

## Appendix K2

### Offsets strategy





## **Department of Infrastructure and Regional Development**

### **Western Sydney Airport EIS Biodiversity Offset Package**

October 2015

## Limitations

*This report has been prepared by GHD for the Commonwealth and may only be used and relied on by the Commonwealth for the purpose agreed between GHD and the Commonwealth as set out in Section 1.2 of this report. GHD otherwise disclaims responsibility to any person other than the Commonwealth arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.*

*The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.*

*The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.*

*The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report in Sections 2 to 5 and GHD disclaims liability arising from any of the assumptions being incorrect.*

*This offset package is only for the proposal that is the subject of the EIS (i.e. Stage 1 of the Western Sydney Airport).*

*GHD has prepared this report on the basis of information provided by the Commonwealth and others who provided information to GHD, which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were included in the information provided by the Commonwealth.*

*The amount of offset required for matters protected under the EPBC Act will be calculated by the Department of the Environment using the offset assessment guide based on inputs identified by GHD in the biodiversity offset package. The Department may choose to adjust values or assumptions in the offset assessment guide which may affect the amount of offset required.*

# Table of contents

1.	Introduction .....	1
1.1	Background .....	1
1.2	Purpose of report .....	3
1.3	BioBanking .....	4
1.4	Relationship with other reports .....	5
2.	Offset Requirements for EPBC Act-listed Biota .....	7
2.1	Identification of affected threatened biota .....	7
2.2	Impacts on affected threatened biota .....	8
3.	Offset Requirements for Impacts on the Environment .....	23
3.1	Overview .....	23
3.2	Credit calculations .....	23
3.3	Biodiversity credits .....	28
3.4	Assumptions and amendments to the BioBanking methodology .....	30
4.	Proposed Offsets .....	33
4.1	Proposed offset strategy .....	33
4.2	Identification of potential offset sites .....	33
4.3	Description of potential offset sites .....	34
4.4	Proposed offset areas .....	39
4.5	Management of offset sites .....	43
5.	Offset Assessment Guide Calculations .....	47
5.1	Overview .....	47
5.2	Quality of offset sites .....	47
5.3	Alternative environmental contributions .....	53
5.4	Preliminary offset assessment guide calculations .....	54
6.	Delivery of Offsets .....	61
6.1	Purchase and retirement of biodiversity credits .....	61
6.2	Identification of additional offsets .....	64
6.3	Cost of delivery of offsets .....	65
6.4	Finalisation of the offset package .....	66
6.5	Consistency with EPBC Act offset policy .....	66
7.	Conclusions .....	69
8.	References .....	71

# Table index

Table 1 Summary of landscape features.....	24
Table 2 Vegetation zones .....	25
Table 3 Management zones .....	26
Table 4 Predicted threatened species (ecosystem credit species) .....	27
Table 5 Impacts on species credit-type species.....	28
Table 6 Ecosystem credits required to offset impacts of the proposed airport .....	29
Table 7 Species credits required to offset impacts of the proposed airport .....	30
Table 8 Potential offset sites .....	35
Table 9 Threatened species recorded at the potential offset sites.....	37
Table 10 Proposed offset areas .....	40
Table 11 Effect of management actions on quality of habitat in the potential offset sites.....	44
Table 12 Attribute values entered in the preliminary offset assessment guide calculations for EPBC Act Cumberland Plain Woodland .....	55
Table 13 Attribute values entered in the preliminary Offset assessment guide calculations for poorer quality Cumberland Plain Woodland.....	56
Table 14 Attribute values entered in the preliminary Offset assessment guide calculations for the Grey-headed Flying-fox.....	58
Table 15 Ecosystem credits for impacts on the natural environment.....	62
Table 16 Species credits potentially available at offset sites .....	63
Table 17 Consistency with the EPBC Act offset principals .....	67
Table 18 Vegetation zones, habitat for the affected threatened biota and available biodiversity credits at the Williamswood biobank (GHD 2014a).....	78
Table 19 Vegetation zones, habitat for the affected threatened biota and available biodiversity credits at the Oaks biobank (GHD 2014g) .....	80
Table 20 Vegetation zones, habitat for the affected threatened biota and estimated biodiversity credits at the Durham biobank (GHD 2014a).....	82
Table 21 Vegetation zones, habitat for the affected threatened biota and estimated biodiversity credits at the Mamre biobank (GHD 2014a) .....	84
Table 22 Vegetation zones, habitat for the affected threatened biota and estimated biodiversity credits at the Forrester biobank (GHD 2014a) .....	86
Table 23 Vegetation zones, habitat for the affected threatened biota and estimated biodiversity credits at the Luddenham biobank (GHD 2014a).....	88
Table 24 Vegetation zones, habitat for the affected threatened biota and estimated biodiversity credits at the Roper biobank (GHD 2014a).....	90
Table 25 Vegetation zones, habitat for the affected threatened biota and estimated biodiversity credits at the Caddens biobank (GHD 2014a) .....	92

Table 26 Vegetation zones, habitat for the affected threatened biota and estimated biodiversity credits at the Dunheved biobank (GHD 2014a) .....	94
Table 27 Vegetation zones, habitat for the affected threatened biota and available biodiversity credits at the Stage 1 Montpelier biobank (GHD 2015d) .....	97
Table 28 Vegetation zones, habitat for the affected threatened biota and estimated biodiversity credits at the Stage 2 Montpelier biobank (GHD in prep.) .....	100
Table 29 Vegetation zones, habitat for the affected threatened biota and available biodiversity credits at the Menangle Road biobank (GHD 2015e) .....	103
Table 30 Vegetation zones, habitat for the affected threatened biota and available biodiversity credits at the Bruelle biobank (GHD 2015f) .....	105

## Figure index

Figure 1 Site location .....	6
Figure 2 Threatened flora and ecological communities.....	14
Figure 3 Threatened fauna and habitat features .....	18
Figure 4 Landscape assessment.....	31
Figure 5 The airport site and potential offset sites .....	38

## Appendices

- Appendix A – Potential offset sites
- Appendix B – BioBanking Credit Calculations



## Glossary of terms

Term	Definition
Airport site	The land declared under the <i>Airports Regulations 1997</i> as the airport site for the proposed Western Sydney Airport.
Affected threatened biota	Threatened species listed under the EPBC Act, which are likely to suffer a significant impacts as a result of a proposal and which require biodiversity offsets in accordance with the EPBC Act offset policy
BBAM	The NSW <i>BioBanking Assessment Methodology</i> (OEH, 2014).
Biobank site	Land that is designated by a biobanking agreement to be a biobank site.
Biobanking agreement	An agreement entered into between the landowner and the Minister under Part 7A of the TSC Act for establishing a biobank site.
BioBanking Trust Fund	The Trust Fund established under Part 7A of the TSC Act to hold funds from the sale of credits.
Biodiversity credit	A unit of biodiversity value to measure specific development impacts or conservation gains in accordance with the BBAM. Includes ecosystem credits or species credits.
BioBanking credit report	Specifies the number and type of biodiversity credits: required to offset the impacts of a development to obtain a Biobanking statement; or required to offset the impacts of a Major Project in accordance with the FBA; or that would be generated through conservation and management of a biobank site under a BioBanking agreement.
Biodiversity offsets	Specific measures that are put in place to compensate for impacts on biodiversity values.
Biodiversity values	The composition, structure and function of ecosystems, including native species, populations and ecological communities, and their habitats.
CEEC	Critically endangered ecological community
Construction impact zone (CIZ)	Includes the area of bulk earthworks in the northern half of the site (particularly for the establishment of the runway, terminal and aviation support facilities) together with areas of disturbance for ancillary infrastructure in the southern half of the site, including additional permissible activities prior to the construction of the second runway as well as minor activities during Stage 1 (e.g. drainage channels).  The construction impact zone does not include the long term development such as the second runway or ancillary development outside the site boundary which will be subject to separate approvals. A full description is provided in Chapter 6 of the EIS.
Department of Infrastructure and Regional Development	The Australian Government Department responsible for proposing Stage 1 of the Western Sydney Airport.
DotE	The Commonwealth Department of the Environment
DPI	The NSW Department of Primary Industries

DSEWPac	The former Department of Sustainability Environment Water Populations and Communities, now the Commonwealth Department of the Environment
Ecosystem credit	The class of biodiversity credits created or required for the impact on EECs, CEECs and threatened species habitat for species that can be reliably predicted to occur within a vegetation type according to the BBAM.
EEC	Endangered ecological community
Environmental conservation zone	The area at the airport site that would be provided as an environmental conservation zone, as outlined in the land use plan in the draft Airport Plan (see Chapter 4 of the EIS).
EPBC Act	The Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i>
FBA	The Framework for Biodiversity Assessment. The methodology to assess impacts on biodiversity that must be used by a proponent to assess all biodiversity values on the development site for a Major Project in accordance with The NSW Biodiversity Offsets Policy for Major Projects.
MNES	'Matters of national environmental significance' listed under the EPBC Act including threatened biota, migratory species, World Heritage/National Heritage sites and Ramsar wetland sites.
NSW-listed biota	Threatened species listed under the NSW TSC Act and their habitats
OEH	The NSW Office of Environment and Heritage
Proposed offset areas	The areas within the proposed offset sites that have been identified in this offset package in order to offset impacts on affected threatened biota listed under the EPBC Act. Only includes vegetation and habitat which is appropriate to offset impacts on the affected threatened biota according to the rules contained in the EPBC Act offset policy and which are linked to biodiversity credits which are available for sale.
Proposed offset sites	The offset sites that have been identified in this offset package in order to offset biodiversity impacts.
PMST	Protected Matters Search Tool, a database administered by the Department of the Environment that contains known and predicted records of matters of national environmental significance listed under the EPBC Act.
Species credit	The class of biodiversity credits created or required for the impact on threatened species that cannot be reliably predicted to use an area of land based on habitat surrogates according to the BBAM.
Stage 1 development	Stage 1 of the airport would comprise one runway and cater for up to approximately 10 million annual passengers. This patronage level may be reached around 2030.  Stage 1 would also include construction of aviation logistics. .
TEC	Threatened ecological community.
The airport	The proposed airport that would be constructed on Commonwealth-owned land at Badgerys Creek, NSW. The proposed action that is the subject of this biodiversity assessment report.



The EPBC Act Offsets Policy	The <i>Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy</i> (DSEWPaC 2012)
The locality	Land within a 10 km radius of the airport site.
The Offset assessment guide	The spreadsheet offset calculator that accompanies the <i>Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy</i> (DSEWPaC 2012)
The region	A bioregion defined in a national system of bio-regionalisation. For this study this is the Sydney Basin Bioregion as defined in the Interim Biogeographic Regionalisation for Australia (Thackway and Cresswell 1995).
Threatened biota	Threatened species, populations or communities listed under the EPBC Act and/or the TSC Act.
TSC Act	The NSW <i>Threatened Species Conservation Act 1995</i>
Western Sydney Airport (the airport)	The proposed airport that would be constructed on Commonwealth-owned land at Badgerys Creek, NSW. The proposed action that is the subject of this biodiversity assessment report.

# 1. Introduction

## 1.1 Background

Planning investigations to identify a site for a second Sydney airport first commenced in 1946 with a number of comprehensive studies—including two previous environmental impact statements for a site at Badgerys Creek—having been completed over the last 30 years.

More recently, the *Joint Study on Aviation Capacity in the Sydney Region* (Department of Infrastructure and Transport, 2012) and *A Study of Wilton and RAAF Base Richmond for civil aviation operations* (Department of Infrastructure and Transport, 2013) led to the Australian Government announcement on 15 April 2014 that Badgerys Creek will be the site of a new airport for Western Sydney (the ‘proposed airport’). The airport is proposed to be developed on approximately 1,700 hectares of land acquired by the Commonwealth in the 1980s and 1990s. Construction could commence as early as 2016, with airport operations commencing in the mid-2020s.

The proposed airport would provide both domestic and international services, with development staged in response to demand. The initial development of the proposed airport would include a single, 3,700 metre runway coupled with landside and airside facilities such as passenger terminals, cargo and maintenance areas, car parks and navigational instrumentation capable of facilitating the safe and efficient movement of up to 10 million passengers per year. While the proposed Stage 1 development does not currently include a rail service, planning for the proposed airport preserves flexibility for several possible rail alignments including a potential express service. A final alignment will be determined in consultation with the New South Wales Government, with any enabling work required during Stage 1 subject to a separate approval and environmental assessment process.

In the longer term, approximately 40 years after operations commence and in accordance with relevant planning processes, the airport development could include parallel runways and additional passenger and transport facilities for around 82 million passenger movements per year. To maximise the potential of the site, the airport is proposed to operate on a 24 hour basis. Consistent with the practice at all federally leased airports, non-aeronautical commercial uses could be permitted on the airport site.

On 23 December 2014, a delegate of the the Australian Government Minister for the Environment determined that the construction and operation of the airport would require assessment in accordance with the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act). Guidelines for the content of an environmental impact statement (EIS) were issued in January 2015. Approval for the construction and operation of the proposed airport will be controlled by the *Airports Act 1996* (Cth) (Airports Act). The Airports Act provides for the preparation of an Airport Plan which will serve as the authorisation for the development of the proposed airport.

The Australian Government Department of Infrastructure and Regional Development (DIRD) is undertaking detailed planning and investigations for the proposed airport, including the development of a draft Airport Plan. The draft Airport Plan is the primary source of reference for, and companion document to, the EIS. The draft Airport Plan identifies a staged development of the proposed airport. It provides details of the initial development being authorised, referred to as Stage 1, as well as a long-term vision of the airport’s development. This enables preliminary consideration of the implications of longer term airport operations. Any stages of airport development beyond Stage 1 would be managed in accordance with the existing process in the Airports Act. This includes a requirement that for major developments (as defined in the Airports Act), a major development plan be approved by the

Australian Government Minister for Infrastructure and Regional Development following a referral under the EPBC Act.

If an Airport Plan is determined, it will be required to include any conditions notified by the Environment Minister following this EIS. Any subsequent approvals for future stages of the development will form part of the airport lessee company's responsibilities in accordance with the relevant legislation.

The EIS guidelines state that the proposed airport will require biodiversity offsets for residual significant impacts associated with the proposed airport, calculated in accordance with the *Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy* (the offset policy) (DSEWPaC 2012a). The key considerations included in the policy are that:

- offsets are required for significant residual impacts on matters that are protected under the EPBC Act including listed threatened species and communities and the environment, where Commonwealth agencies are proposing to take an action;
- the amount of offset required for threatened species and communities listed under the EPBC Act must be calculated using the 'offset assessment guide' spreadsheet. The offset assessment guide uses a balance sheet approach to calculate the percentage of the proposal's impacts that would be directly offset;
- at least 90 per cent of the proposed airport's impacts must be directly offset and the offset site must be identified, assessed and securely conserved under a covenant and management plan, preferably prior to the impact occurring; and
- up to 10% of the proposed airport's impacts may be indirectly offset through contribution to a research fund or a conservation program.

Further consultation with the Commonwealth Department of the Environment (DoE) has revealed that the estimate of offsets for residual impacts on the environment, including threatened biota and their habitats listed under the New South Wales (NSW) *Threatened Species Conservation Act 1995* (TSC Act), should be calculated using the NSW Biodiversity Banking and Offsets Scheme (BioBanking) assessment methodology.

DoE will require biodiversity offset sites to be securely titled under a legally binding conservation covenant and actively managed under a fully funded plan. There are a variety of mechanisms for achieving this, including BioBanking, Voluntary Conservation Agreements or dedication of land to the National Parks estate.

At this stage of the planning and assessment for the proposed airport, the intent is to deliver biodiversity offsets through conservation of suitable offset sites. The offset sites will be secured by registration of a BioBanking agreement on title to the sites. A BioBanking agreement is recognised as a practical and secure way of delivering biodiversity offsets and is endorsed by DoE as well as the NSW Office of Environment and Heritage (OEH) and Department of Planning and Environment (DPE) for this purpose. This approach would require the purchase of the number and type of biodiversity credits that match the required offset area calculated in accordance with the EPBC Act offsets policy.

Biodiversity offsets for the proposed airport would be provided via a staged approach.

1. development of a biodiversity offset package that accompanies the EIS, comprising:
  - a summary of the biodiversity impact assessment for the airport;
  - an estimate of the quantum of biodiversity offsets required;
  - the preferred approach for delivering biodiversity offsets, including a description of potential offset sites or other environmental contributions; and

- concluding statements demonstrating compliance with the assessment requirements for the EIS and that the offsets proposed for the airport, when implemented would improve or maintain the viability of the protected matters and comply with the offset policy.
2. Delivery of biodiversity offsets in accordance with the conditions for the proposal, comprising:
- confirmation of the quantum of impacts and biodiversity offsets required;
  - confirmation of the actual biodiversity offset that would be delivered such as a detailed description of specific offset sites or alternative environmental contributions;
  - description of the funding and management arrangements for delivering the biodiversity offset and the timing of delivery; and
  - concluding statements demonstrating compliance with the conditions for the proposal and the offset policy (DSEWPaC 2012a).

This biodiversity offset package report has been prepared using the EPBC Act offset policy, the offsets assessment guide and BioBanking assessment methodology and comprises the first stages in the delivery of biodiversity offsets for the airport.

## **1.2 Purpose of report**

This offset package has been prepared to support the draft EIS for the proposed airport (GHD, 2015b). The information presented in this report has been compiled from the Biodiversity Assessment for the proposed airport (GHD 2015a), a desktop assessment of BioBanking assessments completed by GHD and other specialists in the region and consultation with the Department and other agencies. The offset package should be read in conjunction with the Biodiversity Assessment and the draft EIS.

This report outlines the approach to the delivery of biodiversity offsets for the proposed airport and comprises:

- a description of the proposed airport's impacts and measures to avoid or mitigate impacts;
- identification of the threatened species and communities listed under the EPBC Act that require biodiversity offsets under the offset policy;
- an estimate of the quantum of biodiversity offsets required for affected threatened biota listed under the EPBC Act as calculated with the offset assessment guide;
- an estimate of the quantum of biodiversity offsets required for residual impacts on the environment as calculated using the BioBanking methodology for a major project;
- a description of how BioBanking would be used as the preferred approach to delivering biodiversity offsets;
- identification of potential offset contributions, including biobank sites with biodiversity credits that are available for sale, existing or potential biobank sites that would generate suitable biodiversity credits in the future, or other environmental contributions;
- identification of the suite of biodiversity credits that would be presented to offset impacts on EPBC Act-listed biota, as calculated using the EPBC Act offset policy; and impacts on the environment (including NSW-listed biota), as calculated using Biobanking.
- concluding statements demonstrating compliance with the assessment requirements of the EPBC Act and that the offset package for the airport, when implemented would improve or maintain the viability of the protected matters and comply with the offset policy.

The final quantum of biodiversity offsets required for the proposed airport would be determined by the Department based on the information presented in this offset package and submitted along with the draft EIS for the proposed airport.

The offset package would build upon biodiversity offsets that would be delivered for the North West and South West growth centres strategic assessment, which include the conservation of a minimum of 998 hectares of Cumberland Plain Woodland within the growth centres (DoP 2010). The offset package has been developed with reference to the strategic assessment for the North West and South West growth centres (DoP 2010) and the Cumberland Plain Recovery Plan (DECCW 2010). The offset package will complement regional conservation strategies including by securing offset sites within identified priority conservation lands that are intended to maintain the biodiversity values of the Cumberland Plain (DECCW 2010).

## **1.3 BioBanking**

### **1.3.1 Overview**

BioBanking was established by the former NSW Department of Environment, Climate Change and Water (DECCW) (now the OEH) as a method to address the loss of biodiversity and threatened species. The scheme attempts to create a market framework for the conservation of biodiversity values and the offsetting of development impacts.

BioBanking is established under Part 7A of the *NSW Threatened Species Conservation Act 1995* (TSC Act), which was enabled by the *Threatened Species Conservation Amendment (Biodiversity Banking) Bill 2006*. The *Threatened Species Conservation (Biodiversity Banking) Regulation 2008* provides additional rules for specific aspects of the scheme that are important for its operation.

The BioBanking Assessment Methodology 2014 (BBAM) sets out how biodiversity values will be assessed, establishes rules for calculating the number and class of biodiversity credits, and determines the trading rules that will apply (OEH 2014a). The BBAM includes a software package known as the BioBanking Credit Calculator (the credit calculator) which processes site survey and assessment data. Data is entered into the credit calculator based on information collected in a desktop assessment, site surveys and from using GIS mapping software.

The credit calculator is used to determine:

- the type and extent of surveys required for a BioBanking assessment;
- the number and type of biodiversity credits that are required for a development site to offset impacts on biodiversity either as part of a major project biodiversity assessment or an application for a BioBanking statement;
- the number and type of biodiversity credits generated through the conservation and management of a biobank site.

The BioBanking credit calculator can be used to complete three types of assessments: 'biobank', 'development' or 'major project'. BioBanking assessments are completed by a person accredited in accordance with section 142B(1)(c) of the TSC Act.

### **1.3.2 Application to this offset package**

BioBanking would be used to secure biodiversity offsets for EPBC Act-listed biota. The quantum of offset required for EPBC Act-listed biota has been calculated using the offset assessment guide in accordance with the EPBC Act offset policy as summarised in Section 5. The quantum of offset is expressed as an area of habitat for the affected threatened biota at offset sites. The EPBC Act offset

policy requires that offset sites be securely titled for conservation and that arrangements are made to ensure funding of appropriate management actions. The offsets would be secured by the site owner registering a BioBanking agreement on title to the offset site. This would ensure that each site would be securely titled and managed for conservation as a biobank in perpetuity. 'Biobank' type credit calculations will be used to calculate the biodiversity credits that would be generated by the conservation and management of offset sites. The number and type of biodiversity credits that are linked to the offset areas for the affected threatened biota would be purchased.

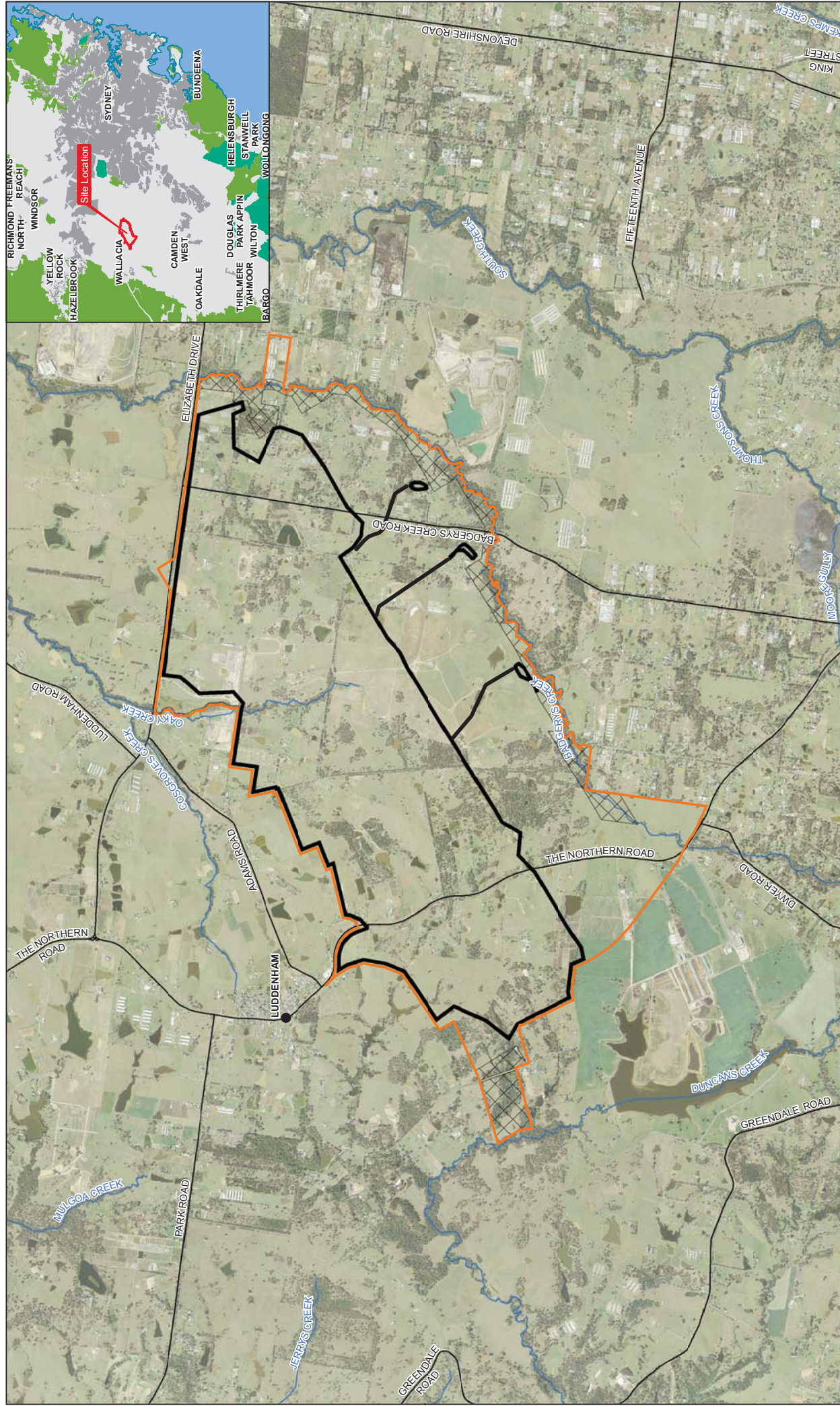
'Major project' type BioBanking credit calculations were used to estimate the number and type of biodiversity credits required to offset the impacts of the proposal on the environment (see Section 3). The impacts of the proposal on the environment were assessed according to the *BioBanking Assessment Methodology 2014* (OEH 2014a), *BioBanking Assessment Methodology and Credit Calculator Operational Manual* (DECC, 2009) and the *Draft Operational Manual for using the BioBanking Credit Calculator v2.0* (OEH, 2011). Some elements of the BBAM as it is applied to a major project are included in the *Framework for Biodiversity Assessment* (FBA) (OEH 2014b) though the FBA does not apply to the proposed airport. The data and assumptions used to perform the BioBanking credit calculations are summarised in Section 3.2. The BioBanking credit report is included as Appendix B.

