed tip. Leaf margins are curved back, or even rolled completely under. The small flowers clustered in groups of 6-12. The whole flower, both tube and protruding style, is white, aging to pinkinsh-red, with rusty-brown hairs on the outside of the corolla. Grows in sandy or light clay soils usually over thin shales, often with lateritic ironstone gravels and nodules. Sydney region occurrences are usually on Tertiary sands and alluvium, and soils derived from the Mittagong Formation. Soil landscapes include Lucas Heights or Berkshire Park. Occurs in a range of vegetation types from heath and shrubby woodland to open forest.	Potential	No	No – species was not detected during targeted survey.

Scientific name	Common name	EPBC Act	BC Act	Description	Likelihood of Occurrence at subject land	Recorded Within Williamtown SAP	Further Consideration
Haliaeetus leucogaster (Breeding)	White-bellied Sea-Eagle	-	V	The White-bellied Sea-Eagle is commonly observed within the Williamtown SAP and broader region. In New South Wales it is widespread along the east coast, and along all major inland rivers and waterways. Habitats are characterised by the presence of large areas of open water including larger rivers, swamps, lakes, and the sea. Terrestrial habitats include coastal dunes, tidal flats, grassland, heathland, woodland, and forest (including rainforest).	Potential	Yes	No – breeding habitat does not occur in the Williamtown SAP
Hieraaetus morphnoides (Breeding)	Little Eagle	-	V	This species occupies open eucalypt forest, woodland or open woodland. Sheoak or Acacia woodlands and riparian woodlands of interior NSW are also used.	Potential	No	No – breeding habitat does not occur in the Williamtown SAP
Hoplocephalus bitorquatus	Pale-headed Snake	-	V	The Pale-headed Snake is a highly cryptic species that can spend weeks at a time hidden in tree hollows. Found mainly in dry eucalypt forests and woodlands, cypress forest and occasionally in rainforest or moist eucalypt forest. In drier environments, it appears to favour habitats close to riparian areas. Shelter during the day between loose bark and tree-trunks, or in hollow trunks and limbs of dead trees. The main prey is tree frogs although lizards and small mammals are also taken.	Low	No	No – species was not detected during targeted survey.
Lathamus discolor (Breeding)	Swift Parrot	CE	E	The Swift Parrot is endemic to south-eastern Australia, breeding only in Tasmania during spring and summer. It migrates to mainland Australia in the autumn and winter months. Within the Hunter and Mid Coast regions, Swift Parrots have been found to forage regularly in Spotted Gum and Swamp Mahogany forests. Swift Parrots migrate the longest distance of any parrot in the world. The Swift Parrot is listed as endangered in NSW and critically endangered under Commonwealth legislation. In 2015, it was listed under the International Union for Conservation of Nature (IUCN) as critically	Known	Yes	Yes – species polygon has been prepared and will be required for a BDAR. Potential for Serious and Irreversible Impacts (SAII)

Scientific name	Common name	EPBC Act	BC Act	Description	Likelihood of Occurrence at subject land	Recorded Within Williamtown SAP	Further Consideration
				endangered as research suggested it could become extinct by 2031.			
Lindernia alsinoides	Noah's False Chickweed	-	E	Diffuse or erect annual herb to 15 cm high. Leaves are opposite, 5-10 mm long and 1.5-5 mm wide, oval-shaped to more or less circular at the base of the plant and almost linear near the flowers. There are 3 veins from the base of the leaf. The leaf stalk is 3 mm long. There are 1-8 blue and white hooded and lobed flowers, approximately 5.5-8.5 mm long. Grows in swamp forests and wetlands along coastal and hinterland creeks	Potential	No	No – species was not detected during targeted survey.
Litoria aurea	Green and Golden Bell Frog	V	E	Inhabits marshes, dams and stream-sides, particularly those containing bullrushes (*Typha* spp.) or spikerushes (*Eleocharis* spp.). Optimum habitat includes water-bodies that are unshaded, free of predatory fish such as Plague Minnow (*Gambusia holbrooki*), have a grassy area nearby and diurnal sheltering sites available. Some sites, particularly in the Greater Sydney region occur in highly disturbed areas.	Unlikely	No	No – suitable habitat does not occur
Litoria brevipalmata	Green-thighed Frog	-	V	Green-thighed Frogs occur in a range of habitats from rainforest and moist eucalypt forest to dry eucalypt forest and heath, typically in areas where surface water gathers after rain. It prefers wetter forests in the south of its range, but extends into drier forests in northern NSW and southern Queensland. Breeding occurs following heavy rainfall from spring to autumn, with larger temporary pools and flooded areas preferred. Frogs may aggregate around breeding sites and eggs are laid in loose clumps among waterplants, including water weeds. The larvae are free swimming. The frogs are thought to forage in leaf-litter.	Unlikely	No	No – suitable habitat does not occur

Scientific name	Common name	EPBC Act	BC Act	Description	Likelihood of Occurrence at subject land	Recorded Within Williamtown SAP	Further Consideration
Lophoictinia isura (Breeding)	Square-tailed Kite	-	V	Found in a variety of timbered habitats including dry woodlands and open forests. Shows a particular preference for timbered watercourses. In arid north-western NSW, has been observed in stony country with a ground cover of chenopods and grasses, open acacia scrub and patches of low open eucalypt woodland. Is a specialist hunter of passerines, especially honeyeaters, and most particularly nestlings, and insects in the tree canopy, picking most prey items from the outer foliage. Appears to occupy large hunting ranges of more than 100km^2. Breeding is from July to February, with nest sites generally located along or near watercourses, in a fork or on large horizontal limbs.	Unlikely	No	No – breeding habitat does not occur in the Williamtown SAP
Maundia triglochinoides		-	V	Perennial with rhizomes about 5mm thick and emergent tufts of leaves arising along their length. Leaves are spongy, inflated and triangular in cross section, to 80 cm long, sometimes longer, 5 – 10mm wide. Inflorescence to 10cm long and 2.5 cm wide. Carpels (female parts of flower) 6 – 8mm long, sessile, each with a spreading beak. The fruit is 1cm long to 8mm wide. Grows in swamps, lagoons, dams, channels, creeks or shallow freshwater 30 – 60 cm deep on heavy clay, low nutrients.	High	Yes	Yes – potential to occur in areas that could not be surveyed.
Melaleuca biconvexa	Biconvex Paperbark	V	V	Biconvex Paperbark generally grows in damp places, often near streams or low-lying areas on alluvial soils of low slopes or sheltered aspects. Flowering occurs over just 3-4 weeks in September and October. Resprouts following fire.	Low. The existing record is a planting HWB offices.	No	No

Scientific name	Common name	EPBC Act	BC Act	Description	Likelihood of Occurrence at subject land	Recorded Within Williamtown SAP	Further Consideration
Melaleuca groveana	Grove's Paperbark	-	V	Grove's Paperbark is a shrub or small tree from 2 – 5 m tall, rarely to 10 m, with firm fibrous-papery bark. The narrow, curved leaves are alternate, 20 – 55 mm long, 3 – 8 mm wide and have a mid vein and lateral veins. The leaves point along the stem and branchlets. The fluffy white flowers form on short spikes 2 – 3 cm long, and appear in the spring. The woody fruit is barrel-shaped with a smooth outer surface, 4 – 7 mm in diameter. Grove's Paperbark grows in heath and shrubland, often in exposed sites, in low coastal hills, escarpment ranges and tablelands on outcopping granite, rhyolite and sandtone on rocky outcrops and cliffs. It also occurs in dry srubby open forest and woodlands.	No	No	No
Miniopterus australis (Breeding)	Little Bent-winged Bat	-	V	Moist eucalypt forest, rainforest, vine thicket, wet and dry sclerophyll forest, Melaleuca swamps, dense coastal forests and banksia scrub. Generally found in well-timbered areas. Little Bentwing-bats roost in caves, tunnels, tree hollows, abandoned mines, stormwater drains, culverts, bridges and sometimes buildings during the day, and at night forage for small insects beneath the canopy of densely vegetated habitats. They often share roosting sites with the Common Bentwing-bat and, in winter, the two species may form mixed clusters.	Known	Yes	No – breeding habitat does not occur in the Williamtown SAP
Miniopterus orianae oceanensis (Breeding)	Large Bent-winged Bat	-	V	Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other man-made structures. Form discrete populations centred on a maternity cave that is used annually in spring and summer for the birth and rearing of young. Maternity caves have very specific temperature and humidity regimes. At other times of the year, populations disperse within about 300 km range of maternity caves.	Known	Yes	No – breeding habitat does not occur in the Williamtown SAP