## **1.4 Relationship with other reports**

This offset package should be read in conjunction with the 'Western Sydney Airport Biodiversity Assessment' (GHD 2015a). The Biodiversity Assessment report: provides a detailed description of the existing environment of the airport site; identifies threatened biota and other ecological Matters of National Environmental Significance (MNES) that may be affected by the airport; assesses the potential impacts arising from the construction and operation of the proposed airport; recommends measures to avoid or mitigate impacts; and assesses the significance of residual impacts on threatened biota and other ecological MNES (GHD 2015a). This offset package relies on the biodiversity impact assessment and mitigation measures presented in the Biodiversity Assessment to calculate the quantum of significant residual impacts that require biodiversity offsets.

This offset package is a specialist appendix to the 'Western Sydney Airport Environmental Impact Statement' (the EIS) (GHD 2015b). The EIS provides: a detailed description of the proposed construction and operation of the proposed airport; assesses the potential impacts of the proposed airport on environmental, social and economic receptors; and identifies measures to manage impacts. This offset package relies on the environmental assessment and mitigation measures presented in the draft EIS to inform assessment of potential impacts on biodiversity values. This includes inputs from specialist areas such as hydrology or noise that are beyond the scope of the Biodiversity Assessment.







## 2. Offset Requirements for EPBC Act-listed Biota

### 2.1 Identification of affected threatened biota

According to the Australian Government's offset policy, biodiversity offsets are required for significant residual impacts on threatened species and communities listed under the EPBC Act (i.e. those significant impacts that cannot otherwise be avoided or mitigated through other measures). A desktop assessment, targeted field surveys and habitat assessments were used to identify the suite of threatened biota listed under the EPBC Act that could occur at the airport site or be affected by the construction or operation of the proposed airport. Assessments of the likely significance of impact on threatened biota with the potential to be affected by the proposed airport have been prepared in accordance with the '*Matters of National Environmental Significance Significant impact guidelines 1.1 Environment Protection and Biodiversity Conservation Act 1999*' (DotE 2013a) (see Appendix D of GHD 2015a).

The outcome of these assessments is that the proposed airport is likely to have a significant impact on:

- Cumberland Shale Plains Woodland and Shale-Gravel Transition Forest (Cumberland Plain Woodland) which is listed as a critically endangered ecological community (CEEC) under the EPBC Act and occurs at the airport site. Construction of Stage 1 of the proposed airport would require the permanent removal of 88.9 hectares of vegetation within the local occurrence of Cumberland Plain Woodland as shown on Figure 2. A permanent reduction in extent of this magnitude would threaten the viability and persistence of Cumberland Plain Woodland within the locality. Stage 1 of the proposed airport is likely to have a significant impact on the local and regional occurrence of Cumberland Plain Woodland through a substantial reduction in the extent of the community, an increase in the degree of fragmentation and a substantial negative effect on the potential for recovery of the community.
- The Grey-headed Flying-fox, which is listed as a vulnerable species under the EPBC Act and which has been observed at the airport site. Construction of Stage 1 of the proposed airport would remove 120.4 hectares of potential foraging habitat for the Grey-headed Flying-fox, including foraging resources for local roost camps when resources are scarce and at critical lifecycle stages. The proposed airport will further fragment foraging habitat for this species within an already highly fragmented landscape.

The quantum of impacts on these affected threatened biota that requires biodiversity offsets is described below.

## 2.2 Impacts on affected threatened biota

### 2.2.1 Cumberland Plain Woodland CEEC

#### *Area of community in impact zone*

Larger and better condition patches of Grey Box - Forest Red Gum grassy woodland on flats, Grey Box - Forest Red Gum grassy woodland on hills and Broad-leaved Ironbark - Grey Box - *Melaleuca decora* grassy open forest at the airport site comprise occurrences of Cumberland Plain Woodland CEEC, as defined under the EPBC Act and associated guidelines. Patches of woodland at the airport site that comprise an occurrence of EPBC Act Cumberland Plain Woodland are shown on Figure 2. There is 153.3 hectares of Cumberland Plain Woodland as defined under the EPBC Act at the airport site.

Derived native grassland and moderate/good –poor condition vegetation at the airport site does not meet the condition criteria for a local occurrence of the CEEC Cumberland Plain Woodland as defined under the EPBC Act and associated guidelines. This vegetation does not qualify because native tree species are not present with a minimum projected foliage cover of greater than 10% (DEWHA 2010). Some patches with native tree cover greater than 10% but that are isolated from other native vegetation and are less than 0.5 hectares in area have also been excluded in accordance with the guidelines (DEWHA 2010).

Construction of Stage 1 of the proposed airport would require the permanent removal of 88.9 hectares of vegetation within the local occurrence of Cumberland Plain Woodland that is commensurate with the form of the community listed under the EPBC Act as shown on Figure 2. Therefore an impact area of '88.9 hectares' has been entered in the 'area of community' field in the 'impact calculator' section of the Offset assessment guide for Cumberland Plain Woodland (see Section 5.4).

Specific measures are proposed to manage weeds at the airport site, to mitigate biosecurity risks and to reduce the risk of off-site impacts. The land use plan for the airport site includes around 122 hectares of land that is zoned 'EC 1 Environmental conservation' and that would be managed for biodiversity conservation (see Figure 1). The proposed environmental conservation zone would provide a buffer between the proposed airport and adjoining areas of native vegetation along its eastern, southern and western boundaries, including the riparian corridors of Badgerys Creek, Oaky Creek and Duncans Creek. There is no Cumberland Plain Woodland or other sensitive environments to the north of the airport site. The extent of native vegetation cover would be increased in the environmental conservation zone and weeds would be managed. This reduces the chance that weeds would spread or that other edge effects would penetrate into habitat outside the airport site.

The proposed airport would have a minor effect on the extent or seriousness of edge effects in the locality and would be unlikely to introduce any new weed species or increase the significance of weed infestations. The environmental conservation zone would help to maintain a vegetated link around the developed portions of the airport site and provide connectivity between aquatic, riparian and floodplain environments. The environmental conservation zone also increases the distance between potential sources of contamination such as runways, storage areas and parking areas and sensitive receptors outside the airport site. The indicative airport concept design and land use plan in the Airport Plan show proposed measures to manage surface water that have been purposefully designed to capture water on-site and to avoid negative impacts on surface water quality or drainage patterns outside of the airport site. These measures would help to mitigate the risk of any impacts on the ecological community outside of the airport site.

There would be minor residual impacts on areas of Cumberland Plain Woodland outside the airport site through factors such as noise, light spill, risk of fauna mortality through plane strike or other

vehicle collisions and contribution to the degree of habitat fragmentation in the locality. Cumberland Plain Woodland in the vicinity of the airport site is already in moderate to poor condition and affected by clearing for agriculture, grazing, weed infestation and the noise, light and traffic associated with human activities. Given this context and the mitigation measures outlined above and in the Biodiversity Assessment (GHD 2015a), the proposed airport is unlikely to tangibly decrease the extent or quality of Cumberland Plain Woodland outside of the airport site. Therefore no additional areas of the community outside of the airport site have been included in the offset calculations.

### ***Quality of community in impact zone***

Cumberland Plain Woodland at the airport site comprises remnant or regrowth native vegetation in moderate condition. The quality of a community is scored out of ten for offset assessment guide calculations. The Department's instructions for the offset assessment guide identify three site characteristics that may contribute to quality: 'site condition', 'site context' and 'species stocking rate'. These three attributes must be weighted according to their relative importance to the offset calculations based on the ecology of the relevant species or community (DSEWPac 2012b) (i.e. their relative contribution to the total score out of ten). The weighting of these three attributes for Cumberland Plain Woodland at the airport site was defined as follows:

- site condition – 50 per cent comprising an assessment of the condition of the airport site in relation to the ecological requirements of the community and based on vegetation structure, native plant cover, species richness and presence of habitat resources;
- site context – 50 per cent comprising an assessment of the relative importance of the airport site in terms of its position in the landscape based on patch size, connectivity and proximity to threats; and
- species stocking rate – 0 per cent because this attribute is not directly relevant to threatened communities.

Each characteristic was then scored based on the results of the Biodiversity Assessment (GHD 2015a).

Site condition was scored as 6/10 based on the BioBanking plot/transects and other field survey data collected within the vegetation zones that comprise Cumberland Plain Woodland at the airport site as outlined below.

- Good condition Grey Box - Forest Red Gum grassy woodland on flats (HN528, around 70 hectares out of the 88.9 hectares of Cumberland Plain Woodland to be removed) - Remnant or regrowth woodland with near-intact over storey. Species richness was above benchmark in eight of the 12 plot/transects sampled in this vegetation zone and most native vegetation cover attributes were at benchmark values for this plant community type in the majority of plot/transects sampled. There were regenerating specimens of all canopy species observed. Few hollow-bearing trees were recorded, including only one in the 14 plots sampled. There were generally low quantities of fallen woody debris, including none in five of the 12 plots sampled. There is frequently high exotic plant cover (10-70 per cent in plot/transects sampled) mainly consisting of grasses and herbs in the under storey.
- Good condition Grey Box - Forest Red Gum grassy woodland on hills - (HN529, around 17 hectares out of the 88.9 hectares of Cumberland Plain Woodland to be removed) - Remnant or regrowth woodland with near-intact over storey that was within or slightly below benchmark values in all five plot/transects sampled. Native mid storey cover was well below benchmark values in four out of the five plot/transects. Species richness, shrub, grass and forb cover attributes and woody debris were at or above benchmark values for this plant community type in

the majority of plot/transects sampled. There were regenerating specimens of all canopy species observed. There are few hollow-bearing trees, including only one in the five plots sampled. There is frequently high exotic plant cover (26-44 per cent in plot/transects sampled) mainly consisting of woody weeds in the mid storey.

- Good condition Broad-leaved Ironbark –*Melaleuca decora* grassy open forest (HN512, around two hectares out of the 88.9 hectares of Cumberland Plain Woodland to be removed) - Near-intact, remnant or regrowth open forest. Species richness and most native vegetation cover attributes were at benchmark values for this plant community type. There were regenerating specimens of all canopy species observed. There were good quantities of hollow-bearing trees, including one in the plot/transect that was sampled and large quantities of fallen woody debris. This vegetation zone contains very little exotic plant cover compared to most of the airport site and included 0 per cent exotic plant cover along the transect sampled. Some exotic plants were observed at low cover/abundances in the surrounding plot (GHD 2015a).

Site context was scored as 6/10, reflecting the position of the local occurrence of the community in a highly fragmented, rural landscape. Fragmentation of native vegetation and associated fauna habitats in the locality has previously occurred through clearing for agriculture, residences and farm buildings and construction of transmission lines and roads. These land uses have created barriers to movement for many fauna species, particularly those that are limited by dispersal abilities and habitat preferences. The patches of Cumberland Plain Woodland that remain at the airport site have high edge to area ratios and are frequently dissected by tracks and fence lines. The suite of fauna species recorded in field surveys is dominated by generalist species of open country such as birds and bats, reflecting the fragmented nature of vegetation at the airport site (see Section 4.3.1 of GHD 2015a). Adjoining areas are dominated by exotic vegetation, including many noxious and environmental weeds that pose a threat to remnant patches. In this context, the species within Cumberland Plain Woodland at the airport site have limited opportunities for dispersal or recruitment and are subject to ongoing threats from exotic plants and pest fauna.

Based on the inputs described above, 'Impact calculator - quantum of impact – quality' (i.e. the quality of habitat in the airport disturbance footprint) was scored as 6/10 overall.

The above values have been entered in the offset assessment guide calculations that are presented in Section 5.4.

### ***Estimated offset requirement***

A notional offset assessment guide calculation was performed as a guide to the size and type of offset that would be required to meet the EPBC Act offset requirements for the proposed airport's impacts on Cumberland Plain Woodland. Based on the notional offset assessment guide calculation the airport would require an offset of around 295 hectares of Cumberland Plain Woodland. Offset sites have been identified that contain the majority of the required area of the community and are described in Section 4.3 below. Offset assessment guide calculations based on the available area of Cumberland Plain Woodland in the offset sites that have been identified to date are included in Section 5.4. DotE would perform the final offset assessment guide calculations for the proposed airport. Based on these preliminary calculations the proposed offset sites could provide around 74% of the direct offsets required for the proposed airport's impacts on Cumberland Plain Woodland. Additional offset sites would be identified to address the shortfall according to the criteria and the process described in Section 6.

### **2.2.2 Grey-headed Flying-fox**

#### ***Area of habitat in the impact zone***

The Grey-headed Flying-fox (*Pteropus poliocephalus*), was recorded foraging at the site or flying over the site during the current and previous surveys (Biosis Research 1999, GHD 2015a). There are no Grey-headed Flying-fox camps located at the airport site, although there are at least seven known camps within 20 kilometres. All native woodland and forest in the airport site provides potential foraging habitat for this species.

The proposed airport would remove 120.4 hectares of foraging habitat associated with the native woodland and forest shown on Figure 3, all of which comprises critical foraging habitat as defined in the Recovery Plan for the Grey-headed Flying-fox (DECCW 2009).

The proposal would not result in a notable increase in the risk of mortality or fragmentation of habitat for this highly mobile species. There is a risk of plane or other vehicle strike during the operation of the airport; however, this is unlikely to harm large numbers of individuals of the species (Avisure 2015, GHD 2015a).

The removal of habitat would be the most notable impact on the Grey-headed Flying-fox arising from the proposed airport. Therefore an area of habitat of '120.4 hectares' has been entered in the 'Impact calculator' section of the offset assessment guide for the Grey-headed Flying-fox (see Section 5.4).

As described above for Cumberland Plain Woodland, there would be minor residual impacts on areas of foraging habitat outside the airport site. Habitat for the Grey-headed Flying-fox in the vicinity of the airport site is already in moderate to poor condition and affected by clearing for agriculture, grazing, weed infestation and the noise, light and traffic associated with human activities. Given this context and the mitigation measures outlined in the Biodiversity Assessment (GHD 2015a), the proposed airport is unlikely tangibly to decrease the extent or quality of habitat outside of the airport site. Therefore no additional areas of the habitat for the Grey-headed Flying-fox outside of the airport site have been included in the offset calculations.

#### ***Quality of habitat in the impact zone***

As described above, all native woodland and forest in the airport site provides foraging habitat for this species. Dominant canopy species include Forest Red Gum (*Eucalyptus tereticornis*), Grey Box (*Eucalyptus molluccana*) and Broad-leaved Ironbark (*Eucalyptus fibrosa*). Forest Red Gum and Grey Box are recognised as 'significant species' in the blossom diet of the Grey-headed Flying-fox (Eby and Law 2008). Forest Red Gum scores in the upper quartile of all diet plants for the region for productivity and reliability of flowering. This species flowers in late winter and spring, partly during the 'food bottleneck' for the Grey-headed Flying-fox. Grey Box has low productivity and reliability. It flowers in late summer and early autumn. Broad-leaved Ironbark has high productivity but is an unreliable flowerer. This species flowers in summer and early autumn, providing foraging habitat during the breeding period for the Grey-headed Flying-fox (Eby and Law 2008). Habitat in the airport site is thus somewhat productive during food bottlenecks, and qualifies as habitat critical to the survival of the species, as defined in the draft recovery plan (DECCW 2009).

The Department's instructions for the offset assessment guide state that the contribution of the three habitat attributes 'site condition', 'site context' and 'species stocking rate' to habitat quality must be weighted according to the ecology of the relevant species or community (DSEWPac 2012b). The weighting of these three attributes for the Grey-headed Flying-fox population with respect to the airport site was defined as follows:

- site condition – 40 per cent comprising an assessment of the condition of the airport site in relation to the ecological requirements of the species and based on vegetation condition and presence of food trees and other habitat resources;
- site context – 40 per cent comprising an assessment of the relative importance of the airport site in terms of its position in the landscape based on patch size, connectivity, presence of roost camps and/or proximity to off-site roost camps and proximity to threats; and
- species stocking rate – 20 per cent comprising an assessment of the usage or density of the species at the site. This factor was given less weighting because the species is highly mobile and all individuals in NSW are considered part of one regional population that undertakes nomadic movements to exploit seasonal resources (OEH 2015b). The Grey-headed Flying-fox is a highly mobile species which regularly travels up to 50 kilometres in a night to forage, and has been shown to make migratory movements of almost 1000 kilometres within a year (Churchill 2008, Webb and Tidemann 1996). Given this mobility and population fluctuations in any given area, the local species stocking rate is a relatively minor component of habitat quality.

Each characteristic was then scored based on the results of the Biodiversity Assessment (GHD 2015a).

Site condition was scored as 7/10 based on the following:

- the health and condition of the vegetation zones that comprise Grey-headed Flying-fox habitat based on BioBanking plot/transects and other field survey data. The majority of the habitat at the airport site is Cumberland Plain Woodland (around 90 out of 120 hectares) which is in moderate condition as described above. Forest Red Gum - Rough-barked Apple grassy woodland (the remaining 30 out of 120 hectares) is also in moderate condition comprising remnant or regrowth native vegetation with near-intact over storey that was within or slightly below benchmark values in all five plot/transects (GHD 2015a); and
- the presence of Forest Red Gum and Grey Box as dominant canopy species across the airport site. As described above these two tree species are recognised as 'significant species' in the blossom diet of the Grey-headed Flying-fox, are somewhat productive during food bottlenecks (Eby and Law 2008) and qualify as habitat critical to the survival of the species, as defined in the draft recovery plan (DECCW 2009)(GHD 2015a).

Site context was scored as 6/10 based on the following:

- the airport site does not contain a roost camp and has such does not play an especially important role in relation to the overall population of the species. There are several known roost camps within 20 km of the site and so it is appropriately located to provide foraging resources for individuals from these camps; and
- habitat at the airport site is in a highly fragmented, rural landscape. The Grey-headed Flying-fox is a highly mobile species and so this would not limit opportunities for dispersal or recruitment or substantially increase the risk or energy cost of travelling to exploit foraging resources. However adjoining areas are dominated by exotic vegetation, including many noxious and environmental weeds that pose a threat to remnant patches of native vegetation and the productivity of food species.

Species stocking rate was scored as 6/10 comprising an area of productive foraging habitat within the broad range of this highly mobile species. Only a single individual was observed flying over the airport site during a total of 13 nights of survey effort between February and May 2015 (GHD 2015a). The survey period coincided with the late Summer – early Autumn flowering period of the other two main canopy species at the site (Eby and Law 2008). Larger numbers of individuals may be present at other

times of year such as during the late Winter-Spring flowering period of Forest Red Gum (Eby and Law 2008) or in other seasons when food trees are more productive at the site and/or less productive in alternative areas.

Based on the inputs described above 'Impact calculator - quantum of impact – quality' (i.e. the quality of habitat in the airport disturbance footprint) was scored as 6/10 overall (rounded to the nearest whole number).

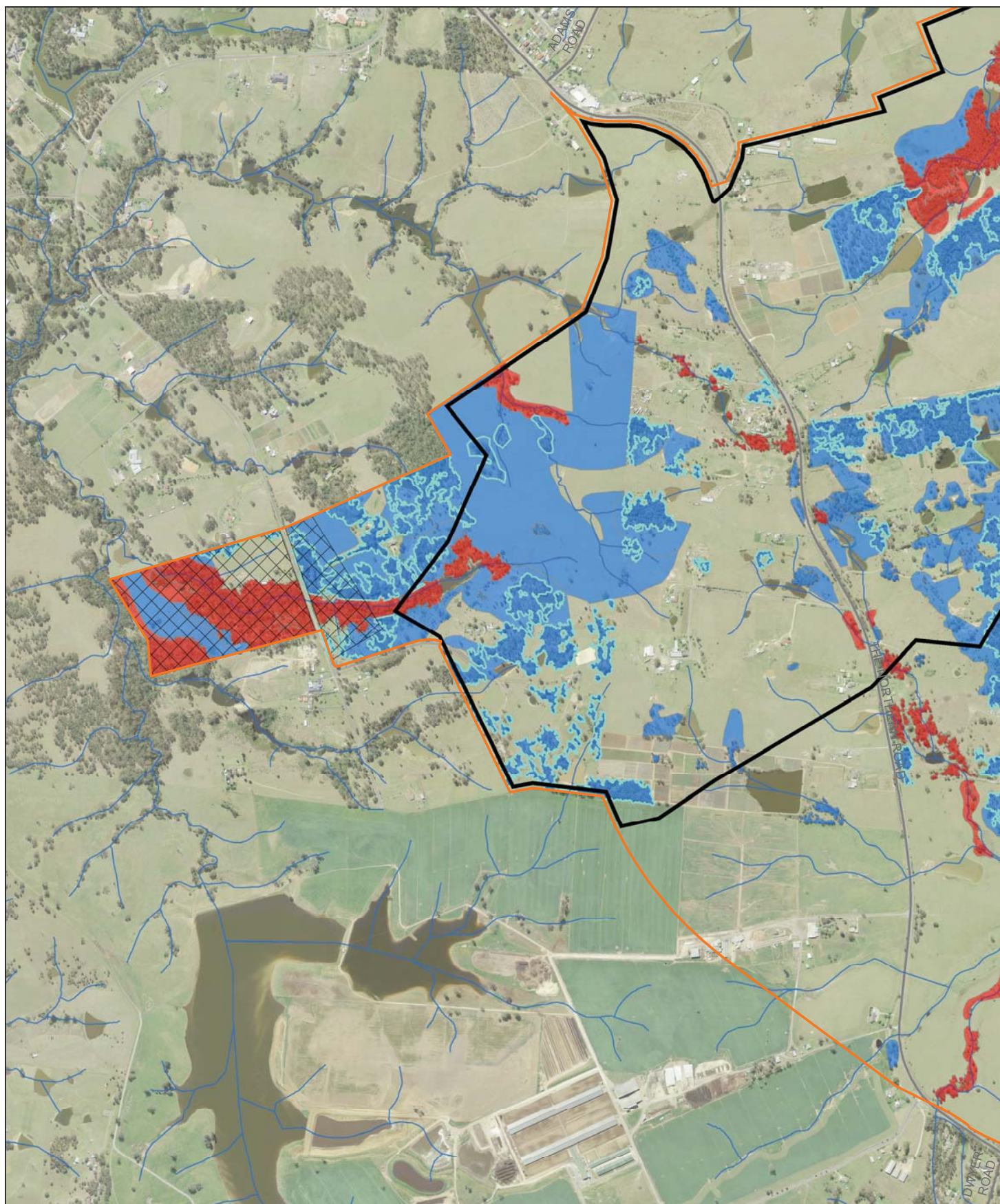
These values have been entered in the offset assessment guide calculations that are presented in Section 5.4.