Scientific name	Common name	EPBC Act	BC Act	Description	Likelihood of Occurrence at subject land	Recorded Within Williamtown SAP	Further Consideration
				Cold caves are used for hibernation in southern Australia. Breeding or roosting colonies can number from 100 to 150,000 individuals. Hunt in forested areas, catching moths and other flying insects above the tree tops.			
Myotis macropus	Southern Myotis	-	V	Southern Myotis generally roost close to water in caves, mine shafts, hollow-bearing trees, stormwater channels, buildings, under bridges and in dense foliage. They forage over streams and pools catching insects and small fish by raking their feet across the water surface.	Potential	No	No – species was not detected during targeted survey.
Ninox connivens (Breeding)	Barking Owl	-	V	Inhabits woodland and open forest, including fragmented remnants and partly cleared farmland. It is flexible in its habitat use, and hunting can extend in to closed forest and more open areas. Sometimes able to successfully breed along timbered watercourses in heavily cleared habitats (e.g. western NSW) due to the higher density of prey found on these fertile riparian soils. Roost in shaded portions of tree canopies, including tall midstorey trees with dense foliage such as Acacia and Casuarina species. During nesting season, the male perches in a nearby tree overlooking the hollow entrance. Breeding occurs in the hollows of large, old trees. Living eucalypts are preferred though dead trees are also used. Nest sites are used repeatedly over years by a pair, but they may switch sites if disturbed by predators.	Potential	No	No – evidence of breeding was not detected during surveys
Ninox strenua (Breeding)	Powerful Owl	-	V	The Powerful Owl requires large tracts of forest or woodland habitat but can occur in fragmented landscapes as well. The species breeds and hunts in open or closed sclerophyll forest or woodlands and occasionally hunts in open habitats. It roosts by day in dense vegetation.	Potential	No (evidence of foraging only)	No – evidence of breeding was not detected during surveys

Scientific name	Common name	EPBC Act	BC Act	Description	Likelihood of Occurrence at subject land	Recorded Within Williamtown SAP	Further Consideration
Pandion cristatus (Breeding)	Eastern Osprey	-	V	This is only one record of the Osprey within the Williamtown SAP from 2000. The species favours coastal areas, especially the mouths of large rivers, lagoons and lakes. They feed on fish over clear, open water. Nests are made high up in dead trees or in dead crowns of live trees, usually within one kilometre of the sea	Unlikely	No	No
Persicaria elatior	Tall Knotweed	V	V	Tall Knotweed is an erect herb to 90 cm tall, with stalked, glandular hairs (i.e. they are knobbed when seen under a lens) on most plant parts. Its leaves are up to 11 cm long and 30 mm wide. A sheath encircles the stem at the base of each leaf, which is characteristic of its plant family. Its tiny flowers are in long, narrow spikes to 5 cm long. The pink flower-segments are less than 4 mm long. This species normally grows in damp places, especially beside streams and lakes. Occasionally in swamp forest or associated with disturbance.	Potential	No	Targeted survey/expert report/assumed presence is required in accordance with BAM requirements to inform the Masterplan and any BDAR
Petalura gigantea	Giant Dragonfly	-	E	Live in permanent swamps and bogs with some free water and open vegetation. Females lay eggs into moss, under other soft ground layer vegetation, and into moist litter and humic soils, often associated with groundwater seepage areas within appropriate swamp and bog habitats. The species does not utilise areas of standing water wetland, although it may utilise suitable boggy areas adjacent to open water wetlands. Larvae dig long branching burrows under the swamp. Larvae are slow growing and the larval stage may last 10 years or more. It is thought that larvae leave their burrows at night and feed on insects and other invertebrates on the surface and also use underwater entrances to hunt for food in the aquatic vegetation.	Unlikely	No	No