### ***Estimated offset requirement***

As described for Cumberland Plain Woodland above, a notional offset assessment guide calculation was performed as a guide to the size and type of offset that would be required to meet the EPBC Act offset requirements for the proposed airport. Based on the notional offset assessment guide calculation the airport would require an offset, including around 300 hectares of habitat for the Grey-headed Flying-fox.

Offset assessment guide calculations based on the available area of Grey-headed Flying-fox habitat in the offset sites that have been identified to date are included in Section 5.4. The Department would perform the final offset assessment guide calculations for the proposed airport. Based on these preliminary calculations the proposed offset sites could provide all of the direct offsets required for the proposed airport's impacts on the Grey-headed Flying-fox.





#### LEGEND

Orange outline The airport site

Black outline Stage one construction impact zone

White box with black cross-hatch Environmental conservation

Thin black line Swale\_Lines\_SYMBOLONLY

Grey line Roads

Blue line Watercourses

#### EPBC Act

Light blue box Cumberland Plain Shale Woodlands and Shale Gravel Transition Forest (CEEC under EPBC Act and TSC Act)

Pink dot *Pultenaea parviflora* (endangered species under the EPBC Act and TSC Act)

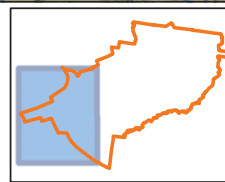
#### TSC Act

Blue box Cumberland Plain Woodland (CEEC under the TSC Act)

Red box River Flat Eucalypt Forest (EEC under the TSC Act)

Green box Shale/gravel Transition Forest (EEC under the TSC Act)

Green dot *Marsdenia viridiflora* subsp. *viridiflora* (endangered population under the TSC Act)



Paper Size A3  
0 55 110 220 330 440  
Metres

Map Projection: Transverse Mercator  
Horizontal Datum: GDA 1994  
Grid: GDA 1994 MGA Zone 56



Western Sydney Unit, Department of Infrastructure and  
Regional Development  
Western Sydney Airport  
Biodiversity Offset Package

Job Number 21-24265  
Revision A  
Date 06 Oct 2015

## Threatened flora and ecological communities Figure 2A

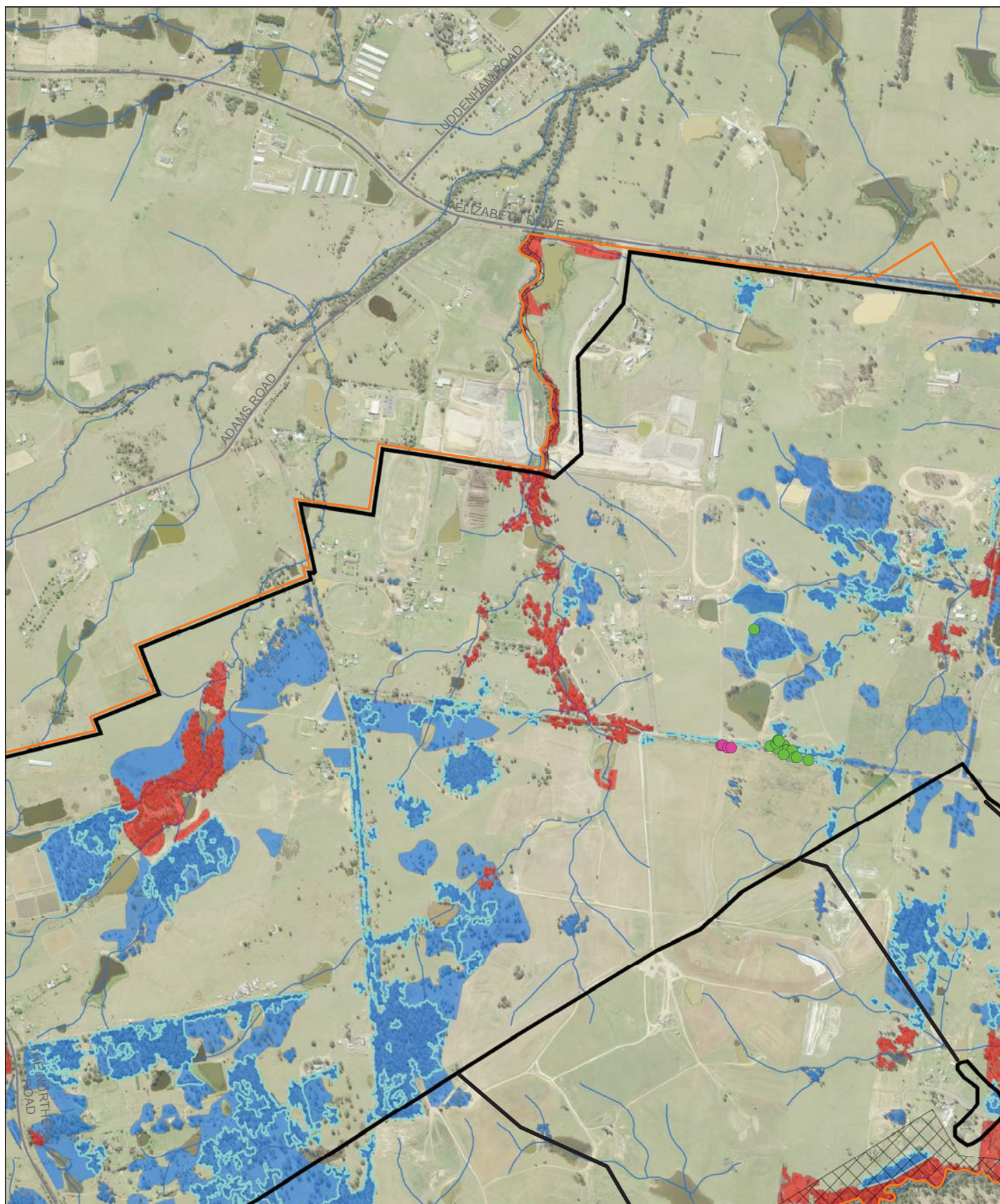
N:\AU\Sydney\Projects\2124265\GIS\Maps\Deliverables\21\_24265\_2080\_ThreatenedFloraAndEcologicalCommunities\_offsets.mxd

© 2015. Whilst every care has been taken to prepare this map, GHD (and NSW Department of Lands) make no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and cannot accept liability and responsibility of any kind (whether in contract, tort or otherwise) for any expenses, losses, damages and/or costs (including indirect or consequential damage) which are or may be incurred by any party as a result of the map being inaccurate, incomplete or unsuitable in any way and for any reason.

Data source: NSW LPI DTDB 2012. Created by richardson

Level 15, 133 Castlereagh Street Sydney NSW 2000 T 61 2 9239 7100 F 61 2 9239 7199 E sydmall@ghd.com.au W www.ghd.com.au





#### LEGEND

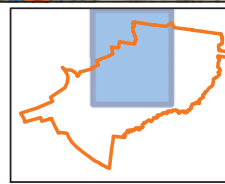
- The airport site
- Stage one construction impact zone
- Environmental conservation
- Swale\_Lines\_SYMBOLONLY
- Roads
- Watercourses

#### EPBC Act

- Cumberland Plain Shale Woodlands and Shale Gravel Transition Forest (CEEC under EPBC Act and TSC Act)
- *Pultenaea parviflora* (endangered species under the EPBC Act and TSC Act)

#### TSC Act

- Cumberland Plain Woodland (CEEC under the TSC Act)
- River Flat Eucalypt Forest (EEC under the TSC Act)
- Shale/gravel Transition Forest (EEC under the TSC Act)
- *Marsdenia viridiflora* subsp. *viridiflora* (endangered population under the TSC Act)



Paper Size A3  
0 55 110 220 330 440  
Metres  
Map Projection: Transverse Mercator  
Horizontal Datum: GDA 1994  
Grid: GDA 1994 MGA Zone 56



Western Sydney Unit, Department of Infrastructure and  
Regional Development  
Western Sydney Airport  
Biodiversity Offset Package

Job Number 21-24265  
Revision A  
Date 06 Oct 2015

## Threatened flora and ecological communities Figure 2B

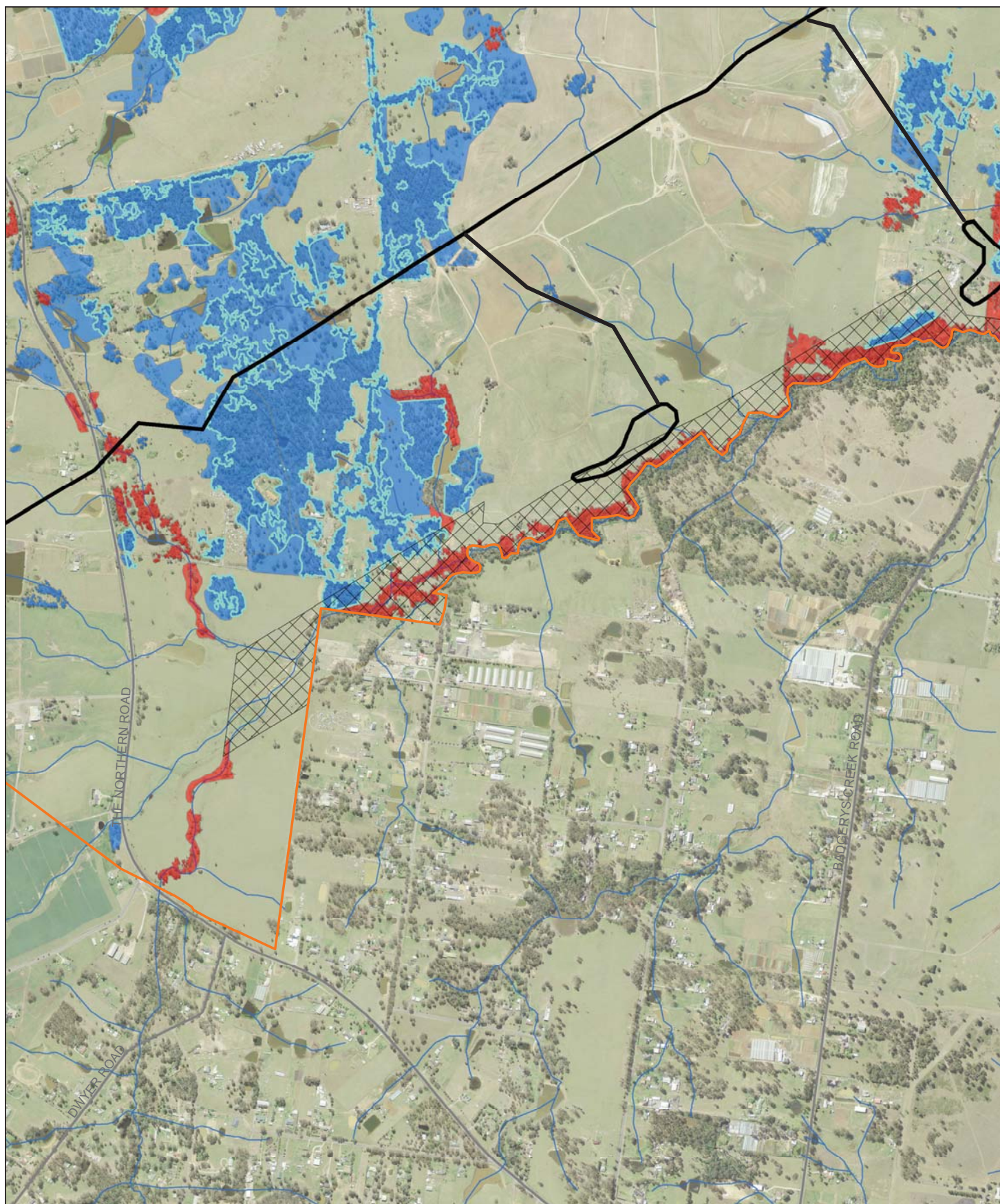
N:\AU\Sydney\Projects\2124265\GIS\Maps\Deliverables\21\_24265\_2080\_ThreatenedFloraAndEcologicalCommunities\_offsets.mxd

© 2015. Whilst every care has been taken to prepare this map, GHD (and NSW Department of Lands) make no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and cannot accept liability and responsibility of any kind (whether in contract, tort or otherwise) for any expenses, losses, damages and/or costs (including indirect or consequential damage) which are or may be incurred by any party as a result of the map being inaccurate, incomplete or unsuitable in any way and for any reason.

Data source: NSW LPI DTDB 2012. Created by gchardson

Level 15, 133 Castlereagh Street Sydney NSW 2000 T 61 2 9239 7100 F 61 2 9239 7199 E sydmall@ghd.com.au W www.ghd.com.au





#### LEGEND

Orange outline The airport site

Black outline Stage one construction impact zone

White box with black border Environmental conservation

Black line Swale\_Lines\_SYMBOLONLY

Grey line Roads

Blue line Watercourses

#### EPBC Act

Light blue box Cumberland Plain Shale Woodlands and Shale Gravel Transition Forest (CEEC under EPBC Act and TSC Act)

Purple dot *Pultenaea parviflora* (endangered species under the EPBC Act and TSC Act)

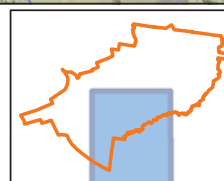
#### TSC Act

Dark blue box Cumberland Plain Woodland (CEEC under the TSC Act)

Red box River Flat Eucalypt Forest (EEC under the TSC Act)

Green box Shale/gravel Transition Forest (EEC under the TSC Act)

Green dot *Marsdenia viridiflora* subsp. *viridiflora* (endangered population under the TSC Act)



Paper Size A3  
0 55 110 220 330 440  
Metres

Map Projection: Transverse Mercator  
Horizontal Datum: GDA 1994  
Grid: GDA 1994 MGA Zone 56



Western Sydney Unit, Department of Infrastructure and  
Regional Development  
Western Sydney Airport  
Biodiversity Offset Package

Job Number 21-24265  
Revision A  
Date 06 Oct 2015

## Threatened flora and ecological communities Figure 2C

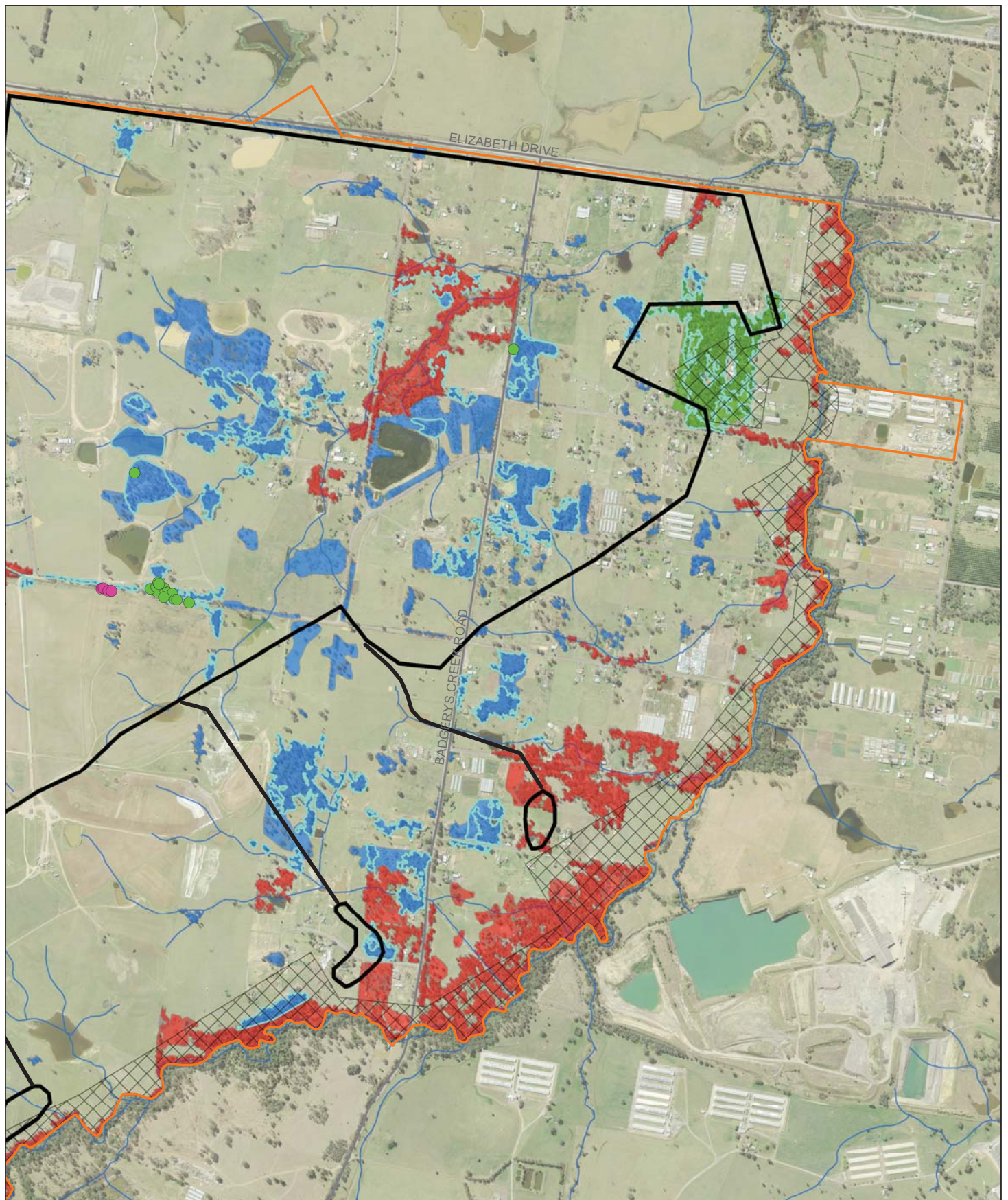
N:\AU\Sydney\Projects\2124265\GIS\Maps\Deliverables\21\_24265\_2080\_ThreatenedFloraAndEcologicalCommunities\_offsets.mxd

© 2015. Whilst every care has been taken to prepare this map, GHD (and NSW Department of Lands) make no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and cannot accept liability and responsibility of any kind (whether in contract, tort or otherwise) for any expenses, losses, damages and/or costs (including indirect or consequential damage) which are or may be incurred by any party as a result of the map being inaccurate, incomplete or unsuitable in any way and for any reason.

Data source: NSW LPI DTDB 2012. Created by richardson

Level 15, 133 Castlereagh Street Sydney NSW 2000 T 61 2 9239 7100 F 61 2 9239 7199 E sydmail@ghd.com.au W www.ghd.com.au





#### LEGEND

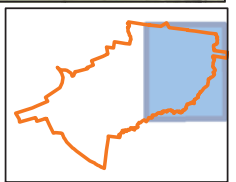
- The airport site
- Stage one construction impact zone
- Environmental conservation
- Swale\_Lines\_SYMBOLONLY
- Roads
- Watercourses

#### EPBC Act

- Cumberland Plain Shale Woodlands and Shale Gravel Transition Forest (CEEC under EPBC Act and TSC Act)
- *Pultenaea parviflora* (endangered species under the EPBC Act and TSC Act)

#### TSC Act

- Cumberland Plain Woodland (CEEC under the TSC Act)
- River Flat Eucalypt Forest (EEC under the TSC Act)
- Shale/gravel Transition Forest (EEC under the TSC Act)
- *Marsdenia viridiflora* subsp. *viridiflora* (endangered population under the TSC Act)



Paper Size A3  
0 55 110 220 330 440  
Metres

Map Projection: Transverse Mercator  
Horizontal Datum: GDA 1994  
Grid: GDA 1994 MGA Zone 56



Western Sydney Unit, Department of Infrastructure and  
Regional Development  
Western Sydney Airport  
Biodiversity Offset Package

Job Number 21-24265  
Revision A  
Date 06 Oct 2015

## Threatened flora and ecological communities Figure 2D

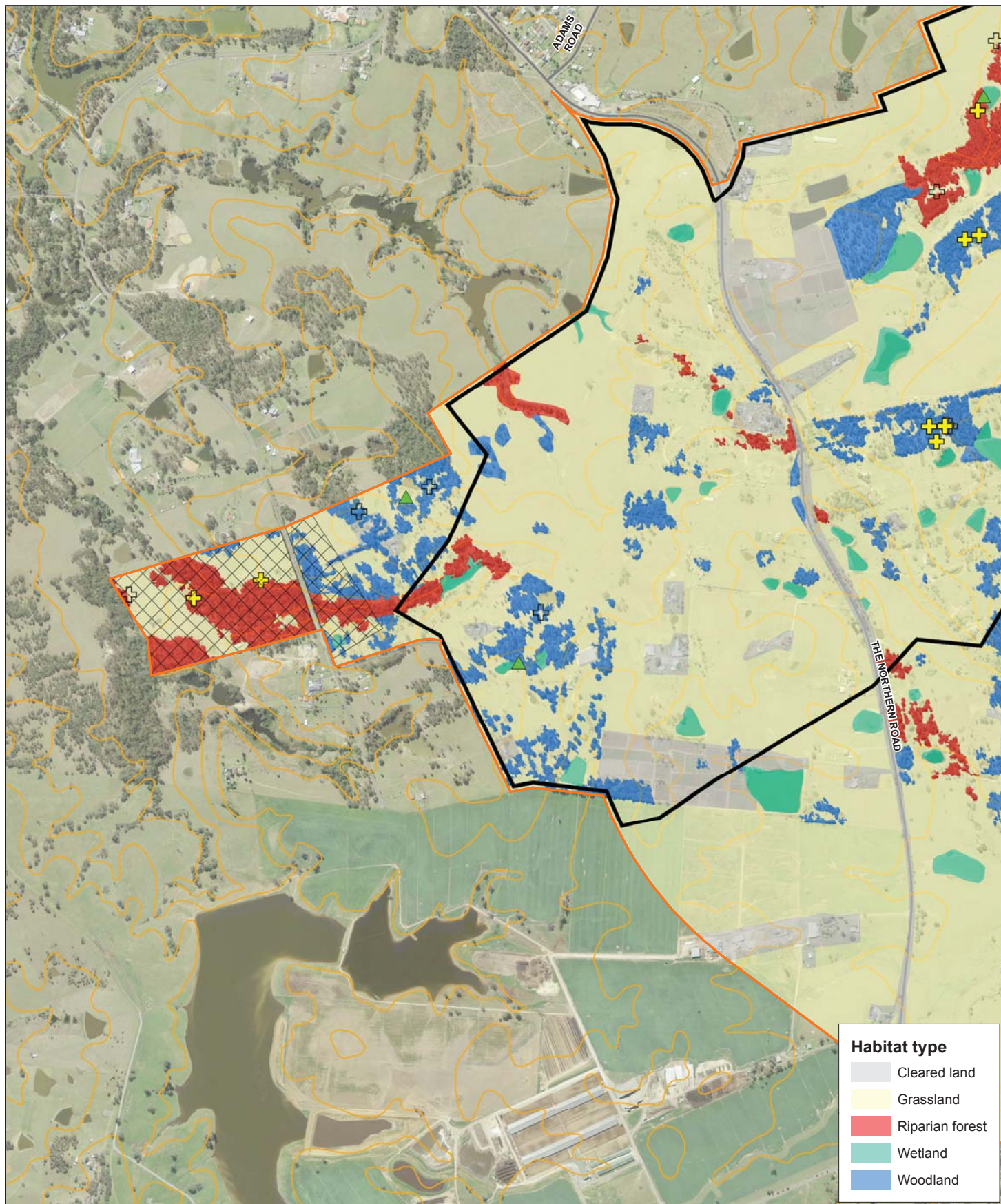
N:\AU\Sydney\Projects\2124265\GIS\Maps\Deliverables\21\_24265\_2080\_ThreatenedFloraAndEcologicalCommunities\_offsets.mxd

© 2015. Whilst every care has been taken to prepare this map, GHD (and NSW Department of Lands) make no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and cannot accept liability and responsibility of any kind (whether in contract, tort or otherwise) for any expenses, losses, damages and/or costs (including indirect or consequential damage) which are or may be incurred by any party as a result of the map being inaccurate, incomplete or unsuitable in any way and for any reason.

Data source: NSW LPI DTDB 2012. Created by richardson

Level 15, 133 Castlereagh Street Sydney NSW 2000 T 61 2 9239 7100 F 61 2 9239 7199 E sydmall@ghd.com.au W www.ghd.com.au





#### Legend

- The airport site
- Stage one construction impact zone
- Environmental conservation
- Contour
- Roads

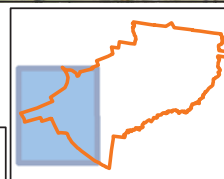
#### Threatened species

- Black Bittern (V)
- Cumberland Plain Land Snail (E) (absent)
- Cumberland Plain Land Snail (E) (present)
- East Coast Freetail Bat (V)
- Large-footed Myotis (V)
- Little Eagle (V)
- Scarlet Robin (V)
- Varied Sittella (V)

#### Habitat type

- Cleared land
- Grassland
- Riparian forest
- Wetland
- Woodland

Notes: V - vulnerable species under the TSC Act;  
E - endangered species under the TSC Act;  
M - migratory species under the EPBC Act.



Paper Size A3  
0 55 110 220 330 440  
Metres  
Map Projection: Transverse Mercator  
Horizontal Datum: GDA 1994  
Grid: GDA 1994 MGA Zone 56



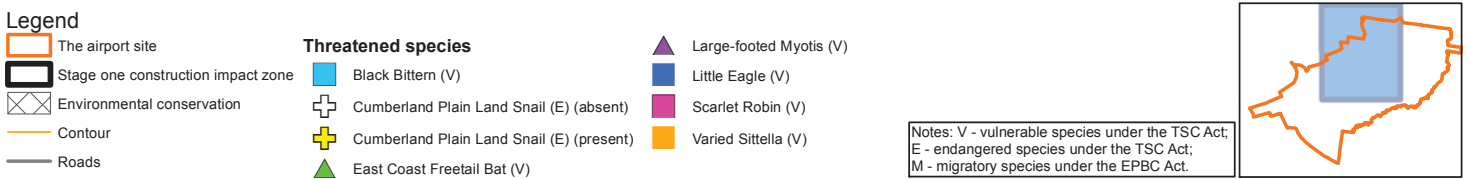
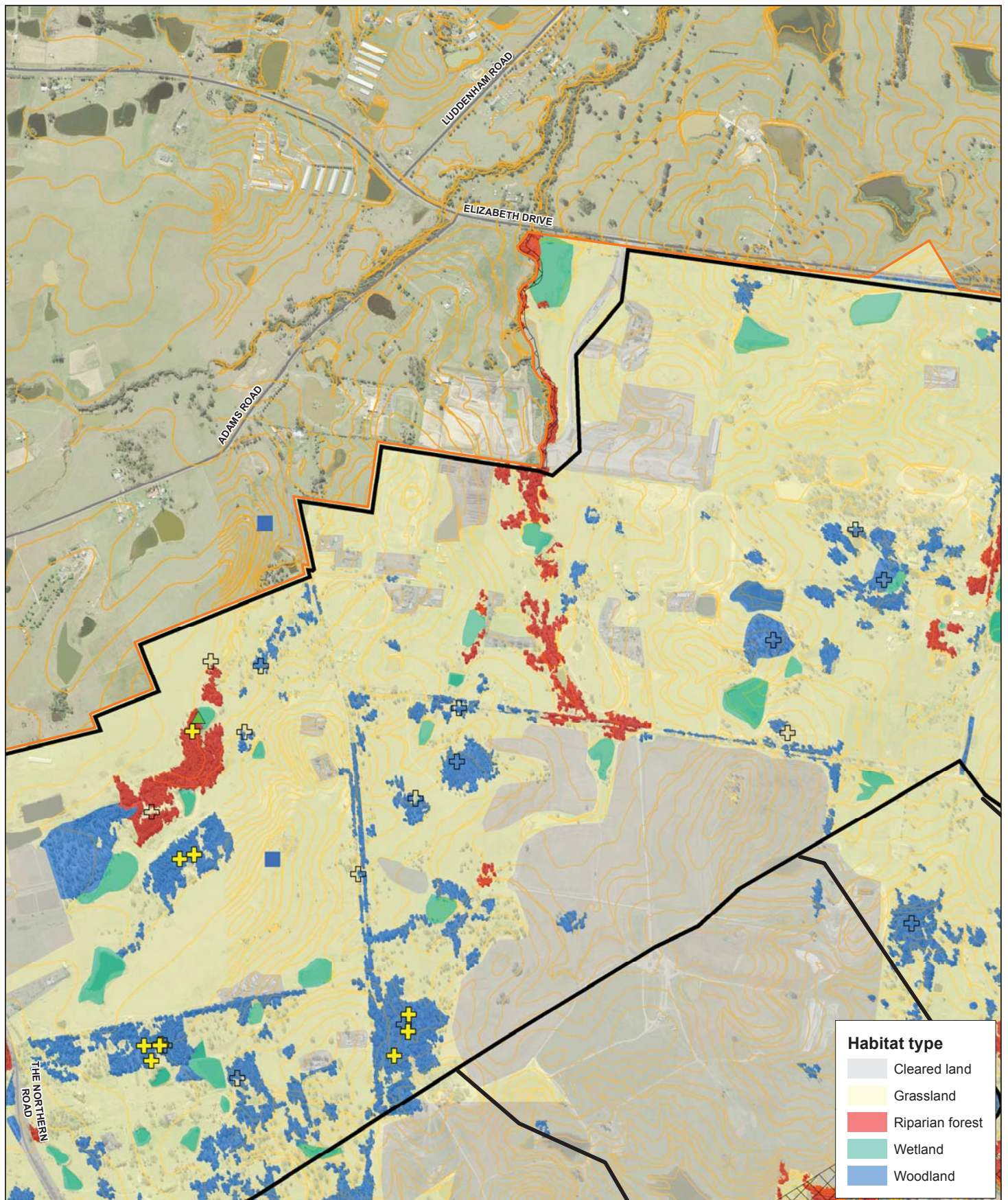
Western Sydney Unit, Department of Infrastructure and  
Regional Development  
Western Sydney Airport  
Biodiversity Offset Package

Job Number 21-24265  
Revision A  
Date 06 Oct 2015

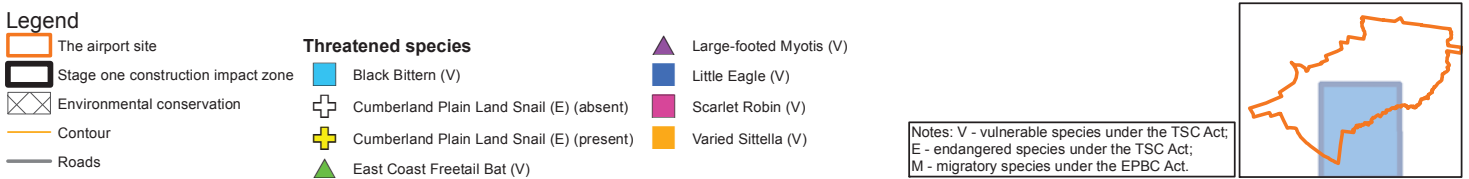
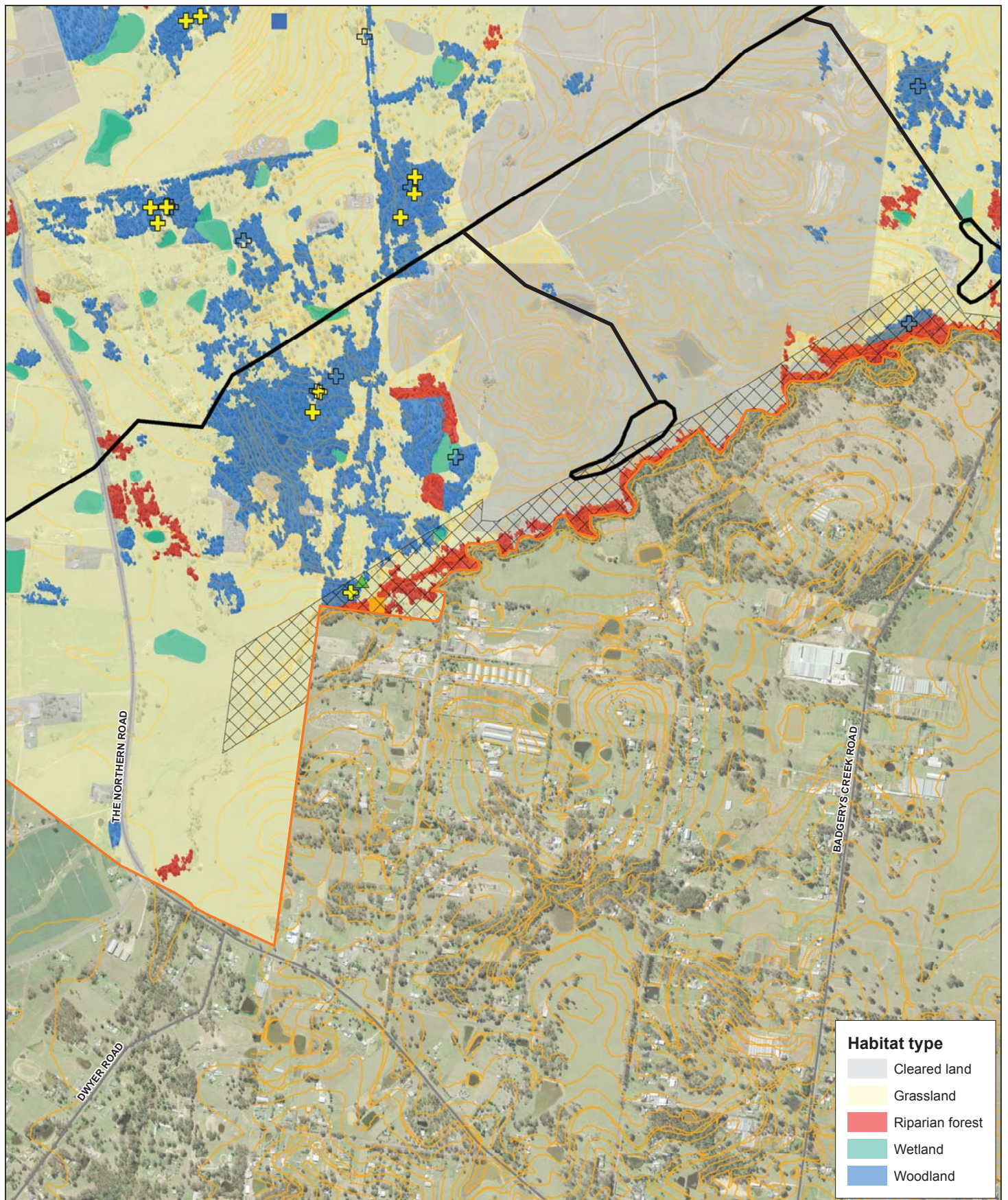
#### Threatened fauna and habitat features

Figure 3A

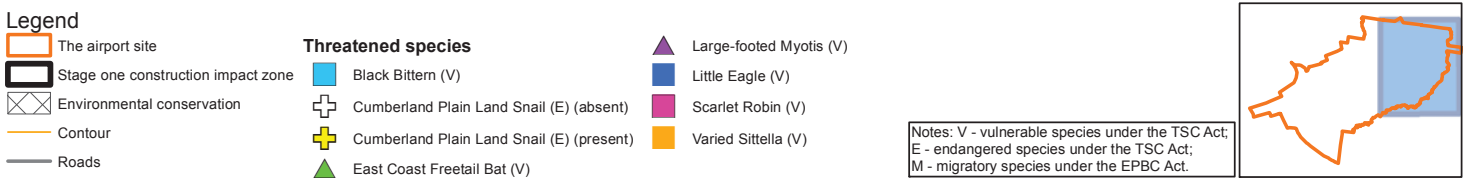
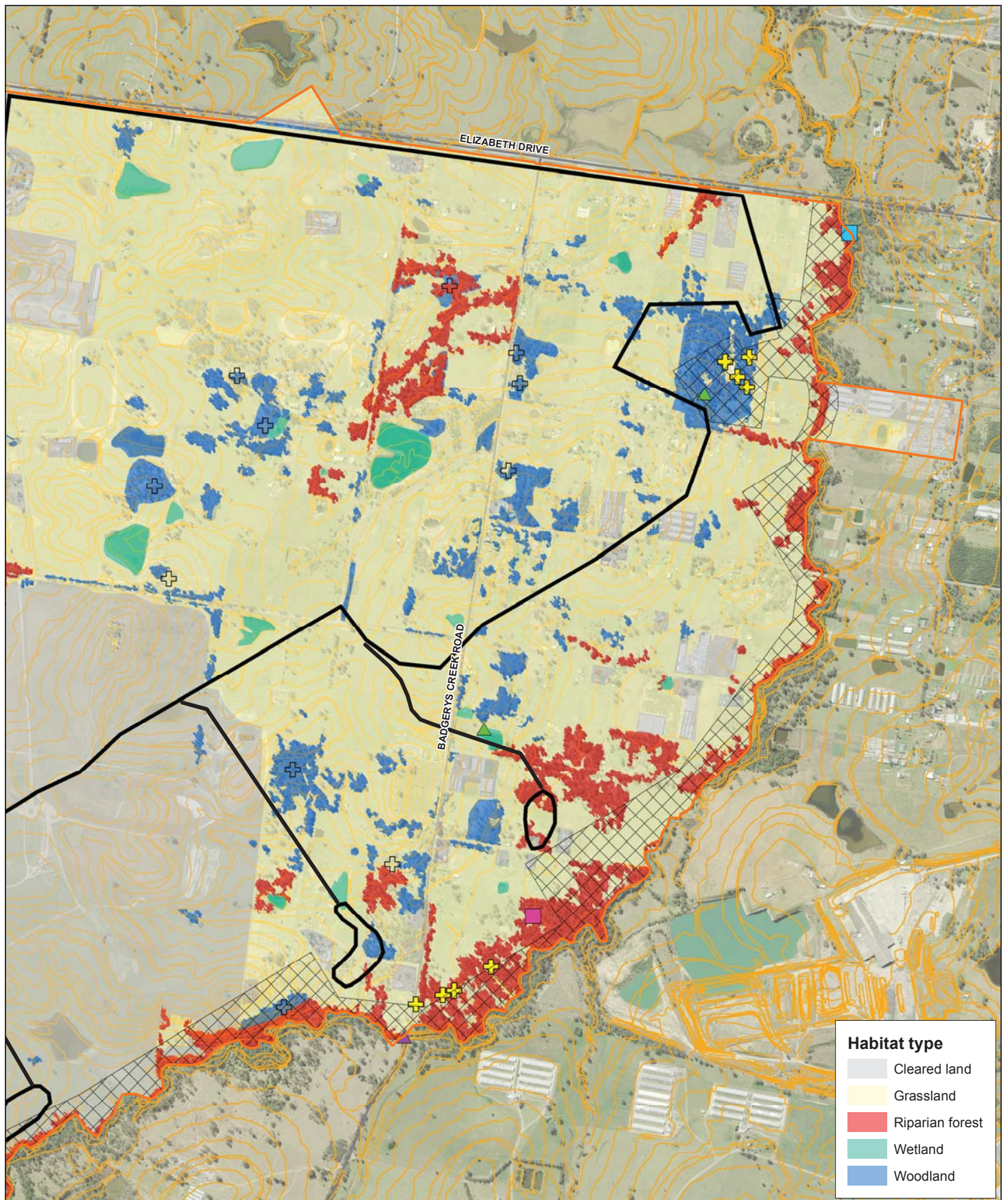














## **3. Offset Requirements for Impacts on the Environment**

### **3.1 Overview**

The Biodiversity Assessment assessed impacts on plants, animals and other features of the natural environment (GHD 2015a) as required by the EPBC Act significant impact guidelines 1.2 (OEH 2013b) for actions being undertaken by the Commonwealth. The Biodiversity Assessment concluded that the project would result in significant residual impacts on features of the natural environment including plant populations, fauna populations and several species and communities listed under NSW legislation (GHD 2015a). The offset assessment guide can only be used to calculate offsets for threatened biota listed under the EPBC Act and so an alternative approach is required for impacts on other protected matters. The EPBC Act offsets policy requires that the approach to calculating offsets must be in proportion to the level of statutory protection that applies to the protected matter, be of a size and scale proportionate to the residual impacts on the protected matter and be scientifically robust and reasonable (DSEWPaC 2013a). The BioBanking assessment methodology meets each of these criteria and is supported by DotE for this purpose.

BioBanking credit calculations using the assessment methodology for a major project in NSW have been used to estimate offsets for impacts on the environment, including species and communities listed under NSW legislation. The BioBanking credit calculations were performed by Ben Harrington (assessor accreditation number 0073) using credit calculator Version 4.0. The biodiversity credit report is included in Appendix B.

The data and assumptions used to perform the BioBanking credit calculations are summarised below.

### **3.2 Credit calculations**

#### **3.2.1 Landscape features**

The BioBanking assessment methodology for a major project requires the assessment of landscape features to help describe the biodiversity values of the study area and assess the impacts of the project. The proposed airport is a site-based development (rather than linear infrastructure) and so the landscape value has been assessed according to the methodology for site-based major projects (OEH 2014b). Landscape features relevant to the credit calculations are shown on Figure 4 and summarised in Table 1.

**Table 1 Summary of landscape features**

Landscape feature	Stage 1 construction impact zone
Major Catchment	The stage 1 construction impact zone is located entirely within the Hawkesbury/Nepean major catchment.
Interim Biogeographic regionalisation of Australia (IBRA) bioregion and IBRA subregions	The stage 1 construction impact zone is located entirely within the 'Sydney Basin' IBRA bioregion and Cumberland – Hawkesbury/Nepean IBRA subregion.
Mitchell landscape	The stage 1 construction impact zone contains the Cumberland Plain Mitchell landscape (DECC 2008a).
% Native vegetation cover	The outer assessment circle is 4000 hectares in area and the inner assessment circle is 400 hectares.
	The current percent native vegetation cover in the outer assessment circle is 16-20% (around 795 hectares out of the 4000 hectare circle).
	The future percent native vegetation cover in the outer assessment circle is 11-15% (around 530 hectares out of the 4000 hectare circle, given the removal of around 265 hectares of native vegetation for the proposed airport).
	The current percent native vegetation cover in the inner assessment circle is 26-30% (around 110 hectares out of the 400 hectare circle).
	The future percent native vegetation cover in the inner assessment circle is 21-25% (around 88 hectares out of the 400 hectare circle, given the removal of 22 hectares of native vegetation for the proposed airport).
Connectivity value - class	The proposed airport would affect only a local area biodiversity link, because it would not affect the riparian corridor of any 4 <sup>th</sup> order or greater streams, important wetlands, estuaries or state or regionally significant biodiversity links. The airport site contains multiple connecting links including the vegetated riparian corridors of Oaky Creek, Duncans Creek and Badgerys Creek.
Connectivity value - width	The current linkage width class of the narrowest point of each of these connecting links is 'Narrow' (>5-30m wide).
	The future linkage width class of the narrowest point of each of these connecting links is also 'Narrow' (>5-30m wide) because each connecting link would be maintained as at least this width after development.
Connectivity value - condition	The average projective foliage cover (PFC) of over storey and mid storey vegetation in the connecting link before development is at benchmark values.
	The average projective foliage cover (PFC) of over storey and mid storey vegetation in the connecting links after development would be at benchmark values because the connecting links extend outside of the airport site.
	A patch size polygon of around 670 hectares is shown on Figure 4 however the actual patch of connected native vegetation continues outside this area in the riparian corridors of Badgerys Creek to the north and Duncans Creek to the west. This is well above the patch size required to achieve the maximum patch size score for major projects (OEH, 2014b) (>100 ha, as the airport site is in the Cumberland Mitchell landscape, which is 89 % cleared (OEH 2015d).

### 3.2.2 Native vegetation

One vegetation zone was created for each NSW vegetation type and broad condition state in the stage 1 construction impact zone. The area of each zone was calculated using GIS. Vegetation zones within the stage 1 construction impact zone are summarised in Table 2.

Development impacts are likely to be restricted to the stage 1 construction impact zone. Given the mitigation measures specified in the biodiversity assessment (GHD 2015a) and EIS (GHD 2015b), adjoining land uses, and the extent of existing weed infestation and disturbance in the study area, the development would not result in any tangible secondary impacts.

Therefore no additional, secondary impacts have been included in the credit calculations.

**Table 2 Vegetation zones**

Veg Zone ID	Vegetation Zone	Condition	TSC Act Status	EPBC Act Status	Area	Plot/transects required	Plot/transects completed
1	Good condition Grey Box - Forest Red Gum grassy woodland on flats (HN528)	Moderate/good	CEEC	CEEC	71.3	14	Plot/transects 2, 5, 6, 7, 10, 11, 12, 16, 22, 23, 25, 31, 32, 35
2	Poor condition Grey Box - Forest Red Gum grassy woodland on flats (HN528)	Moderate/good - poor	CEEC		107.8	7	Plot/transects 8, 19, 24, 28, 30, 37, 42
3	Good condition Grey Box - Forest Red Gum grassy woodland on hills (HN529)	Moderate/good	CEEC	CEEC	17.3	5	Plot/transects 20, 21, 36, 38, 40
4	Poor condition Grey Box - Forest Red Gum grassy woodland on hills (HN529)	Moderate/good - poor	CEEC		22.3	4	Plot/transects 39, 41 <sup>1</sup>
5	Good condition Forest Red Gum - Rough-barked Apple grassy woodland (HN526)	Moderate/good	EEC		29.8	8	Plot/transects 9, 13, 15, 17, 18, 26, 29, 33
6	Poor condition Forest Red Gum - Rough-barked Apple grassy woodland (HN526)	Moderate/good - poor	EEC		4.2	3	Plot/transects 14, 27, 34
7	Good condition Broad-leaved Ironbark - Grey Box - <i>Melaleuca decora</i> grassy open forest (HN512)	Moderate/good	EEC	CEEC	2.2	2	Plot/transect 1 <sup>1</sup>
8	Poor condition Broad-leaved Ironbark - Grey Box - <i>Melaleuca decora</i> grassy open forest (HN512)	Moderate/good - poor	EEC		0.4	1	Plot/transect 43
9	Good condition artificial freshwater wetland on floodplain (HN630)	Moderate/good			25.4	4	Wetland assessment at targeted frog survey sites 2, 4, 5, 8, 9, 10, 11 <sup>2</sup>

Notes: 1) less than the required number of plot/transects were sampled in the biodiversity assessment (GHD 2015a) and so available plot/transects were duplicated.

2) Wetland assessment data was used to extrapolate equivalent plot/transect data.

Site value data was collected using the BioBanking plot/transect methodology and was entered for each plot/transect field in each vegetation zone.

Changes in site biodiversity values through the development of a site is the basis for calculation of biodiversity credits required to offset impacts. Complete clearing of vegetation for a development reduces the site values to zero. There are certain circumstances where portions of a development are managed such that some site value is retained. These circumstances include asset protection zones (APZs) where only partial vegetation removal may be required. In such cases, vegetation zones

should be split into separate management zones to allow separate calculation of impacts of full vegetation removal versus partial vegetation removal.

All native vegetation and habitat within the stage 1 construction impact zone would be removed. The default decrease in site value was entered in the credit calculator for all management zones (i.e. the site values for all vegetation and habitat attributes were reduced to zero). Management zones in the stage 1 construction impact zone are summarised in Table 3.