Scientific name	Common name	EPBC Act	BC Act	Description	Likelihood of Occurrence at subject land	Recorded Within Williamtown SAP	Further Consideration
Petaurus norfolcensis	Squirrel Glider	-	V	The species is widely though sparsely distributed in eastern Australia. Prefers mixed species stands with a shrub or Acacia midstorey. Live in family groups of a single adult male one or more adult females and offspring. Require abundant tree hollows for refuge and nest sites.	Known	Yes	Yes – species polygon has been prepared and will be required for a BDAR
Petauroides volans	Greater Glider	E	E	Feeds exclusively on eucalypt leaves, buds, flowers and mistletoe. Shelter during the day in tree hollows and will use up to 18 hollows in their home range.	Potential	No	No – was not detected during surveys
Phascogale tapoatafa	Brush-tailed Phascogale	-	V	The Brush-tailed Phascogale has a patchy distribution around the coast of Australia. Prefer dry sclerophyll open forest with sparse groundcover of herbs, grasses, shrubs or leaf litter. Also inhabit heath, swamps, rainforest and wet sclerophyll forest. Females have exclusive territories of approximately 20 - 40 ha, while males have overlapping territories often greater than 100 ha.	Potential	No	No – was not detected during surveys
Phascolarctos cinereus (Breeding)	Koala	V	V	The Koala has a fragmented distribution throughout eastern Australia. They feed on the foliage of more than 70 eucalypt species and 30 non-eucalypt species, but in any one area will select preferred browse species.	Known	Yes	Yes – species polygon has been prepared and will be required for a BDAR
Planigale maculata	Common Planigale	-	V	Common Planigales inhabit rainforest, eucalypt forest, heathland, marshland, grassland and rocky areas where there is surface cover, and usually close to water. They are active at night and during the day shelter in saucer-shaped nests built in crevices, hollow logs, beneath bark or under rocks. They are fierce carnivorous hunters and agile climbers, preying on insects and small vertebrates, some nearly their own size. They breed from October to January. The female builds a nest lined with grass, eucalypt leaves or shredded bark.	Unlikely	No	No

Scientific name	Common name	EPBC Act	BC Act	Description	Likelihood of Occurrence at subject land	Recorded Within Williamtown SAP	Further Consideration
Potorous tridactylus	Long-nosed Potoroo	V	V	Inhabits coastal heaths and dry and wet sclerophyll forests. Dense understorey with occasional open areas is an essential part of habitat, and may consist of grass-trees, sedges, ferns or heath, or of low shrubs of tea-trees or melaleucas. A sandy loam soil is also a common feature. The fruit-bodies of hypogeous (underground-fruiting) fungi are a large component of the diet of the Long-nosed Potoroo. They also eat roots, tubers, insects and their larvae and other soft-bodied animals in the soil.	Unlikely	No	No
Prostanthera densa	Villous Mint-bush	V	V	Erect mint-smelling shrub to 2 m tall, though in the southern part of its range it is rarely more than 1 m tall. Branches and leaves are covered with long, spreading hairs. The leaves are in pairs and almost triangular in shape, to 15 mm long and 12 mm wide. Prostanthera densa generally grows in sclerophyll forest and shrubland on coastal headlands and near coastal ranges, chiefly on sandstone, and rocky slopes near the sea. Plants regenerate from rootstock after fire and flower within the first year or two. In Port Stephens it occurs on volcanic peaks.	Unlikely	No	No
Pteropus poliocephalus (Breeding)	Grey-headed Flying-fox	V	V	Occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are generally located within 20 km of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy. Individual camps may have tens of thousands of animals and are used for mating, and for giving birth and rearing young. The closest recorded camp is located at Raymond Terrace, 2.5km to the north west of the Williamtown SAP.	Known	Yes	No – breeding habitat does not occur in the Williamtown SAP