**Table 3 Management zones**

Management Zone	Veg Zone ID	Vegetation Zone	Condition	Area (ha)	Management / Site Attribute Scores
MZ1	1	Good condition Grey Box - Forest Red Gum grassy woodland on flats (HN528)	Moderate/good	71.3	Full removal / Default decrease in site value.
MZ2	2	Poor condition Grey Box - Forest Red Gum grassy woodland on flats (HN528)	Moderate/good - poor	107.8	Full removal / Default decrease in site value.
MZ3	3	Good condition Grey Box - Forest Red Gum grassy woodland on hills (HN529)	Moderate/good	17.3	Full removal / Default decrease in site value.
MZ4	4	Poor condition Grey Box - Forest Red Gum grassy woodland on hills (HN529)	Moderate/good - poor	22.3	Full removal / Default decrease in site value.
MZ5	5	Good condition Forest Red Gum - Rough-barked Apple grassy woodland (HN526)	Moderate/good	29.8	Full removal / Default decrease in site value.
MZ6	6	Poor condition Forest Red Gum - Rough-barked Apple grassy woodland (HN526)	Moderate/good - poor	4.2	Full removal / Default decrease in site value.
MZ7	7	Good condition Broad-leaved Ironbark - Grey Box - <i>Melaleuca decora</i> grassy open forest (HN512)	Moderate/good	2.2	Full removal / Default decrease in site value.
MZ8	8	Poor condition Broad-leaved Ironbark - Grey Box - <i>Melaleuca decora</i> grassy open forest (HN512)	Moderate/good - poor	0.4	Full removal / Default decrease in site value.
MZ9	9	Good condition artificial freshwater wetland on floodplain (HN630)	Moderate/good	25.4	Full removal / Default decrease in site value.

### 3.2.3 Threatened Species

#### *Predicted threatened species*

The credit calculator reports the suite of threatened fauna species that are predicted to be associated with ecosystem credits generated for the development. That is, the threatened fauna species that are predicted to use habitat within the vegetation types at the development site. Each of these species has a 'threatened species multiplier' that feeds into the ecosystem credit calculations. The species with the highest threatened species multiplier drives the credit calculations. If that fauna species or specific

habitat resources for that species are not present at the development site, then the threatened species multiplier score may be adjusted.

The suite of threatened species associated with ecosystem credits for the development is shown in Table 4. There is known or potential habit for each of these threatened species in the stage 1 construction impact zone and so the threatened species multipliers have not been adjusted.

**Table 4 Predicted threatened species (ecosystem credit species)**

Common name	Scientific name	Threatened species multiplier	On site <sup>1</sup>
Australian Painted Snipe	<i>Rostratula australis</i>	1.3	Yes
Barking Owl	<i>Ninox connivens</i>	3.0	Yes
Black-chinned Honeyeater (eastern subspecies)	<i>Melithreptus gularis</i> subsp. <i>gularis</i>	1.3	Yes
Black-tailed Godwit	<i>Limosa limosa</i>	2.6	Yes
Brown Treecreeper (eastern subspecies)	<i>Climacteris picumnus</i> subsp. <i>victoriae</i>	2.0	Yes
Bush Stone-curlew	<i>Burhinus grallarius</i>	2.6	Yes
Diamond Firetail	<i>Stagonopleura guttata</i>	1.3	Yes
Eastern False Pipistrelle	<i>Falsistrellus tasmaniensis</i>	2.2	Yes
Eastern Freetail-bat	<i>Mormopterus norfolkensis</i>	2.2	Yes
Flame Robin	<i>Petroica phoenicea</i>	1.3	Yes
Freckled Duck	<i>Stictonetta naevosa</i>	1.3	Yes
Gang-gang Cockatoo	<i>Callocephalon fimbriatum</i>	2.0	Yes
Glossy Black-Cockatoo	<i>Calyptrorhynchus lathamii</i>	1.8	Yes
Greater Broad-nosed Bat	<i>Scoteanax rueppellii</i>	2.2	Yes
Hooded Robin (south-eastern form)	<i>Melanodryas cucullata</i> subsp. <i>cucullata</i>	1.7	Yes
Little Eagle	<i>Hieraaetus morphnoides</i>	1.4	Yes
Little Lorikeet	<i>Glossopsitta pusilla</i>	1.8	Yes
Masked Owl	<i>Tyto novaehollandiae</i>	3.0	Yes
Painted Honeyeater	<i>Grantiella picta</i>	1.3	Yes
Powerful Owl	<i>Ninox strenua</i>	3.0	Yes
Scarlet Robin	<i>Petroica boodang</i>	1.3	Yes
Speckled Warbler	<i>Chthonicola sagittata</i>	2.6	Yes
Spotted Harrier	<i>Circus assimilis</i>	1.4	Yes
Spotted-tailed Quoll	<i>Dasyurus maculatus</i>	2.6	No
Square-tailed Kite	<i>Lophoictinia isura</i>	1.4	Yes
Swift Parrot	<i>Lathamus discolor</i>	1.3	Yes
Turquoise Parrot	<i>Neophema pulchella</i>	1.8	Yes
Varied Sittella	<i>Daphoenositta chrysoptera</i>	1.3	Yes
White-fronted Chat	<i>Epthianura albifrons</i>	0.8	Yes
Yellow-bellied Sheath-tail-bat	<i>Saccolaimus flaviventris</i>	2.2	Yes

Notes: 1) There are habitat resources for the species at the site that would be removed by the proposed development.

### Species credits

The credit calculator references geographic, vegetation and habitat data for the project site to generate a list of the species credit-type threatened species predicted to occur and requiring targeted survey.

A table of 'Threatened species survey / time matrix and survey effort' in accordance with the BBAM is included in Appendix B. The majority of the species credit-type species predicted to occur has been reliably excluded from occurring at the airport site or being impacted by the proposed airport based on the field survey effort undertaken for the biodiversity assessment (GHD 2015a). A total of four species were not targeted by surveys at appropriate times of year according to the survey / time matrix. These species can be reliably excluded from occurring at the airport site or being impacted by the proposed airport based on the desktop assessment and habitat assessments undertaken for the biodiversity assessment (GHD 2015a) as summarised in Appendix B.

The species credit-type threatened species that are present at the airport site are summarised in Table 5 along with the extent of impacts. For plants, impacts were calculated based on the number of individuals in the stage 1 construction impact zone. For animals, impacts were calculated based on the extent of habitat for the species in the stage 1 construction impact zone as presented in the biodiversity assessment (GHD 2015a).

**Table 5 Impacts on species credit-type species**

Common name	Scientific name	TSC Act Status	Likelihood of occurrence	Quantum of impact
<i>Pultenaea parviflora</i>	<i>Pultenaea parviflora</i>	Endangered	Present. Four individuals were recorded at the airport site.	4 individuals
<i>Marsdenia viridiflora</i> subsp. <i>viridiflora</i>	<i>Marsdenia viridiflora</i> subsp. <i>viridiflora</i>	Endangered population	Present. 93 individuals were recorded at the airport site.	93 individuals
Southern Myotis roosting habitat	<i>Myotis macropus</i>	Vulnerable	Probably recorded (based on echo-location call analysis). Likely to forage along creeks and above dams. May roost under bridges and in tree hollows at the airport site.	29.8 hectares
Cumberland Plain Land Snail	<i>Meriodolum corneovirens</i>	Endangered	Present. Generally occurs in larger remnant patches of Cumberland Plain Woodland with deep leaf litter.	120.6 hectares
Black Bittern		Vulnerable	Present. Recorded in riparian vegetation along Badgerys Creek.	55.3 hectares

### 3.3 Biodiversity credits

The data summarised above was entered into Version 4.0 of the credit calculator to determine the number of biodiversity credits that would be required to offset the removal of vegetation and habitat in the stage 1 construction impact zone. The BioBanking Credit Report is included in Appendix B and summarised below.



### 3.3.1 Ecosystem credits

The ecosystem credits that would be required to offset the impacts of the proposed airport on the environment are shown in Table 6 along with potential offset options (i.e. the plant community types which can be used to offset these impacts according to the BioBanking credit trading rules).

**Table 6 Ecosystem credits required to offset impacts of the proposed airport**

Plant community type name	Condition	TSC Act Status	EPBC Act Status	Management zone area	Ecosystem credit requirement	Offset options – Plant community types
Good condition Grey Box - Forest Red Gum grassy woodland on flats (HN528)	Moderate/ Good	CEEC	CEEC	71.27	3,555	HN528, HH526 <sup>1</sup>
Poor condition Grey Box - Forest Red Gum grassy woodland on flats (HN528)	Moderate/ Good_Poor	CEEC		107.79	3,208	HN528, HH526
Good condition Grey Box - Forest Red Gum grassy woodland on hills (HN529)	Moderate/ Good	CEEC	CEEC	17.32	751	HN529, HN528, HN526 <sup>1</sup>
Poor condition Grey Box - Forest Red Gum grassy woodland on hills (HN529)	Moderate/ Good_Poor	CEEC		22.29	647	HN529, HN528, HN526
Good condition Forest Red Gum - Rough-barked Apple grassy woodland (HN526)	Moderate/ Good	EEC		29.83	1,530	HN526, HN528
Poor condition Forest Red Gum - Rough-barked Apple grassy woodland (HN526)	Moderate/ Good_Poor	EEC		4.22	127	HN526, HN528
Good condition Broad-leaved Ironbark - Grey Box - <i>Melaleuca decora</i> grassy open forest (HN512)	Moderate/ Good	EEC	CEEC	2.19	161	HN512, HN513, HN604, HN556 <sup>1</sup>
Poor condition Broad-leaved Ironbark - Grey Box - <i>Melaleuca decora</i> grassy open forest (HN512)	Moderate/ Good_Poor	EEC		0.39	20	HN512, HN513, HN604, HN556
Good condition artificial freshwater wetland on floodplain (HN630)	Moderate/ Good			25.44	700	HN630, HN520

Notes: 1) Ecosystem credits that are used to offset impacts on EPBC Act Cumberland Plain Woodland would need to be plant community types HN528, HN529 or HN512 and associated with better quality vegetation in order to comply with the EPBC Act offset policy (DSEWPaC 2012).

### 3.3.2 Species credits

The species credits that would be required to offset the impacts of the proposed airport on the environment are shown in Table 7. The intent of this offset package is to offset impacts with matching species credits.

**Table 7 Species credits required to offset impacts of the proposed airport**

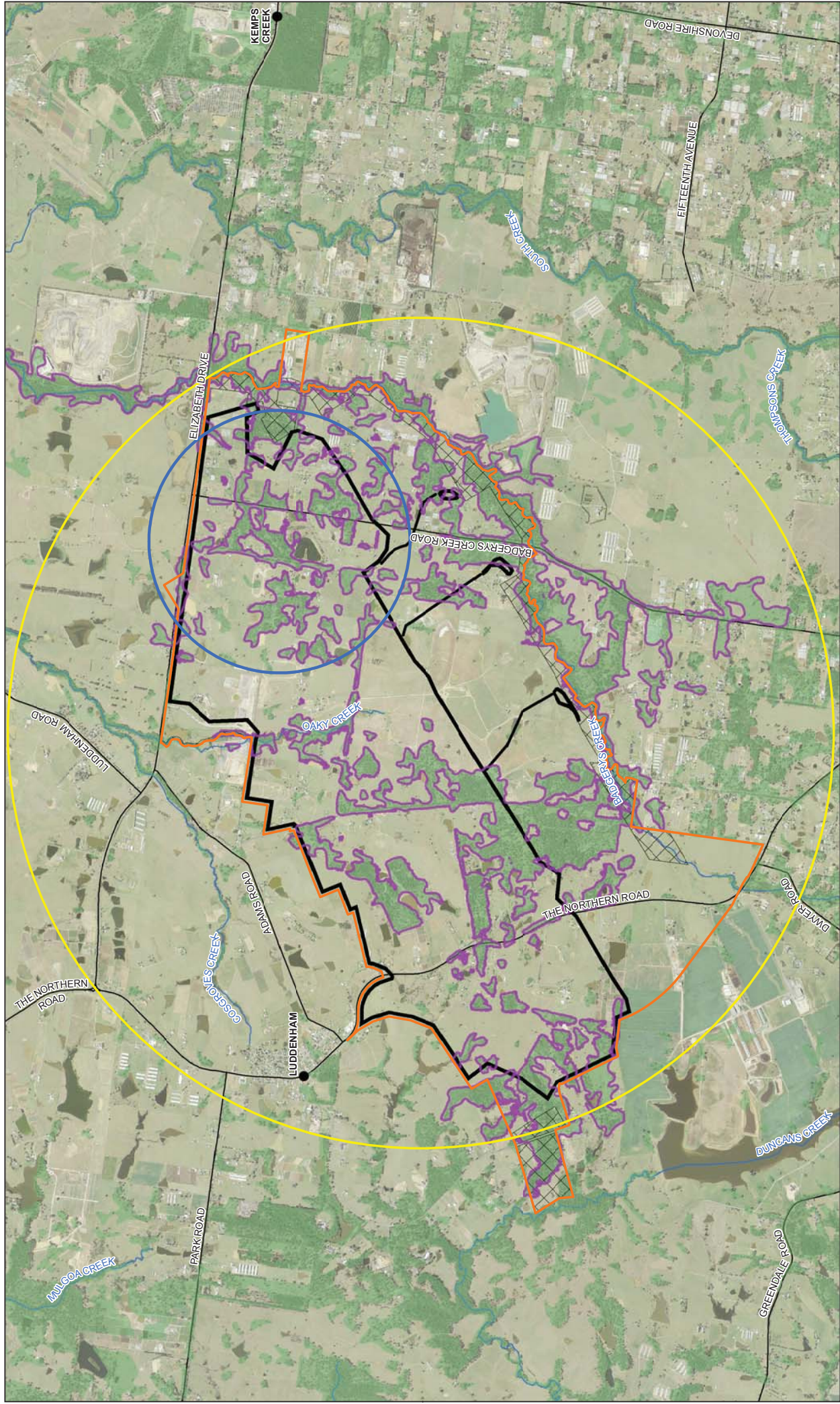
Common name	Scientific name	Threatened species multiplier	Species credits required
Black Bittern	<i>Ixobrychus flavicollis</i>	1.3	719
Cumberland Plain Land Snail	<i>Meridolum corneovirens</i>	1.3	1568
<i>Marsdenia viridiflora</i> subsp. <i>viridiflora</i> in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas	<i>Marsdenia viridiflora</i> subsp. <i>viridiflora</i> - endangered population	4.0	3720
<i>Pultenaea parviflora</i>	<i>Pultenaea parviflora</i>	1.5	60
Southern Myotis	<i>Myotis macropus</i>	2.2	656

### 3.4 Assumptions and amendments to the BioBanking methodology

The biodiversity offsets for impacts on the natural environment have been determined using the BioBanking credit calculator as it is applied to major projects as described above. Some data has been estimated or modified to enable BioBanking credit calculations based on the biodiversity assessment results (GHD 2015a). The assumptions and amendments to the BioBanking assessment methodology for major projects are listed below:

- BioBanking credit calculations have not been completed for proposed biobank sites (see Table 8). A rate of seven ecosystem credits per hectare has been used to estimate the number of credits that would be generated at these sites, which is based on the results of BioBanking calculations from similar biobank sites.
- Wetlands were not sampled with plot/transects because of the inherent safety risk. Wetland vegetation was sampled by walking the margins of waterbodies and noting dominant plant species and percentage cover in each vegetation strata present (i.e. trees, shrubs, emergent, aquatic and fringing plants). These 'wetland survey' results were then used as surrogates for plot/transect data in credit calculations.
- Less than the minimum number of plot/transects required by the BioBanking assessment methodology for major projects were sampled in two out of the nine native vegetation zones at the airport site. In these instances the available plot/transect data for each vegetation zone were duplicated.
- It is assumed that all vegetation in the stage one construction impact zone would be completely removed for construction of the proposed airport. One management zone was created for each vegetation zone in the stage one construction impact zone and all site value scores were reduced to zero after the development.





Job Number 21-24265  
Revision A  
Date 06 Oct 2015

Western Sydney Unit, Department of  
Infrastructure and Regional Development  
Western Sydney Airport  
Biodiversity Offset Package



## Landscape assessment

Figure 4

Level 15, 133 Castlereagh Street Sydney NSW 2000 T 61 2 9239 7100 F 61 2 9239 7199 E sydney@ghd.com.au W www.ghd.com.au

- LEGEND**
- Inner assessment circle (400 hectares)
  - Outer assessment circle (4000 hectares)
  - Patch size
  - Native woodland and forest
  - The airport site
  - Stage one construction impact zone
  - Environmental conservation
  - Watercourses
  - Roads



Paper Size A3  
0 10 20 40  
Kilometers

Map Projection: Transverse Mercator  
Horizontal Datum: GDA 1994  
Grid: GDA 1994 MGA Zone 56

N:\AUS\sydney\projects\104265\MapData\Drawings\21\_24265\_2015\_LandscapeAssessment.mxd  
© 2015. Whilst every care has been taken to prepare this map, GHD and NSW Department of Lands, Geoscience Australia make no representations or warranties about the accuracy, reliability, completeness or suitability for any particular purpose and cannot accept liability and responsibility of any kind (whether in contract, tort or otherwise) for any expenses, losses, damages and/or costs (including indirect or consequential damage) which are or may be incurred by any party as a result of the map being inaccurate, incomplete or unsuitable in any way and for any reason.  
Data source: NSW LPI DTDB 2012, Inset - Geoscience Australia. Created by jrdharden



## 4. Proposed Offsets

### 4.1 Proposed offset strategy

The biodiversity offset strategy for the proposed airport is to conserve habitat for the affected threatened biota in suitable offset sites using BioBanking. The offsets would be secured by registration of a BioBanking agreement on title to the offset sites that would ensure that they would be securely titled and managed for conservation as a biobank in perpetuity.

The EPBC Act offset policy requires that a minimum of 90 per cent of the proposed airport's impacts must be directly offset as calculated with the offset assessment guide for listed threatened species and communities or as calculated with bioBanking or an alternative metric for other matters. The remaining offset requirement is able to be met by alternative contributions such as a financial contribution to research or conservation.

The specific components of this strategy that are included in the offset package are described below.

### 4.2 Identification of potential offset sites

A desktop assessment was performed to identify and describe potential offset sites for the proposed airport. Candidate sites would be secured under a BioBanking agreement that would ensure that the offset sites would be securely titled for conservation as a biobank in perpetuity.

The sources that were considered in the desktop assessment included:

- the 'biodiversity credits register' (OEH 2015b) which was used to identify existing biobank sites with biodiversity credits that would offset impacts on the affected threatened biota and that are available for sale;
- the BioBanking 'Expression of interest register' (OEH 2015c) which was used to identify potential biobank sites that could generate suitable biodiversity credits in the future;
- BioBanking assessment reports for existing and potential biobank sites, which were used to describe the biodiversity values of the sites and especially to confirm the extent and quality of habitat for the affected threatened biota; and
- consultation with private landowners and agencies such as OEH, the NSW Department of Planning and Environment (DPE) and the Western Sydney Parklands Trust to identify or to describe potential offset sites.

The following criteria were used to identify potential offset sites:

- presence of Cumberland Plain Woodland, comprising the NSW vegetation types HN528, HN529 and HN512 (OEH 2014);
  - that meets the condition criteria required to comprise the community as defined under the EPBC Act and associated policy (DEWHA 2010); or
  - is poorer quality Cumberland Plain Woodland that could be managed to achieve that condition and is connected to EPBC Act Cumberland Plain Woodland.
- presence of habitat for the Grey-headed Flying-fox based on the presence of known food tree species (Eby and Law 2008) and the critical habitat criteria listed in the Draft National Recovery Plan for the Grey-headed Flying-fox (DECCW 2009);

- land that is relatively close to the airport site, in order to more directly benefit the populations and communities affected by the proposed airport, and which as a minimum is located in the Cumberland IBRA sub-region; and
- land that is already set aside as a biobank and that has suitable biodiversity credits for sale, that is likely to be set aside as a biobank or otherwise protected under a conservation covenant, or that may be available for sale.

The offset package will include the conservation of core areas of Cumberland Plain Woodland in offset sites that already meet the condition criteria required to comprise the community as defined under the EPBC Act and associated policy (DEWHA 2010). The offset package will also include the conservation and management of poorer quality Cumberland Plain Woodland that could be managed to achieve that condition.

The guide to identifying and protecting EPBC Act Cumberland Plain Woodland notes that appropriate management of patches that do not meet the condition thresholds may still play an important ecological role, especially where they are linking native vegetation remnants in the landscape and contributing to the future viability of listed patches of the ecological community. Both patches that meet the condition thresholds and those that do not should be considered in recovery and other management actions (DEWHA 2010). This approach builds upon the information presented in the Commonwealth listing advice for Cumberland Plain Woodland which notes that if a patch does not meet the condition criteria, suitable recovery and management actions may improve it to the point that it can be regarded as part of the ecological community listed under the EPBC Act.

The listing advice also notes that derived grasslands and shrub lands can be quite easily recovered to meet the description and condition thresholds for the listed ecological community through planting of key canopy tree species and ongoing management actions, whereas loss of ground layer diversity is much more difficult to replace (TSSC 2008). In line with the listing advice, only derived native grassland and scrub with predominantly native groundcover and the capacity for natural regeneration will be included as poorer quality Cumberland Plain Woodland in the offset package.

### **4.3 Description of potential offset sites**

The desktop assessment has revealed suitable offset sites that contain Cumberland Plain Woodland and/or Grey-headed Flying-fox habitat. The potential offset sites include established biobank sites with suitable biodiversity credits for sale and proposed biobank sites that are at various stages of the assessment and approval process for obtaining a BioBanking agreement.

Potential offset sites that contain habitat for the affected threatened biota and that could be included in this offset package are listed in Table 8. The locations of the potential offset sites relative to the airport site are shown on Figure 5. Portions of the Williamswood, Montpelier Stages 1 and 2 and Durham biobanks containing a total of 190 hectares of native vegetation and habitat are located in mapped Cumberland Plain Priority Conservation Lands that are identified in the recovery plan for Cumberland Plain Woodland (DECCW 2010, 2011). In addition, the Menangle Road and Dunheved biobank sites are connected to Cumberland Plain Priority Conservation Lands by remnant native vegetation (DECCW 2011).

A detailed description of each of the potential offset sites is provided in Appendix A, including their location, tenure, land uses, the vegetation types present, the extent and quality of habitat for the affected threatened biota, existing threats and recommended management actions. An overview of these sites is provided below.

The 'Williamswood biobank' and 'The Oaks biobank' offset sites are biobanks that have been subject to detailed field survey and BioBanking assessment and have already been set aside for conservation



under a BioBanking agreement. They are located within the Wollondilly Local Government Area (LGA) around 20 kilometres to the south of the airport site and feature a variety of grassy woodland vegetation types on shale and alluvial substrate. Both sites are currently zoned RU2 Rural Landscape under the *Wollondilly Local Environment Plan 2011* (LEP) and were grazed by cattle prior to being set aside as a biobank. Both sites contain Cumberland Plain Woodland that also comprises Grey-headed Flying-fox habitat as well as additional habitat associated with other vegetation types on shale or alluvium.

The 'Durham biobank', 'Mare biobank', 'Forrester biobank', 'Luddenham biobank', 'Caddens biobank' and 'Dunheved biobank' offset sites are proposed biobanks on land owned by the NSW DPE in the Ropes Creek and South Creek riparian corridors around 10-20 kilometres to the north of the airport site. These sites have been subject to a detailed field survey and a preliminary BioBanking assessment but have not yet been set aside for conservation under a BioBanking agreement. These offset sites each feature a variety of grassy woodland vegetation types on shale and alluvial substrate. These sites contain Cumberland Plain Woodland that also comprises Grey-headed Flying-fox habitat as well as additional habitat associated with other vegetation types.

The 'Stage 1 Montpelier Biobank', 'Stage 2 Montpelier biobank', 'Menangle Road biobank' and 'Bruelle biobank' offset sites are each proposed biobanks that have been subject to field surveys and BioBanking assessments prior to applications for BioBanking agreements from OEH (GHD, 2015d). Each of these biobanks is located within 20 kilometres of the airport site in the Wollondilly or Penrith LGAs. They are currently zoned RU2 Rural Landscape under applicable LEPs and are subject to cattle grazing. These sites each feature a variety of grassy woodland vegetation types on shale and alluvial substrate, including Cumberland Plain Woodland and Grey-headed Flying-fox habitat.

The 'Western Sydney Parklands biobank ID 120' and 'Western Sydney Parklands biobank ID 70' offset sites have already been set aside for conservation under a BioBanking agreement. They are located around 10 kilometres to the north-east of the airport site and feature a variety of grassy woodland vegetation types on shale and alluvial substrate. These sites contain Cumberland Plain Woodland that also comprises Grey-headed Flying-fox habitat.

**Table 8 Potential offset sites**

Potential Offset Site	Location	Total area (ha)	Status and ownership	Source
Williamstown biobank	Mount Hunter	104.4	Established biobank, private owner.	Williamstown Biobank BioBanking Assessment (GHD 2014a).
Durham biobank	Oxley Park (Ropes Creek riparian corridor)	46.85	Potential biobank, DPE.	Ropes and South Creek Preliminary BioBanking Assessment Report (GHD 2015c).
Mamre biobank	Mamre Park (South Creek riparian corridor)	98.1	Potential biobank, DPE.	Ropes and South Creek Preliminary BioBanking Assessment Report (GHD 2015c).
Luddenham biobank	Mamre Park (South Creek riparian corridor)	42	Potential biobank, DPE.	Ropes and South Creek Preliminary BioBanking Assessment Report (GHD 2015c).
Roper biobank	Minchinbury (Ropes Creek riparian corridor)	14.05	Potential biobank, DPE.	Ropes and South Creek Preliminary BioBanking Assessment Report (GHD 2015c).

Potential Offset Site	Location	Total area (ha)	Status and ownership	Source
Caddens biobank	Claremont Meadows (South Creek riparian corridor)	36.08	Potential biobank, DPE.	Ropes and South Creek Preliminary BioBanking Assessment Report (GHD 2015c)
Dunheved biobank	Werrington County (South Creek riparian corridor)	90.17	Potential biobank, DPE.	Ropes and South Creek Preliminary BioBanking Assessment Report (GHD 2015c).
Forrester biobank	Tregear (Ropes Creek riparian corridor)	9.16	Potential biobank, DPE.	Ropes and South Creek Preliminary BioBanking Assessment Report (GHD 2015c).
Stage 1 Montpelier biobank	The Oaks	76.24	Potential biobank, private owner.	Stage 1 Montpelier Biobank BioBanking Assessment (GHD 2015d).
Stage 2 Montpelier biobank	The Oaks	79.5	Potential biobank, private owner	Stage 2 Montpelier Biobank BioBanking Assessment (GHD in prep).
Menangle Road biobank	The Oaks	57.07	Potential biobank, private owner	Menangle Road Biobank BioBanking Assessment (GHD 2015e).
Bruelle biobank	Mulgoa	27.5	Potential biobank, private owner	Bruelle biobank site Draft Biobank agreement assessment (GHD 2015f).
The Oaks	Mowbray Park	40	Established biobank, private owner	The Oaks Biobank BioBanking Assessment (GHD 2015g).
Western Sydney Parklands ID 120	Cecil Park	19.4	Established biobank, Western Sydney Parklands Trust	The biodiversity credits register (OEH 2015b).
Western Sydney Parklands ID 70	Cecil Park and Chandos West	40.5	Established biobank, Western Sydney Parklands Trust	The biodiversity credits register (OEH 2015b).

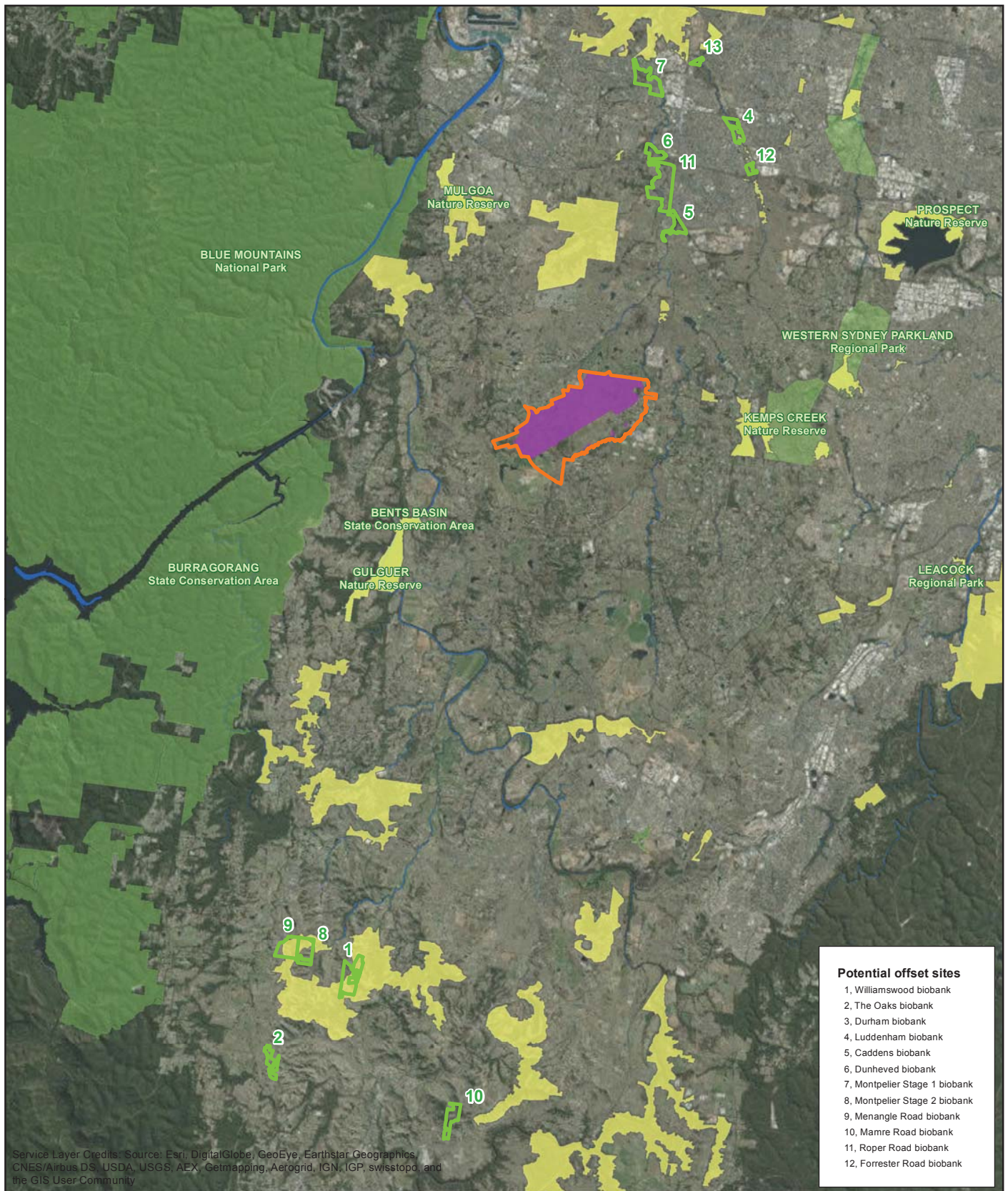
There are local occurrences of each of the TECs that would be removed for construction of the airport and known or potential habitat for many of the threatened species that would be affected at the offset sites (see Appendix A and Table 9).

**Table 9 Threatened species recorded at the potential offset sites**

Common name	Scientific name	TSC Act Status	EPBC Act Status	Sites recorded
Brown Treecreeper (eastern subspecies)	<i>Climacteris picumnus</i> subsp. <i>victoriae</i>	V		Dunheved <sup>1</sup>
Eastern Freetail-bat	<i>Mormopterus norfolkensis</i>	V		Mamre <sup>2</sup>
Little Eagle	<i>Hieraaetus morphnoides</i>	V		Roper, Luddenham, Montpelier Stage 1, Montpelier Stage 2, Williamswood <sup>3</sup>
Powerful Owl	<i>Ninox strenua</i>	V		Mamre <sup>2</sup>
Swift Parrot	<i>Lathamus discolor</i>	E	E	Dunheved <sup>1</sup>
Turquoise Parrot	<i>Neophema pulchella</i>	V		Luddenham <sup>1</sup>
Varied Sittella	<i>Daphoenositta chrysoptera</i>	V		Dunheved <sup>1</sup> , Mamre <sup>2</sup>
Cumberland Plain Land Snail	<i>Meridolum corneovirens</i>	E		Forrester <sup>1</sup> , Caddens <sup>2</sup>
Juniper-leaved Grevillea	<i>Grevillea juniperina</i> subsp. <i>juniperina</i>	V		Durham <sup>3</sup> , Roper <sup>3</sup>
<i>Dillwynia tenuifolia</i>	<i>Dillwynia tenuifolia</i>	V		Roper <sup>4</sup>
Grey-headed Flying-fox	<i>Pteropus poliocephalus</i>	V	V	Caddens <sup>2</sup> and roost camp within 500 metres <sup>4</sup> ,
Large-footed Myotis	<i>Myotis macropus</i>	V		Mamre <sup>2</sup>
<i>Pultenaea parviflora</i>	<i>Pultenaea parviflora</i>	V	V	Dunheved <sup>3</sup>
Spiked Rice-flower	<i>Pimelea spicata</i>	E	E	Williamswood <sup>3</sup>

1 = Toolijooa (various dates); 2 = OEH (2015a); 3 = GHD (2014a,b; 2015a,b,c,d,e; in prep.); 4 = PB (2013).





#### LEGEND

- Airport site
- Potential offset sites
- Cumberland Plain Priority Conservation Lands
- Stage one construction impact zone
- Drainage lines
- Reserves

Paper Size A4  
0 8751.750 3,500 5,250 7,000  
Metres  
Map Projection: Transverse Mercator  
Horizontal Datum: GDA 1994  
Grid: GDA 1994 MGA Zone 56



Western Sydney Unit, Department of Infrastructure  
and Regional Development  
Western Sydney Airport  
Biodiversity Offset Package

Job Number | 21-24265  
Revision | A  
Date | 27 Aug 2015

#### The airport site and potential offset sites

Figure 5

G:\21\24265\GIS\Maps\Deliverables\21-24265-Z082\_AirportSiteAndOffsetSites.mxd

Level 15, 133 Castlereagh Street Sydney NSW 2000 T 61 2 9239 7100 F 61 2 9239 7199 E sydmail@ghd.com.au W www.ghd.com.au

© 2015. Whilst every care has been taken to prepare this map, GHD, ESRI, NSW LPMA and DECCW make no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and cannot accept liability and responsibility of any kind (whether in contract, tort or otherwise) for any expenses, losses, damages and/or costs (including indirect or consequential damage) which are or may be incurred by any party as a result of the map being inaccurate, incomplete or unsuitable in any way and for any reason.

Data source: Aerial Imagery: ESRI, 2015. Offset sites: GHD, 2015. Cumberland Plain Conservation: DECCW, 2011. Created by: Afoddy

#### 4.4 Proposed offset areas

The potential offset sites described above contain some areas of native vegetation and habitat that is not an appropriate 'like for like' match for impacts on the EPBC Act-listed affected threatened biota or is associated with biodiversity credits that have already been sold. A subset of the habitat available at the potential offset sites has been selected on the basis that it would directly offset impacts on the affected threatened biota, and the biobanking credits which are generated to represent the offsets for that area are available for purchase. DotE will require these specific areas to be clearly documented and mapped in the final offset package.

The criteria for selecting the proposed offset areas are:

- areas that are linked to biodiversity credits that area available for sale at established biobanks or that would be available for sale at proposed biobanks;
- presence of EPBC Act Cumberland Plain Woodland;
- presence of habitat for the Grey-headed Flying-fox.

The 'proposed offset areas' (i.e. the specific areas of habitat at potential offset sites that would be included in the offset package to offset impacts on the affected threatened biota) are summarised in Table 10.

The area of Grey-headed Flying-fox habitat available in the proposed offset areas (around 401 hectares) is substantially greater than the estimated area required to meet this species' offset requirement. This area would also contribute offsets for impacts on the environment as estimated in Section 3 and so the full area has been included in the Offset assessment guide calculations in Section 5.2.3.



**Table 10 Proposed offset areas**

Potential Offset Site	Total area (ha)	Extent of available EPBC Act Cumberland Plain Woodland (ha) <sup>1</sup>	Extent of available poorer quality Cumberland Plain Woodland (ha) <sup>2</sup>	Grey-headed Flying fox habitat (ha) <sup>3</sup>	Notes
Williamswood biobank	104.5	31.9	28.0	50.4	EPBC Act Cumberland Plain Woodland linked to credits that are available for sale, which also comprises Grey-headed Flying-fox habitat. Additional poorer quality Cumberland Plain Woodland.
The Oaks	40.0	10.0	3.0	10.4	EPBC Act Cumberland Plain Woodland linked to credits that are available for sale, which also comprises Grey-headed Flying-fox habitat. Additional poorer quality Cumberland Plain Woodland.
Durham biobank	42.7	2.9	0.0	24.1	EPBC Act Cumberland Plain Woodland linked to credits that are available for sale, which also comprises Grey-headed Flying-fox habitat. Additional Grey-headed Flying-fox habitat associated with River Flat Eucalypt Forest and close to a known roost camp.
Mamre Biobank	98.1	0.0	0.0	52.5	Grey-headed Flying-fox habitat associated with River Flat Eucalypt Forest and linked to biodiversity credits that area available for sale.
Luddenham biobank	40.0	4.1	0.7	34.6	EPBC Act Cumberland Plain Woodland linked to credits that are available for sale, which also comprises Grey-headed Flying-fox habitat. Additional Grey-headed Flying-fox habitat associated with River Flat Eucalypt Forest. Additional poorer quality Cumberland Plain Woodland.
Roper biobank	13.3	3.0	1.7	6.7	EPBC Act Cumberland Plain Woodland and poorer quality Cumberland Plain Woodland linked to credits that are available for sale.

Potential Offset Site	Total area (ha)	Extent of available EPBC Act Cumberland Plain Woodland (ha) <sup>1</sup>	Extent of available poorer quality Cumberland Plain Woodland (ha) <sup>2</sup>	Grey-headed Flying fox habitat (ha) <sup>3</sup>	Notes
Caddens biobank	33.3	4.8	1.2	17.3	EPBC Act Cumberland Plain Woodland linked to credits that are available for sale, which also comprises Grey-headed Flying-fox habitat. Additional poorer quality Cumberland Plain Woodland. Biodiversity credits for other impacts on the environment.
Dunheved biobank	65.0	3.8	8.7	23.0	EPBC Act Cumberland Plain Woodland linked to credits that are available for sale, which also comprises Grey-headed Flying-fox habitat. Additional poorer quality Cumberland Plain Woodland. Biodiversity credits for other impacts on the environment.
Forrester biobank	9.2	0.0	0.0	5.9	Grey-headed Flying-fox habitat associated with River Flat Eucalypt Forest and linked to biodiversity credits that area available for sale.
Stage 1 Montpellier biobank	76.2	34.1	11.4	40.9	EPBC Act Cumberland Plain Woodland linked to credits that are available for sale, which also comprises Grey-headed Flying-fox habitat. Additional poorer quality Cumberland Plain Woodland. Biodiversity credits for other impacts on the environment.
Stage 2 Montpellier biobank	79.5	20.9	9.2	48.5	EPBC Act Cumberland Plain Woodland linked to credits that are available for sale, which also comprises Grey-headed Flying-fox habitat. Additional poorer quality Cumberland Plain Woodland. Biodiversity credits for other impacts on the environment.
Menangle Road biobank	57.1	27.0	21.1	36.0	EPBC Act Cumberland Plain Woodland linked to credits that are available for sale, which also comprises Grey-headed Flying-fox habitat. Additional poorer quality Cumberland Plain Woodland. Biodiversity credits for other impacts on the environment.
Bruelle biobank	26.8	14.4	0.0	27.5	EPBC Act Cumberland Plain Woodland linked to credits that are available for sale, which also comprises Grey-headed Flying-fox habitat. Biodiversity credits for other impacts on the environment.

Potential Offset Site	Total area (ha)	Extent of available EPBC Act Cumberland Plain Woodland (ha) <sup>1</sup>	Extent of available poorer quality Cumberland Plain Woodland (ha) <sup>2</sup>	Grey-headed Flying fox habitat (ha) <sup>3</sup>	Notes
Western Sydney Parklands ID 120	19.4	18.2	0.0	18.2	EPBC Act Cumberland Plain Woodland linked to credits that are available for sale, which also comprises Grey-headed Flying-fox habitat. Biodiversity credits for other impacts on the environment.
Western Sydney Parklands ID 70	40.5	5.2	0.0	5.2	EPBC Act Cumberland Plain Woodland linked to credits that are available for sale, which also comprises Grey-headed Flying-fox habitat. Biodiversity credits for other impacts on the environment.
	<b>786.2</b>	<b>180.3</b>	<b>78.6</b>	<b>401.2</b>	

Notes:

- 1- Vegetation types HN528, HN529 and HN512 that meet the condition criteria required to comprise Cumberland Plain Woodland as defined under the EPBC Act and associated policy (DEWHA 2010) and which are linked to biodiversity credits associated with an established biobank site that are currently available for sale and/or which are in a parcel of land that is likely to be set aside as a biobank.
- 2- Poorer condition patches of vegetation types HN528, HN529 and HN512 that do not meet the condition criteria required to comprise Cumberland Plain Woodland as listed under the EPBC Act (DEWHA 2010). Comprises derived native scrub or grassland with <10 per cent canopy cover.
- 3- Based on vegetation type descriptions in offset site assessment reports compared with the critical habitat criteria listed in the *Draft National Recovery Plan for the Grey-headed Flying-fox* (DECCW 2009).

The quality of habitat in the proposed offset areas is described further in Section 5.2. These data have been used to perform the preliminary offset assessment guide calculations included in Section 5. Based on these preliminary offset calculations the proposed offset areas could deliver 100 per cent of the required offsets for the Grey-headed Flying-fox as direct offsets but only around 74 per cent of the estimated requirement for Cumberland Plain Woodland. The process of identification of potential offset sites will continue until the required quantum of offsets can be delivered. As additional offset sites are identified the proposed offset areas would be reconsidered to ensure that the most suitable offset areas are included in the final offset package. Similarly, if some of the proposed areas are set aside as offsets for another project or otherwise become unavailable then alternative options would be considered.

## **4.5 Management of offset sites**

### **4.5.1 Legal protection of offset sites**

BioBanking agreements would be registered over each of the proposed offset sites that are included in the offset package. Several of the potential offset sites described above have already been set aside as biobanks.

A BioBanking agreement comprises a conservation covenant on the title of the lots within the biobank site. The covenant is the strongest available on private lands and extinguishes all land uses other than conservation unless the BioBanking agreement is varied or terminated by the NSW Minister for the Environment to permit alternative uses. Certain mining rights may be granted over a biobank site, and certain development can be carried out by public authorities on a biobank site, but any impacts from these activities must be offset again as an addition to any offsetting activities required by a given project in its own right.

Therefore the risk of loss of the offset sites with the BioBanking agreement in place has been assessed as 1 per cent for the purposes of the offset assessment guide calculations (see Section 5.4).

### **4.5.2 Management actions**

A BioBanking agreement includes a binding requirement to perform management actions that will achieve improvements in biodiversity values at the biobank site (i.e. the offset sites). The following sections provide an outline of the actions that would be required for ongoing management of the offset sites and to achieve the proposed improvements in biodiversity values. A management action plan (MAP), detailing rehabilitation activities and a management program would be prepared for inclusion in the BioBanking agreement application. The MAP would include the costs and timeline for each proposed management action.

Management actions that would be performed at the offset sites may include:

- exclusion of domestic grazing;
- fencing;
- weed control;
- management of fire for conservation;
- management of human disturbance;
- retention of regrowth and remnant native vegetation;
- retention of dead timber;
- erosion control; and

- retention of rocks.

These management actions would improve the condition and viability of Cumberland Plain Woodland. Management would also improve the quality of habitat for the Grey-headed Flying-fox and especially the quality of foraging resources by increasing the extent, health and productivity of native vegetation containing food tree species.

Management actions would be specified in greater detail in the BioBanking assessments and/or MAPs for the offset sites as part of arrangements for protection of the sites in perpetuity. Additional site specific management actions may be required under the BioBanking methodology to alleviate specific threats for other species. Both threats and actions would be identified during field surveys conducted as part of the BioBanking assessment. Site specific management actions may include feral herbivore control or feral cat and/or fox control, in line with existing control programs in the locality, as required.

Based on an understanding of management measures which typically would be required for an offset site under a biobanking agreement, an increase in habitat quality score with offset has been entered in the offset assessment guide calculations (see Section 5.4). Table 11 provides the justification for the increase in habitat quality score with reference to conservation advice and recovery plans for the affected threatened biota as relevant.

**Table 11 Effect of management actions on quality of habitat in the potential offset sites**

Management action	Effect on Cumberland Plain Woodland	Effect on Grey-headed Flying-fox habitat
Retention of regrowth and remnant native vegetation.	Maintenance and improvement of the condition of the community. Improved viability of the populations of component species. Continued development of vegetation structure and habitat resources. Contributes to the following recovery objectives identified in the recovery plan for the community: Objective 1. To build a protected area network, comprising public and private lands, focused on the priority conservation lands (DECCW 2010). Five of the potential offset sites are located in mapped Cumberland Plain Priority Conservation Lands that are identified in the recovery plan for Cumberland Plain Woodland (DECCW 2010, 2011). BioBanking agreements are recognised as a preferred conservation mechanism (DECCW 2010).	Maintenance and improvement of shelter and foraging habitat. Regeneration and maturation of food tree species. Contributes to the following recovery objectives identified in the recovery plan for the species: Objective 1. To identify and protect foraging habitat critical to the survival of Grey-headed Flying-foxes throughout their range; and Objective 2. To protect and increase the extent of key winter and spring foraging habitat of Grey-headed Flying-foxes (DECCW 2009).
Regeneration of canopy vegetation in derived native grassland and scrub.	Increased extent of the EPBC Act community. Development of natural vegetation structure and microclimate and associated benefits for vegetation condition and species richness. Increased shelter and foraging habitat for component species. Improved connectivity of habitat. Improved quality and viability of the community through reduced edge effects.	Increased extent of shelter and foraging habitat. Improved connectivity of habitat resulting in reduced risk and energy costs of movement between patches of habitat. Improved quality and viability of retained habitat through reduced edge effects. Regeneration and maturation of food tree species. Contributes to objective 2 identified in the recovery plan for the species: to protect and increase the extent of key winter and spring foraging habitat of Grey-headed Flying-foxes (DECCW 2009).



Management action	Effect on Cumberland Plain Woodland	Effect on Grey-headed Flying-fox habitat
Weed control	Maintenance and improvement in the condition of the community by increasing the extent, health and productivity of native vegetation and restoring natural vegetation structure and microclimate. Reduced competition for component plant species. Consistent with one of main principles presented in the recovery plan for the community, which is that active management to best practice standards is needed to prevent the degradation of the remaining bushland in the fragmented landscape of Western Sydney (DECCW 2010).	Maintenance and improvement in quality of foraging habitat by increasing the extent, health and productivity of native vegetation containing food tree species.
Exclusion of domestic grazing and management of human disturbance.	Improved health and productivity of native vegetation. Reduced risk of secondary impacts such as erosion and sedimentation and transmission of weeds or disease.	Likely increase in the extent and quality of foraging habitat by increasing the extent, health and productivity of native vegetation containing food tree species.
Fire management (ecological burning and reduced risk of wildfire)	Maintenance of natural vegetation structure and microclimate and associated benefits for vegetation condition and species richness. Reduced risk of wildfire and associated erosion having an impact on the quality of the community.	Improvement in the health of vegetation and quality of foraging resources. Reduced risk of wildfire and associated risk of harm to individual animals and of erosion having an impact on the quality of the habitat.
Control of pest fauna (deer, rabbits, pigs, feral cattle).	Improved health and productivity of native vegetation. Reduced risk of secondary impacts such as erosion and sedimentation and transmission of weeds or disease.	Likely increase in the extent and quality of foraging habitat by increasing the extent, health and productivity of native vegetation containing food tree species.
Property maintenance (perimeter fencing, rubbish and barbed wire fence strand removal, erosion control etc.).	Increased condition of vegetation. Reduced risk and energy costs of movement between patches of habitat for component species. Reduced risk of uncontrolled access, erosion, rubbish dumping etc. having an impact on the quality of habitat.	Increased quality of shelter and foraging habitat. Reduced risk and energy costs of movement between patches of habitat. Reduced risk of adverse impacts on the quality of habitat. Contributes to objective 9 identified in the recovery plan for the species: To assess and reduce the impact on Grey-headed Flying-foxes of electrocution on power lines and entanglement in netting and on barbed-wire (DECCW 2009).