Scientific name	Common name	EPBC Act	BC Act	Description	Likelihood of Occurrence at subject land	Recorded Within Williamtown SAP	Further Consideration
Pterostylis chaetophora	Tall Rusty Hood	-	V	A terrestrial orchid with a slender flowering stem to 40 cm with up to 5 closely sheathing stem leaves. Leave are elliptic to ovate, up to 3.5 cm long and 15 mm wide. Up to 8 leaves form the basal rosette that slightly ascends the stem. The 4 - 10 (12) flowers are 1.5 cm long, semi-erect, transparent with red-brown suffusions. The preferred habitat is seasonally moist, dry sclerophyll forest with a grass and shrub understorey. The most commonly observed habitat is vegetation characterised by grassy open forests or derived native grasslands of *Eucalyptus amplifolia* and *Eucalyptus moluccana* on gentle flats, or that are dominated by *Corymbia maculata* with any of *Eucalyptus fibrosa, Eucalyptus sideroploia* or *Eucalyptus crebra*.	Unlikely	No	No
Rhizanthella slateri	Eastern Australian Underground Orchid	E	V	An orchid with a whitish, fleshy underground stem to 15 cm long and 15 mm diameter. The flowering heads mature below the soil surface or may extend to 2 cm above the ground. Each flower head has up to 30, tubular, purplish flowers. Habitat requirements are poorly understood and no particular vegetation type has been associated with the species, although it is known to occur in sclerophyll forest. Highly cryptic given that it grows almost completely below the soil surface, with flowers being the only part of the plant that can occur above ground. Therefore usually located only when the soil is disturbed. Flowers September to November.	Unlikely	No	No
Syzygium paniculatum	Magenta Lilly Pilly	E	V	A small to medium rainforest tree that grows to 8 m tall. The bark is flaky and the leaves are shiny, dark-green above and paler underneath. Plants produce deep magenta fruits and white flower-clusters at the end of each branch, between November and February.	Potential	No	No – was not detected during targeted survey

Scientific name	Common name	EPBC Act	BC Act	Description	Likelihood of Occurrence at subject land	Recorded Within Williamtown SAP	Further Consideration
				On the south coast the Magenta Lilly Pilly occurs on grey soils over sandstone, restricted mainly to remnant stands of littoral (coastal) rainforest. On the central coast Magenta Lilly Pilly occurs on gravels, sands, silts and clays in riverside gallery rainforests and remnant littoral rainforest communities.			
Tetratheca juncea	Black-eyed Susan	V	V	It is usually found in low open forest/woodland with a mixed shrub understorey and grassy groundcover. However, it has also been recorded in heathland and moist forest. The majority of populations occur on low nutrient soils associated with the Awaba Soil Landscape. While some studies show the species has a preference for cooler southerly aspects, it has been found on slopes with a variety of aspects. It generally prefers well-drained sites below 200m elevation and annual rainfall between 1000 - 1200mm. The preferred substrates are sandy skeletal soil on sandstone, sandy-loam soils, low nutrients; and clayey soil from conglomerates, pH neutral. It usually spreads via underground stems which can be up to 50 cm long. Consequently, individual plants may be difficult to identify. It also reproduces sexually but this requires insect pollination.	Potential	No	No – was not detected during targeted survey
Thesium australe	Austral Toadflax	V	V	Occurs in grassland on coastal headlands or grassland and grassy woodland away from the coast. Often found in association with Kangaroo Grass (*Themeda triandra*). A root parasite that takes water and some nutrient from other plants, especially Kangaroo Grass.	Unlikely	No	No
Tyto novaehollandiae	Masked Owl	-	V	Lives in dry eucalypt forests and woodlands from sea level to 1100 m. A forest owl, but often hunts along the edges of forests, including roadsides.	Unlikely	No	No

Scientific name	Common name	EPBC Act	BC Act	Description	Likelihood of Occurrence at subject land	Recorded Within Williamtown SAP	Further Consideration
				The typical diet consists of tree-dwelling and ground mammals, especially rats. Pairs have a large home-range of 500 to 1000 hectares. Roosts and breeds in moist eucalypt forested gullies, using large tree hollows or sometimes caves for nesting.			
Uperoleia mahonyi	Mahony's Toadlet	-	E	Mahony's Toadlet is endemic to the central coast of New South Wales (NSW) and to date has been found between Kangy Angy and Seal Rocks. Current observations indicate Mahony's Toadlet inhabits ephemeral and semi-permanent swamps and swales on the coastal fringe. Known records occur in heath or wallum habitats almost exclusively associated with leached (highly nutrient impoverished) white sand. Commonly associated with acid paperbark swamps, Mahony's Toadlet also is known to occur in wallum heath, swamp mahogany-paperbark swamp forest, heath shrubland and Sydney red gum woodland. Recent studies suggest intact vegetation adjacent to and within water bodies is an important habitat feature for this species. Limited information exists on ecological information such as fecundity, survival rates, specific habitat attributes, and response to disturbance.	Potential	No	No - species was not detected during targeted survey.
Vespadelus troughtoni	Eastern Cave Bat	-	V	Very little is known about the biology of this uncommon species. A cave-roosting species that is usually found in dry open forest and woodland, near cliffs or rocky overhangs; has been recorded roosting in disused mine workings, occasionally in colonies of up to 500 individuals. Occasionally found along cliff-lines in wet eucalypt forest and rainforest. Little is understood of its feeding or breeding requirements or behaviour.	Unlikely	No	No