#### 4.5.3 Funding of offset sites

The management of the offset sites would be funded through the purchase and retirement of biodiversity credits through BioBanking. The credits would be purchased from the biobank site owner at an agreed market rate.

The cost of biodiversity credits includes a minimum value set by the BioBanking methodology known as the 'total fund deposit'. This value is the minimum required to be paid into the BioBanking trust fund to ensure that adequate funds are available to perform the management actions specified in the MAP on an ongoing, annual basis, in perpetuity. BioBanking includes provision for annual monitoring of biobank sites and scope for OEH to enforce expenditure on management actions or acquire the property if management has not been performed satisfactorily (DECC, 2009). OEH provides a work

sheet as part of the BBAM: the 'total fund deposit worksheet (Part A costs)'. This work sheet is used to determine the costs that are included in the MAP and is part of the BioBanking agreement application.

BioBanking provides certainty that the management of the offset site would be fully funded. The total cost of delivering the offset package will not be confirmed until agreements have been made to purchase enough biodiversity credits to deliver the offset package for the proposed airport.

## 5. Offset Assessment Guide Calculations

### 5.1 Overview

The EPBC Act policy requires a formal assessment of impacts and offset contributions for EPBC Act-listed species and communities using the 'offsets assessment guide'. The offsets assessment guide utilises a balance sheet approach to measure impacts and offsets. According to the EPBC Act Environmental Offsets Policy (DSEWPaC 2012a), controlled actions requiring offsets must achieve a minimum 90 per cent 'direct offset'. Direct offsets are defined as 'those actions that provide a measurable conservation gain for an impacted protected matter'. A conservation gain for the protected matter may be achieved by measures such as:

- improving existing habitat;
- creating new habitat;
- reducing threats; and/or
- averting the loss of a protected matter or its habitat that is under threat.

The offset package comprises the conservation and management of the affected threatened biota and their habitat in offset sites. This would achieve improvement in the condition of habitat, creation of new habitat and resources, mitigation of threats and averted risk of loss through development or agricultural activities. The quality of habitat in the proposed offset areas and the change in site quality with management is assessed in Section 5.2 below.

A single offset area can compensate for impacts on multiple threatened biota if they have common habitat requirements (DSEWPaC 2012b). EPBC Act Cumberland Plain Woodland at the airport site and in the proposed offset areas also comprises Grey-headed Flying-fox habitat.

Offset assessment guide calculations have been performed based on the significant residual impacts documented in the EIS (GHD 2015a, 2015b) and likely conservation and management of the potential offset sites. The output of this preliminary offset guide assessment is an estimate of the percentage of the proposed airport's impacts that would be 'directly offset' by the potential offset sites. The other data and assumptions that were used to perform the offset calculations are described in Table 12, Table 13 and Table 14.

Once the final offset sites have been identified, a 90 per cent direct offset would be acceptable under the DSEWPaC (2012a) policy with up to 10 per cent of the offset able to be achieved through 'other compensatory measures', which are 'those actions that ... are anticipated to lead to benefits for the impacted protected matter, for example funding for research or educational programs'. The intent of the offset package is to secure 100 per cent direct offsets, through conservation of appropriate vegetation and habitat in offset sites, if possible.

### 5.2 Quality of offset sites

#### 5.2.1 EPBC Act Cumberland Plain Woodland

Cumberland Plain Woodland in the proposed offset areas that already meets the condition criteria for the EPBC Act listed form of the community (hereafter referred to as 'EPBC Act Cumberland Plain Woodland') comprises remnant or regrowth native vegetation in moderate condition. The quality of a community is scored out of ten for offset assessment guide calculations. As described above, for the airport site there are three site characteristics that may contribute to quality: 'site condition', 'site context' and 'species stocking rate' that must be weighted according to their relative importance to the



offset calculations (DSEWPaC 2012b). The weighting of these three attributes for Cumberland Plain Woodland in the proposed offset areas was defined as site condition – 50 per cent, site context - 50 per cent and species stocking rate – 0 per cent, as for the airport site.

Each characteristic was scored based on the results of the various BioBanking assessments for the various offset sites, weighted according to the size of the area at each site that would be included in the offset package.

Site condition was scored as 5/10 based on the BioBanking plot/transects and other field survey data collected within the vegetation zones that comprise Cumberland Plain Woodland in the proposed offset areas. This score is based on the characteristics outlined below.

- Moderate/good - medium condition Grey Box - Forest Red Gum grassy woodland on hills (HN529) (around 140 hectares out of around 180 hectares of EPBC Act Cumberland Plain Woodland in the proposed offset areas). Remnant or regrowth native woodland at the Williamswood, The Oaks, Bruelle, Menangle Road and Stage 1 and 2 Montpelier biobanks. Vegetation zones at these biobanks have relatively similar characteristics comprising partially cleared grazing country on undulating shale hills. These vegetation zones feature near-intact over storey, moderate scores for native species richness and most vegetation cover attributes, occasional hollow-bearing trees and relatively little woody debris. There is frequently high exotic plant cover mainly consisting of woody weeds such as African Olive (*Olea europaea* subsp. *cuspidata*) in the mid storey.
- Moderate/good - medium condition Grey Box - Forest Red Gum grassy woodland on flats (HN528) or Broad-leaved Ironbark – *Melaleuca decora* grassy open forest (HN512) (around 40 hectares out of around 180 hectares of EPBC Act Cumberland Plain in the proposed offset areas). Remnant or regrowth woodland at the Ropes and South Creek and Western Sydney Parklands biobanks. Vegetation zones at these biobanks have relatively similar characteristics comprising partially cleared grazing country or open space on lower slopes and flats near to major drainage lines. These vegetation zones feature near-intact over storey, moderate scores for native species richness and most vegetation cover attributes, occasional hollow-bearing trees and relatively little woody debris. There is frequently high exotic plant cover mainly consisting of perennial grasses such as Kikuyu (*Pennisetum clandestinum*) and herbs in the under storey or woody weeds such as Privet (*Ligustrum* species) in the mid storey.

A more detailed description of site condition at each of these offset sites is provided in Appendix A.

Site context was scored as 5/10, reflecting the position of each of the local occurrences of the community in highly fragmented, rural landscapes (the Wollondilly and Penrith LGA biobanks) or narrow bushland remnants surrounded by suburban development (the Ropes and South Creeks and Western Sydney Parklands biobanks). Fragmentation of native vegetation and associated fauna habitats in the locality of these offset sites has previously occurred through clearing for agriculture, residences and industry and construction of transmission lines, railways and roads. These land uses have created barriers to movement for many fauna species, particularly those that are limited by dispersal abilities and habitat preferences. The patches of Cumberland Plain Woodland that remain at the proposed offset sites have high edge to area ratios and are frequently dissected by tracks and fence lines. In this context, many of the species within Cumberland Plain Woodland at the proposed offset sites have limited opportunities for dispersal or recruitment and are subject to ongoing threats from human activities, grazing, exotic plants and pest fauna.

Based on the inputs described above, 'offset calculator – start area and quality – quality' (i.e. the current quality of the community in the proposed offset area) was scored as 5/10 overall. This is a slightly lower site quality score than the airport site, reflecting generally more severe weed infestation and generally smaller patches of vegetation, surrounded by more intensive development.

The EPBC Act Cumberland Plain Woodland in the proposed offset areas could be managed and improved to the same condition as the community at the airport site in the short to medium term, particularly through the intensive treatment of weed infestations. The 'time until ecological benefit' (i.e. the time period required to achieve the probable increase in site quality score and/or decline in site quality without management) was set as ten years. Ten years is the expected time it takes to establish a biobank, complete primary activities such as fencing and erosion control, complete the initial more, intensive weed control activities and achieve natural regeneration. The proposed management actions and the likely benefits to the community are described in greater detail in Section 4.5.2.

The 'offset calculator - future quality without offset' component for EPBC Act Cumberland Plain Woodland in the proposed offset areas (i.e. the likely decline in site condition if the site was not managed as a biodiversity offset) was scored as 4/10 reflecting a decline in the condition and possibly also extent of the community in the offset areas through an additional ten years of impacts arising from grazing, weed infestation, erosion, human activities and other threats.

The 'offset calculator - future quality with offset' component (i.e. the likely increase in site condition if the site is managed as a biodiversity offset) was scored as 8/10 reflecting a substantial improvement in the condition of the community through measures such as exclusion of grazing and unauthorised access, removal of rubbish, an ecological burn, treatment of erosion and especially treatment of weed infestations. After ten years the severe infestations of woody weeds through the mid storey in much of the proposed offset area would be substantially controlled and a natural vegetation structure would be restored. The management of additional poorer quality Cumberland Plain Woodland in offset areas (see Section 5.2.2) would improve the 'site context' component of the site quality score by increasing the extent of the community, removing threats associated with adjoining areas of exotic vegetation and connecting fragmented remnants.

The proposed offset area would be managed in perpetuity and additional gains in site quality would be achieved over the longer term through bush regeneration activities, continued development of species richness and vegetation structure, increased patch sizes, improved habitat connectivity and development of habitat resources such as woody debris and hollow-bearing trees.

These values have been entered in the offset assessment guide calculations that are presented in Section 5.4.

### **5.2.2 Poorer quality Cumberland Plain Woodland**

Poorer quality Cumberland Plain Woodland in the proposed offset areas comprises derived native scrub or grassland. These patches of the community do not meet the condition criteria for the EPBC Act listed form of the community because the native over storey cover is less than 10 per cent (see DEWHA 2010). When purposefully managed for conservation in a biobank site suitable recovery and management actions may improve these patches to the point that they can be regarded as part of the ecological community listed under the EPBC Act (TSSC 2008).

The quality of a community is scored out of ten for offset assessment guide calculations. As described above there are three site characteristics that may contribute to quality: 'site condition', 'site context' and 'species stocking rate' that must be weighted according to their relative importance to the offset calculations (DSEWPaC 2012b). The weighting of these three attributes for Cumberland Plain Woodland in the proposed offset areas was defined as site condition – 50 per cent, site context – 50 per cent and species stocking rate – 0 per cent, as for the airport site.

Each characteristic was scored based on the results of the BioBanking assessments for the various offset sites, weighted according to the size of the area at each site that would be included in the offset package.

Site condition was scored as 3/10 based on the BioBanking plot/transects and other field survey data collected within the vegetation zones that comprise Cumberland Plain Woodland in the proposed offset areas. This score is based on the following characteristics.

- Moderate/good - poor condition Grey Box - Forest Red Gum grassy woodland on hills (HN529) (around 53 hectares out of around 78 hectares of poorer quality Cumberland Plain Woodland in the proposed offset areas). This comprises immature regrowth or derived native grassland or scrub at the Williamswood, The Oaks, Bruelle, Menangle Road and Stage 1 and 2 Montpelier biobanks. The relevant vegetation zones at these biobanks have relatively similar characteristics comprising partially cleared grazing country on undulating shale hills. These vegetation zones feature minimal over storey cover, moderate scores for native species richness, moderate to high cover of native mid storey, shrubs and/or grasses, very occasional hollow-bearing trees present as isolated paddock trees and relatively little woody debris. Canopy species were observed regenerating in these areas around paddock trees and adjoining patches of better condition vegetation. There is frequently high exotic plant cover mainly consisting of woody weeds such as African Olive or Lantana (*Lantana camara*) in the mid storey or exotic perennial grasses such as African Love Grass (*Eragrostis curvula*).
- Moderate/good - poor condition Grey Box - Forest Red Gum grassy woodland on flats (HN528) (around 25 hectares out of around 78 hectares of poorer quality EPBC Act Cumberland Plain in the proposed offset areas). This comprises immature regrowth, immature planted vegetation or derived native grassland or scrub at the Ropes and South Creek and Western Sydney Parklands biobanks. Vegetation zones at these biobanks have relatively similar characteristics comprising partially cleared grazing country or open space on lower slopes and flats near to major drainage lines. These vegetation zones feature minimal over storey cover, moderate scores for native species richness, moderate to high cover of native mid storey, shrubs and/or grasses, very occasional hollow-bearing trees as isolated paddock trees and relatively little woody debris. Canopy species were observed regenerating in these areas, around paddock trees and adjoining patches of better condition vegetation. There is frequently high exotic plant cover mainly consisting of perennial grasses such as Kikuyu, African Love Grass and herbs in the under storey or woody weeds such as Privet and Lantana in the mid storey.

A more detailed description of site condition at each of the offset sites is provided in Appendix A.

Site context was scored as 3/10, reflecting the position of each of the local occurrences of the community in highly fragmented, rural landscapes or narrow bushland remnants surrounded by suburban development as described above for the EPBC Act Cumberland Plain Woodland at the same offset sites. The poorer quality patches of Cumberland Plain Woodland at the proposed offset sites actually comprise gaps in over storey vegetation and habitat in this context and make a minor contribution to the viability of the community.

Based on the inputs described above 'offset calculator – start area and quality – quality' (i.e. the current quality of the community in the proposed offset area) was scored as 3/10 overall.

The EPBC Act Cumberland Plain Woodland in the proposed offset areas could be managed and improved to the same condition as the community at the airport site in the medium to long term, through the intensive treatment of weed infestations and exclusion of grazing to permit regeneration of over storey vegetation. The 'time until ecological benefit' (i.e. the time period required to achieve the probable increase in site quality score and/or decline in site quality without management) was set as 20 years. Twenty years is the expected time it takes to establish a biobank, complete primary weed control and other management activities, achieve natural regeneration and for regenerating *Eucalyptus* to mature into over storey vegetation.



The proposed management actions and the likely benefits to the community are described in greater detail in Section 4.5.2. The aims of this management would be to achieve restoration of vegetation that comprises EPBC Act Cumberland Plain Woodland, specifically vegetation with >10 per cent canopy cover and >50 per cent native groundcover in accordance with the condition criteria specified in the conservation and listing advice for the community (TSSC 2008, DEWHA 2010).

The 'offset calculator - future quality with offset' component (i.e. the likely increase in site condition if the site is managed as a biodiversity offset) was scored as 6/10 reflecting a substantial improvement in the condition of the community through exclusion of grazing and unauthorised access, removal of rubbish, treatment of erosion, treatment of weed infestations and facilitated natural regeneration. After 20 years the severe infestations of woody weeds through the mid storey in much of the proposed offset area would be substantially controlled. Canopy species would have regenerated in areas of derived native grassland or scrub and a natural vegetation structure with >10 per cent canopy cover would be restored. Twenty years is likely to be sufficient to achieve natural regeneration over broad areas and for regenerating *Eucalyptus* to mature into over storey vegetation.

Monitoring of regeneration of poorer condition Cumberland Plain Woodland without a canopy at Mount Annan revealed:

- recovery of mid-storey plants (mainly Native Blackthorn) after 5-7 years in areas where they had been suppressed by grazing;
- significant declines in exotic groundcover after 15 years; and
- regeneration of canopy species and growth up to 8 metres after 17 years in areas of adequate water supply (Royal Botanic Gardens & Domain Trust undated). The Commonwealth listing advice notes that the canopy in regrowth stands of EPBC Act Cumberland Plain Woodland may be shorter than 10 metres tall (TSSC 2008).

The management of poorer quality Cumberland Plain Woodland in offset areas would also connect fragmented patches of vegetation and substantially improve the 'site context' component of the site quality score.

The 'offset calculator - future quality with offset' of 6/10 is the same site quality score as the airport site, as is required by the offset policy (DSEWPaC 2013). The proposed offset areas would not be of the same quality as the current condition of the airport site with regards to all condition attributes after 20 years. For instance, there would still be fewer hollow-bearing trees. However the offset areas would be in better condition with respect to some attributes such as native vegetation cover and especially the extent of weed infestation. For these reasons, an overall site quality of at least 6/10 could be achieved.

The 'offset calculator - future quality without offset' component for EPBC Act Cumberland Plain Woodland in the proposed offset areas (i.e. the likely decline in site condition if the site was not managed as a biodiversity offset) was scored as 2/10 reflecting a decline in the condition and possibly also extent of the community in the offset areas through an additional 20 years of impacts arising from grazing, weed infestation, erosion, human activities and other threats.

The proposed offset area would be managed in perpetuity and additional gains in site quality would be achieved over the longer term through bush regeneration activities, continued development of species richness and vegetation structure and development of habitat resources such as woody debris and hollow-bearing trees.

These values have been entered in the offset assessment guide calculations that are presented in Section 5.4.

### 5.2.3 Grey-headed Flying-fox

A Grey-headed Flying-fox roost camp has been recorded in the Ropes Creek riparian corridor less than 500 metres to the south of the Durham biobank (PB 2013). The species would be likely to occur at each of the proposed offset sites (noting that the ecological survey effort conducted at these sites to date has focussed on vegetation and habitat resources and has not included nocturnal fauna surveys).

The Department's instructions for the offset assessment guide state that the contribution of the three habitat attributes 'site condition', 'site context' and 'species stocking rate' to habitat quality must be weighted according to the ecology of the relevant species or community (DSEWPac 2012b). The weighting of these three attributes for the Grey-headed Flying-fox population at the proposed offset sites was scored the same as for the airport site: site condition – 40 per cent; site context – 40 per cent; species stocking rate – 20 per cent.

Each characteristic was then scored based on the results of the BioBanking assessments for each of the offset sites (see Appendix A).

Site condition was scored as 8/10 based on the characteristics outlined below.

- The health and condition of the vegetation zones that comprise Grey-headed Flying-fox habitat based on BioBanking plot/transects and other field survey data. The habitat in the proposed offset areas is Cumberland Plain Woodland and River Flat Eucalypt Forest which is in moderate condition comprising remnant or regrowth native vegetation with near-intact over storey. .
- The presence of Forest Red Gum and Grey Box as dominant canopy species within Cumberland Plain Woodland and River Flat Eucalypt Forest in the proposed offset areas. As described above, these two tree species are recognised as 'significant species' in the blossom diet of the Grey-headed Flying-fox, are productive during food bottlenecks (Eby and Law 2008) and qualify as habitat critical to the survival of the species, as defined in the draft recovery plan (DECCW 2009)(GHD 2015a).

Site context was scored as 7/10 based on the characteristics outlined below.

- There are no camps located at the proposed offset sites, although there are multiple roost camps within 20 kilometres of each site and so they are appropriately located to provide foraging resources for individuals from those camps. A Grey-headed Flying-fox roost camp has been recorded in the Ropes Creek riparian corridor less than 500 metres to the south of the Durham biobank (PB 2013). Mother flying-foxes were recorded suckling young at this roost camp (PB 2013).
- Habitat at many of the proposed offset sites is in highly fragmented, rural landscapes or narrow bushland remnants surrounded by suburban development, as described above for the Cumberland Plain Woodland at the same offset sites.

Species stocking rate was scored as 7/10 comprising an area of productive foraging habitat within the broad range of this highly mobile species but which includes foraging and shelter habitat in the immediate vicinity of a roost camp at the Durham biobank.

Based on the inputs described above, the 'offset calculator – start area and quality – quality' (i.e. the current quality of the habitat in the proposed offset area) component was scored as 7/10 overall. This is a higher site quality score than the airport site, reflecting the fact that the majority of the habitat in the proposed offset area is of a similar quality to the airport site but that it also includes habitat in the immediate vicinity of a roost camp.

The Grey-headed Flying-fox habitat in the proposed offset areas would be managed to improve the health and productivity of food tree species and to reduce threats. The 'time until ecological benefit'

(i.e. the time period required to achieve the probable increase in site quality score and/or decline in site quality without management) was set as ten years. Ten years is the expected time it takes to establish a biobank, complete primary activities such as fencing and erosion control, complete the initial more intensive weed control activities and achieve natural regeneration. The proposed management actions and the likely benefits to Grey-headed Flying-fox habitat are described in greater detail in Section 4.5.2.

The 'offset calculator - future quality without offset' component for Grey-headed Flying-fox habitat in the proposed offset areas (i.e. the likely decline in site condition if the sites were not managed as biodiversity offsets) was scored as 6/10 reflecting a decline in the condition and possibly also extent of habitat in the offset areas through an additional ten years of impacts arising from grazing, weed infestation, human activities and other threats.

The 'offset calculator - future quality with offset' component (i.e. the likely increase in site condition if the site is managed as a biodiversity offset) was scored as 8/10 reflecting an improvement in the quality of habitat through exclusion of grazing and unauthorised access, treatment of weed infestations, regeneration and maturation of food tree species and development of habitat resources. After ten years the severe infestations of woody weeds through the mid storey in much of the proposed offset area would be substantially controlled and a natural vegetation structure and composition would be restored. This is likely to increase the health and productivity of food tree species. The management of additional poorer quality Cumberland Plain Woodland in offset areas (see Section 5.2.2) would improve the 'site context' component of the site quality score by increasing the extent of potential habitat, removing threats associated with adjoining areas of exotic vegetation and connecting fragmented remnants.

The proposed offset area would be managed in perpetuity and additional gains in site quality would be achieved over the longer term through continued development of vegetation structure and habitat resources and maturation of poorer quality Cumberland Plain Woodland to the extent that it would also comprise Grey-headed Flying-fox habitat.

These values have been entered in the offset assessment guide calculations that are presented in Section 5.4.

### **5.3 Alternative environmental contributions**

There is a variety of alternative conservation mechanisms to BioBanking, including Voluntary Conservation Agreements or dedication of land to the National Parks estate. These alternative options may be more practical under certain circumstances such as if the Commonwealth, or another body has a specific parcel of land available for this purpose. Consultation with these agencies and bodies such as the Western Sydney Parklands Trust would be completed throughout the environmental assessment of the proposed airport and may identify more suitable options.

As described above the offset policy requires that a minimum of 90 per cent of the proposed airport's impacts must be directly offset and the remainder may be met by alternative contributions such as a financial contribution to research or conservation. The intent of the offset package is to secure 100 per cent of the offset requirement as direct offsets. Alternative contributions would be explored if there is a shortfall or if an appropriate contribution is identified by the Department or otherwise revealed by the environmental assessment and approvals process.



## 5.4 Preliminary offset assessment guide calculations

It is intended that the offset package would include the conservation and management of the proposed offset areas listed in Table 10 and based on the extent and quality of habitat for the affected MNES described in Section 5.2.

Preliminary offset assessment guide calculations were performed for the affected threatened biota based on the following:

- removal of approximately 88.9 hectares of EPBC Act Cumberland Plain Woodland with a site quality score of 6/10 (as described in Section 2.2.1);
- removal of approximately 120.4 hectares of habitat for the Grey-headed Flying-fox with a site quality score of 7/10 (as described in Section 2.2.2); and
- the conservation and management of offset sites to achieve increased site quality, containing:
  - EPBC Act Cumberland Plain Woodland (as described in Section 5.2.1);
  - poorer quality Cumberland Plain Woodland (as described in Section 5.2.2); and
  - Grey-headed Flying-fox habitat (as described in Section 5.2.3).

The outcome of these preliminary offset assessment guide calculations is that:

- the proposed offset areas containing around 180 hectares of EPBC Act Cumberland Plain Woodland would offset 59 per cent of the proposed airport's impacts on the ecological community;
- the proposed offset areas containing around 79 hectares of poorer condition Cumberland Plain Woodland would offset around 15 per cent of the proposed airport's impacts on the ecological community, resulting in a total offset contribution of 74 per cent of the proposed airport's impacts.
- The proposed offset areas containing up to 401 hectares of habitat for the Grey-headed Flying-fox would offset around 136 per cent of the proposed airport's impacts on this vulnerable species.