APPENDIX G PRELIMINARY BAM CREDIT REPORT

BAM Credit Summary Report

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00025885/BAAS18088/21/00025886	Williamtown SAP - Structure Plan	14/10/2022
Assessor Name	Report Created	BAM Data version *
Evelyn Craigie	12/12/2022	55
Assessor Number	BAM Case Status	Date Finalised
BAAS18088	Open	To be finalised
Assessment Revision	Assessment Type	BOS entry trigger
1	Part 4 Developments (General)	BOS Threshold: Area clearing threshold

* 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	TEC name	Current Vegetation integrity score	Change in Vegetation integrity (loss / gain)	Area (ha)	Sensitivity to loss (Justification)	Species sensitivity to gain class	BC Act Listing status	EPBC Act listing status	Biodiversity risk weighting	Potential SAII	Ecosystem credits

Broad-leaved Paperbark - Swamp Oak - Saw Sedge swamp forest on coastal lowlands of the Central Coast and Lower North Coast												
3	1724_inundated	Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	23.1	23.1	3.8	PCT Cleared - 31%	High Sensitivity to Gain	Endangered Ecological Community	Not Listed	2.00		44
4	1724_low	Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	12.6	12.6	4.5	PCT Cleared - 31%	High Sensitivity to Gain	Endangered Ecological Community	Not Listed	2.00		0
											Subtotal	**44**

Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast												
1	1646_good	Not a TEC	57.9	57.9	0.06	PCT Cleared - 45%	High Sensitivity to Gain			1.50		1
2	1646_regrowth	Not a TEC	28.1	28.1	0.54	PCT Cleared - 45%	High Sensitivity to Gain			1.50		6
											Subtotal	**7**
											Total	**51**

Species credits for threatened species

Vegetation zone name	Habitat condition (Vegetation Integrity)	Change in habitat condition	Area (ha)/Count (no. individuals)	Sensitivity to loss (Justification)	Sensitivity to gain (Justification)	BC Act Listing status	EPBC Act listing status	Potential SAII	Species credits
Crinia tinnula / Wallum Froglet (Fauna)									
1724_low	12.6	12.6	4.5			Vulnerable	Not Listed	False	21
1724_inundated	23.1	23.1	3.8			Vulnerable	Not Listed	False	33
								Subtotal	**54**
Lathamus discolor / Swift Parrot (Fauna)									
1646_good	57.9	57.9	0.06			Endangered	Critically Endangered	True	3
1646_regrowth	28.1	28.1	0.53			Endangered	Critically Endangered	True	11

1724_inundated	23.1	23.1	0.88			Endangered	Critically Endangered	True	15
								Subtotal	**29**
Petaurus norfolcensis / Squirrel Glider (Fauna)									
1646_good	57.9	57.9	0.06			Vulnerable	Not Listed	False	2
								Subtotal	**2**
Phascolarctos cinereus / Koala (Fauna)									
1646_good	57.9	57.9	0.06			Endangered	Endangered	False	2
								Subtotal	**2**

ERM has over 160 offices across the following countries and territories worldwide

Argentina
Australia
Belgium
Brazil
Canada
Chile
China
Colombia
France
Germany
Ghana
Guyana
Hong Kong
India
Indonesia
Ireland
Italy
Japan
Kazakhstan
Kenya
Malaysia
Mexico
Mozambique
The Netherlands
New Zealand
Norway
Panama
Peru
Poland
Portugal
Puerto Rico
Romania
Senegal
Singapore
South Africa
South Korea
Spain
Sweden
Switzerland
Taiwan
Tanzania
Thailand
UAE
UK
US
Vietnam

ERM's Newcastle Office
Level 1 Watt Street Commercial Centre
45 Watt Street
Newcastle NSW 2300

P: (02) 4903 5500
F: (02) 4929 5363

www.erm.com

The business of sustainability

ERM