Based on these preliminary calculations, the proposed offset sites could not meet all of the proposed airport's EPBC Act offsetting requirements as direct offsets. Additional offset sites containing Cumberland Plain Woodland will be identified throughout the environmental assessment and approval process for the proposed airport and will be included in the final offset package.

The data that were entered in the preliminary offset assessment guide calculations are summarised in Table 12, Table 13 and Table 14 along with the justification for the attribute values that were entered and the estimated percentage of the direct offset requirement for each MNES that would be met by this Preliminary EPBC Act biodiversity offset proposal.

**Table 12 Attribute values entered in the preliminary offset assessment guide calculations for EPBC Act Cumberland Plain Woodland**

Offset assessment guide attribute	Value	Justification
Impact Calculator - Quantum of impact - Area	88.9 hectares	A direct reduction in extent of an occurrence of EPBC Act Cumberland Plain Woodland as documented in the Biodiversity Assessment (GHD 2015a) and Section 2.2.1 above.
Impact Calculator - Quantum of impact – Quality	6/10	Removal of moderate quality patches of the community as documented in the Biodiversity Assessment (GHD 2015a) and Section 2.2.1 above.
Offset calculator – Time horizon – Risk related time horizon	20 years	The offset sites would be protected and managed in perpetuity under a BioBanking agreement. Twenty years is the maximum timeframe for averting loss in the guide.
Offset calculator – Time horizon – Time until ecological benefit	10 years	The offset sites contain EPBC Act Cumberland Plain Woodland that would be managed through measures such as exclusion of stock, weed control and treatment of pest fauna. Ecological benefits in moderate condition vegetation can be achieved in the short to medium term. A tangible increase in site quality score with management or decrease because of ongoing threats would be expected after 10 years.
Offset calculator - Future area and quality without offset – Risk of loss without offset	15 per cent	<p>The offset sites are located in partially cleared and developed parcels of land in western Sydney. The majority of the offset area is agricultural land that is zoned RU2 Rural Landscape. This zoning enables a range of industries and developments to occur while preserving the rural nature of a landscape. Should the site not be secured under a BioBanking agreement the impacts of existing agricultural use would continue and/or the land would be used for another purpose or development as long as it can be shown the rural nature of the site can be maintained.</p> <p>The locality surrounding the offset sites is moderately populated and is subject to potential impacts from housing development, agriculture and infrastructure construction. Western Sydney is, in general, experiencing some of the greatest development pressure and especially demand for housing, of any region in Australia.</p> <p>Under this scenario a risk of loss without offset of 15 per cent was considered appropriate.</p>
Offset calculator - Future area and quality with offset – Risk of loss with offset	1 per cent	The offset sites would be protected and managed in perpetuity under a BioBanking agreement. This is the strongest conservation mechanism available on privately owned land in NSW. DSEWPac (2013) guidance and recent determinations by the Department suggest that one per cent is a reasonable residual risk of loss for land protected under a BioBanking agreement.

Offset assessment guide attribute	Value	Justification
Confidence in result – averted loss of offset	95 per cent	DSEWPaC (2013) guidance and recent determinations by the Department suggest that 95% is a reasonable estimate of the confidence in the strength and effectiveness of a BioBanking agreement.
Offset calculator – Start area and quality – Area	180.3 hectares	There are 180.3 hectares of EPBC Act Cumberland Plain Woodland in the proposed offset areas (see Table 10).
Offset calculator – Start area and quality – Start quality	5/10	The proposed offset areas contain EPBC Act Cumberland Plain Woodland in moderate condition as described in Section 5.2.1.
Offset calculator - Future area and quality without offset – Future quality without offset (1-10)	4/10	EPBC Act Cumberland Plain Woodland would continue to deteriorate through impacts from grazing, weed infestation etc. in the proposed offset areas if they were not set aside for conservation as described in Section 5.2.1.
Offset calculator - Future area and quality with offset – Future quality with offset (1-10)	8/10	EPBC Act Cumberland Plain Woodland at the offset sites would be managed as described in Section 5.2.1 and would improve in quality and would exceed the condition of habitat at the airport site. The improvement in site quality of poorer condition Cumberland Plain Woodland would contribute to this increase in site quality by connecting remnant patches of EPBC Act Cumberland Plain Woodland. The DSEWPaC (2012a) offset policy requires that an offset site must reach the quality of vegetation in the impact footprint as a minimum.
Confidence in result – change in quality	85 per cent	DSEWPaC (2013) guidance and recent determinations by the Department suggest that 85% is a reasonable estimate of the effectiveness of standard environmental management and bush regeneration techniques.
<b>Percentage of impact offset</b>	<b>59.14 per cent</b>	

**Table 13 Attribute values entered in the preliminary Offset assessment guide calculations for poorer quality Cumberland Plain Woodland**

Offset assessment guide attribute	Value	Justification
Impact Calculator - Quantum of impact - Area	88.9 hectares	A direct reduction in extent of an occurrence of EPBC Act Cumberland Plain Woodland as documented in the Biodiversity Assessment (GHD 2015a) and Section 2.2.1 above.
Impact Calculator - Quantum of impact – Quality	6/10	Removal of moderate quality patches of the community as documented in the Biodiversity Assessment (GHD 2015a) and Section 2.2.1 above.
Offset calculator – Time horizon – Risk related time horizon	20 years	The offset sites would be protected and managed in perpetuity under a BioBanking agreement. Twenty years is the maximum timeframe for averting loss in the guide.



Offset assessment guide attribute	Value	Justification
Offset calculator – Time horizon – Time until ecological benefit	20 years	The offset sites contain poorer quality Cumberland Plain Woodland comprising derived native grassland and scrub. This vegetation would be managed through measures such as exclusion of stock, weed control and facilitated natural regeneration. Ecological benefits in poorer condition vegetation without a canopy can be achieved in the medium term. An increase in site quality score with management that is sufficient to achieve the restoration of the EPBC Act listed community would be expected after 20 years. Further justification for this time period is provided in 5.2.2.
Offset calculator - Future area and quality without offset – Risk of loss without offset	15 per cent	<p>The offset sites are located in partially cleared and developed parcels of land in western Sydney. The majority of the offset area is agricultural land that is zoned RU2 Rural Landscape. This zoning enables a range of industries and developments to occur while preserving the rural nature of a landscape. Should the site not be secured under a BioBanking agreement the impacts of existing agricultural use would continue and/or the land would be used for another purpose or development as long as it can be shown the rural nature of the site can be maintained.</p> <p>The locality surrounding the offset sites is moderately populated and is subject to potential impacts from housing development, agriculture and infrastructure construction. Western Sydney is, in general, experiencing some of the greatest development pressure and especially demand for housing, of any region in Australia.</p> <p>Under this scenario a risk of loss without offset of 15% was considered appropriate.</p>
Offset calculator - Future area and quality with offset – Risk of loss with offset	1 per cent	The offset sites would be protected and managed in perpetuity under a BioBanking agreement. This is the strongest conservation mechanism available on privately owned land in NSW. DSEWPac (2013) guidance and recent determinations by the Department suggest that one per cent is a reasonable residual risk of loss for land protected under a BioBanking agreement.
Confidence in result – averted loss of offset	95 per cent	DSEWPac (2013) guidance and recent determinations by the Department suggest that 95% is a reasonable estimate of the confidence in the strength and effectiveness of a BioBanking agreement.
Offset calculator – Start area and quality – Area	88 hectares	There are 88 hectares of poorer quality Cumberland Plain Woodland in the proposed offset areas (see Table 10).
Offset calculator – Start area and quality – Start quality	3/10	The proposed offset areas contain poorer quality Act Cumberland Plain Woodland that comprises derived native grassland or scrub as described in Section 5.2.2.

Offset assessment guide attribute	Value	Justification
Offset calculator - Future area and quality without offset – Future quality without offset (1-10)	2/10	Poorer quality Cumberland Plain Woodland would continue to deteriorate through impacts from grazing, weed infestation etc. in the proposed offset areas if they were not set aside for conservation as described in Section 5.2.2.
Offset calculator - Future area and quality with offset – Future quality with offset (1-10)	6/10	EPBC Act Cumberland Plain Woodland the offset sites would be managed as described in Section 5.2.2 and would improve in quality and would achieve the quality of habitat at the airport site and the restoration of vegetation that comprises EPBC Act Cumberland Plain Woodland. Further justification for increase in site quality score after 20 years is provided in 5.2.2. The improvement in site quality of EPBC Act Cumberland Plain Woodland at the offset sites would contribute to the site context component of this increase in site quality by improving the condition of connected vegetation. The DSEWPac (2012a) offset policy requires that an offset site must reach the quality of vegetation in the impact footprint as a minimum.
Confidence in result – change in quality	85 per cent	DSEWPac (2013) guidance and recent determinations by the Department suggest that 85 per cent is a reasonable estimate of the effectiveness of standard environmental management and bush regeneration techniques.
Percentage of impact offset	16.32 per cent	

**Table 14 Attribute values entered in the preliminary Offset assessment guide calculations for the Grey-headed Flying-fox**

Offset assessment guide attribute	Value	Justification
Impact Calculator - Quantum of impact - Area	120 hectares	Direct removal of 120.4 hectares of Grey-headed Flying-fox habitat as documented in the Biodiversity Assessment (GHD 2015a) and Section 2.2.2 above.
Impact Calculator - Quantum of impact – Quality	6/10	Removal of moderate quality Grey-headed Flying-fox habitat as documented in the Biodiversity Assessment (GHD 2015a) and Section 2.2.2 above.
Offset calculator – Time horizon – Risk related time horizon	20 years	The offset sites would be protected and managed in perpetuity under a BioBanking agreement. Twenty years is the maximum timeframe for averting loss in the guide.
Offset calculator – Time horizon – Time until ecological benefit	10 years	The offset sites contain occupied Grey-headed Flying-fox habitat that would be managed through measures such as exclusion of stock, weed control and treatment of pest fauna. Ecological benefits in moderate condition habitat can be achieved in the short to medium term. A tangible increase in site quality score with management or decrease because of ongoing threats would be expected after 10 years.

Offset assessment guide attribute	Value	Justification
Offset calculator - Future area and quality without offset – Risk of loss without offset	15 per cent	<p>The offset sites are located in partially cleared and developed parcels of land in western Sydney. The majority of the offset area is agricultural land that is zoned RU2 Rural Landscape. This zoning enables a range of industries and developments to occur while preserving the rural nature of a landscape. Should the site not be secured under a BioBanking agreement the impacts of existing agricultural use would continue and/or the land would be used for another purpose or development as long as it can be shown the rural nature of the site can be maintained.</p> <p>The locality surrounding the offset sites is moderately populated and is subject to potential impacts from housing development, agriculture and infrastructure construction. Western Sydney is, in general, experiencing some of the greatest development pressure and especially demand for housing, of any region in Australia.</p> <p>Under this scenario a risk of loss without offset of 15% was considered appropriate.</p>
Offset calculator - Future area and quality with offset – Risk of loss with offset	1 per cent	<p>The offset sites would be protected and managed in perpetuity under a BioBanking agreement. This is the strongest conservation mechanism available on privately owned land in NSW. DSEWPac (2013) guidance and recent determinations by the Department suggest that one per cent is a reasonable residual risk of loss for land protected under a BioBanking agreement.</p>
Confidence in result – averted loss of offset	95 per cent	<p>DSEWPac (2013) guidance and recent determinations by the Department suggest that 95% is a reasonable estimate of the confidence in the strength and effectiveness of a BioBanking agreement.</p>
Offset calculator – Start area and quality – Area	401 hectares	<p>There are up to 401 hectares of Grey-headed Flying-fox habitat in the proposed offset areas (see Table 10).</p>
Offset calculator – Start area and quality – Start quality	7/10	<p>The proposed offset areas contain Grey-headed Flying-fox habitat in good condition as described in Section 5.2.3.</p>
Offset calculator - Future area and quality without offset – Future quality without offset (1-10)	6/10	<p>Grey-headed Flying-fox habitat would deteriorate through impacts from grazing, weed infestation etc. in the proposed offset areas if they were not set aside for conservation as described in Section 5.2.3.</p>
Offset calculator - Future area and quality with offset – Future quality with offset (1-10)	8/10	<p>Grey-headed Flying-fox habitat at the offset sites would be managed as described in Section 5.2.3 and would improve in quality and exceed the condition of habitat at the airport site. The improvement in site quality of poorer condition Cumberland Plain Woodland would contribute to this increase in site quality by connecting remnant patches and eventually also providing foraging resources. The DSEWPac (2012a) offset policy requires that an offset site must reach the quality of vegetation in the impact footprint as a minimum.</p>



Offset assessment guide attribute	Value	Justification
Confidence in result – change in quality	85 per cent	DSEWPaC (2013) guidance and recent determinations by the Department suggest that 85 per cent is a reasonable estimate of the effectiveness of standard environmental management and bush regeneration techniques.
<b>Percentage of impact offset</b>	<b>135.82 per cent</b>	

## 6. Delivery of Offsets

### 6.1 Purchase and retirement of biodiversity credits

Biodiversity credits would be purchased to secure the proposed offset areas for EPBC Act-listed biota. Subject to confirmation of the overall offset requirement for the proposed airport, additional biodiversity credits would be purchased to offset the proposal's impacts on the environment.

The EPBC Act offset policy and the BioBanking assessment methodology include different rules that govern the biodiversity offsets that can be delivered for a development's impacts. The EPBC Act offset policy requires 'like for like' biodiversity offsets and the offset site must be able to reach the same site quality score as the development site. Therefore only EPBC Act Cumberland Plain Woodland, poorer quality Cumberland Plain Woodland that could reach this standard and Grey-headed Flying Fox habitat have been included in the proposed offset areas (see Section 5.2). The suite of biodiversity credits that are associated with the proposed offset areas would be purchased and retired in order to secure the offsets for EPBC Act-listed biota.

The BioBanking assessment methodology includes greater flexibility with respect to some criteria. This flexibility allows trading of ecosystem credits for closely related vegetation types if they are in the same vegetation class and are at least as extensively cleared (i.e. have the same or greater conservation significance). BioBanking also allows trading of ecosystem credits associated with low condition vegetation at a biobank site, including vegetation that could not meet the standard of EPBC Act Cumberland Plain Woodland. This flexibility should be considered along with the fact that BioBanking requires the calculation of biodiversity offsets for poorer condition vegetation. A substantial area of poor condition vegetation at the airport site has contributed to the amount of offset required for residual significant impacts on the environment. Species credits should be traded on a like for like basis.

The number and type of biodiversity credits that would be required to offset the proposed airport's impacts on the environment are specified in the BioBanking credit report (see Appendix B). The suite of matching biodiversity credits that are available at the proposed offset sites to offset impacts on the environment are summarised in Table 15. Many of the offset sites included in Table 15 are proposed biobanks that have not yet been subject to detailed BioBanking credit calculations and so a rate of seven credits per hectare has been used to estimate the number of biodiversity credits available.

Table 15 includes a comparison of the credits available at the proposed offset sites and the ecosystem credit requirement to offset the proposed airport's impacts on the natural environment as estimated in Section 3. There would be sufficient ecosystem credits available to offset impacts on Grey Box - Forest Red Gum grassy woodland on shale (HN529) and Forest Red Gum - Rough-barked Apple grassy woodland (HN526). The 'Credit balance' in Table 15 shows that additional ecosystem credits would be required to offset impacts on other vegetation types and associated predicted threatened species. The credit shortfall for Grey Box - Forest Red Gum grassy woodland on flats (HN528) can be partially met by trading surplus HN526 credits, which is permitted by the BioBanking credit trading rules.

The credit shortfall for HN528 could also be partially met by up to 1365 ecosystem credits associated with HN529 and Grey Box - Forest Red Gum shrubby woodland (HN524). These are not matching credits according to the BioBanking credit trading rules but are associated with very closely related ecological communities with similarly high conservation significance. Both vegetation types are associated with EPBC Act-listed critically endangered ecological communities and HN528 and HN529 are both consistent with Cumberland Plain Woodland.

**Table 15 Ecosystem credits for impacts on the natural environment**

Potential Offset Site	Total area (hectares)	Available HN528 credits	Available HN529 credits	Available HN526 credits	Available HN512 credits	Available HN630 credits	Available HN524 credits
Williamswood biobank	104.5	0	694	280	0	0	38
Durham biobank	42.7	31	0	246	0	0	0
Mamre biobank	98.1	0	0	680	0	7	0
Luddenham biobank	40.0	34	0	246	0	0	0
Roper biobank	13.3	48	0	20	25	0	0
Caddens biobank	33.3	47	0	181	0	5	0
Dunheved biobank	65.0	93	0	362	0	0	0
Forrester biobank	9.2	0	0	56	0	0	0
Stage 1 Montpelier biobank	76.2	119	442	0	0	0	153
Stage 2 Montpelier biobank	79.5	0	363	0	0	0	118
Menangle Road biobank	57.1	0	454	36	0	0	29
Bruelle biobank	26.8	0	141	0	0	0	0
The Oaks	40.0	0	261	11	0	0	69
Western Sydney Parklands ID 120	19.4	120	0	61	0	0	0
Western Sydney Parklands ID 70	40.5	49	0	10	0	0	0
<b>Total</b>	<b>892.8</b>	<b>542</b>	<b>2355</b>	<b>2188</b>	<b>25</b>	<b>12</b>	<b>407</b>
<b>Ecosystem credit requirement</b>		<b>6763</b>	<b>1398</b>	<b>1657</b>	<b>181</b>	<b>700</b>	<b>0</b>
<b>Credit balance</b>		<b>-6221</b>	<b>957</b>	<b>531</b>	<b>-156</b>	<b>-688</b>	<b>407</b>
<b>Total including trading of matching credits</b>		<b>1074<sup>1</sup></b>		<b>1657</b>			
<b>Credit balance including trading of matching credits</b>		<b>-5689</b>	<b>957</b>	<b>0</b>	<b>-156</b>	<b>-688</b>	<b>407</b>

Notes: 1) includes 531 HN526 credits which may be traded with HN528.



No species credits have been calculated at any of the existing or proposed biobank sites included in this offset package. Species credits may be generated once targeted surveys have been undertaken to confirm the presence of threatened species and the numbers of individuals of plants and area of habitat for fauna. Based on the assessments undertaken to date, the proposed offset sites contain known or potential habitat for each of the species credit-type threatened species affected by the proposed airport. Table 16 summarises the species credits required to offset the impacts of the proposed airport as calculated in Section 3.3.2, the equivalent area of fauna habitat or number of plants required to generate these credits at an offset site and a summary of the potential habitat available at offset sites.

Sufficient *Pultenaea parviflora* has already been recorded at the Dunheved biobank site to generate the required number of species credits (GHD 2014a). Based on the site surveys and habitat assessments undertaken it is likely that supplementary surveys would confirm the presence of the fauna species at these offset sites and allow the calculation of species credits. *Marsdenia viridiflora* subsp. *viridiflora* is very sparsely and sporadically distributed within its range and so it is likely to be difficult to locate a population of the required size at offset sites. The proposed translocation program will be important in avoiding or minimising impacts on this endangered population (GHD 2015a) and should be coordinated with the offset package.

**Table 16 Species credits potentially available at offset sites**

Common name	Scientific name	Species credits required	Individuals / area required in offset site	Individuals / area available in offset site(s)
Black Bittern	<i>Ixobrychus flavicollis</i>	719	101	Up to around 314 hectares of potential habitat in Forest Red Gum - Rough-barked Apple grassy woodland (HN526) and Coastal freshwater wetland (HN630) at proposed off set sites.
Cumberland Plain Land Snail	<i>Meridolum corneovirens</i>	1568	221	Up to around 414 hectares of potential habitat in Grey Box - Forest Red Gum grassy woodland on shale (HN529) and Grey Box - Forest Red Gum grassy woodland on plains (HN528). The species has been recorded at the Forrester and Caddens biobank sites.
<i>Marsdenia viridiflora</i> subsp. <i>viridiflora</i> in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas	<i>Marsdenia viridiflora</i> subsp. <i>viridiflora</i> - endangered population	3720	524	Up to around 476 hectares of potential habitat in Grey Box - Forest Red Gum grassy woodland on shale (HN529), Grey Box - Forest Red Gum grassy woodland on plains (HN528) and Grey Box - Forest Red Gum shrubby woodland (HN524).
<i>Pultenaea parviflora</i>	<i>Pultenaea parviflora</i>	60	8	100 individuals recorded at the Dunheved biobank site.
Southern Myotis	<i>Myotis macropus</i>	656	92	Up to around 313 hectares of potential habitat in Forest Red Gum - Rough-barked Apple grassy woodland (HN526) at proposed off set sites. The species has been recorded at the Mamre biobank site.

## 6.2 Identification of additional offsets

Based on the preliminary offset assessment guide calculations and BioBanking calculations, the proposed offset sites could not meet all of the proposed airport's EPBC Act offsetting requirements as direct offsets. Additional offset sites containing Cumberland Plain Woodland and other additional offset contributions will be identified throughout the environmental assessment process for the proposed airport and will be included in the final offset package. Any additional offset sites would be identified according to the approach specified in Section 4.2 and the following specific criteria:

- areas that are linked to biodiversity credits that are available for sale at established biobanks, that would be available for sale at proposed biobanks or are in parcels of land that area available for sale and suitable for BioBanking;
- presence of EPBC Act Cumberland Plain Woodland;
- presence of habitat for the Grey-headed Flying-fox; and
- proximity to the airport site, in order to more directly benefit the populations and communities affected by the proposed airport.

These criteria will ensure that offset sites are an appropriate 'like for like' match for the proposed airport's impacts and meet the other requirements of the EPBC Act offset policy.

A similar approach would be taken in the event that any credits which have been identified for purchase from biobank sites identified in this EIS are sold to third parties before they can be secured as offsets for the proposed airport.

A number of potential offset sites have already been considered in the preparation of this offset package but could not be formally included at this stage because insufficient information was available about their biodiversity values and/or future ownership and management. These sites include:

- additional land in the Western Sydney Parklands that has not yet been set aside as a biobank; and
- the "Hardwicke" property, which is a 200 hectare site located in the Wollondilly LGA. There would be four separate biobank agreements across the site, each of which may contribute offsets for the proposal as follows:
  - Biobank 1 (56 hectares), issue of the BioBanking agreement is imminent and up to 87 HN529 ecosystem credits would be available to offset impacts on Cumberland Plain Woodland.
  - Biobank 2 (57 hectares), BioBanking assessment has been completed, OEH are undertaking a site audit in late 2015 and up to 550 HN529 ecosystem credits would potentially be available to offset impacts on Cumberland Plain Woodland.
  - Biobanks 3 and 4 (87 hectares), BioBanking assessment has not yet commenced but around 1000-1300 HN529 and HN528 ecosystem credits would potentially be available to offset impacts on Cumberland Plain Woodland.

Additional survey and assessment would be required to confirm that these potential offset sites would be suitable for inclusion in the offset package for the proposed airport. A particular focus would be to determine if they contain EPBC Act-listed Cumberland Plain Woodland, poorer quality Cumberland Plain Woodland and/or habitat suitable for offsetting impacts on other features of the natural environment.

### 6.3 Cost of delivery of offsets

Attachment 4 to the EIS guidelines for the proposed airport specifies that the offset package must include an assessment of the overall cost of the proposed offsets package; including costs associated with acquisition and transfer of land, implementation of all related management actions and monitoring, reporting and auditing of offset performance. The offset package is expected to be delivered using BioBanking and so each of these costs are included in the price of the biodiversity credits that would be purchased and retired to offset the impacts of the proposed airport.

BioBanking includes rules for determining the price of biodiversity credits. Notably these rules specify that the biodiversity credit sale price must be at least equal to the 'Total Fund Deposit' as calculated with the Biodiversity Credits Pricing Spreadsheet (also known as the 'Part A costs'). The Total Fund Deposit proportion of the total credit sale price is held in the BioBanking Trust Fund administered by the NSW Government to cover the costs of managing the biobank site in perpetuity. Payments are made from the Trust Fund to the biobank site owner annually to cover the cost of management actions. The BioBanking rules ensure that the cost of delivering the offset package will include appropriate funds to cover the implementation of all related management actions and monitoring, reporting and auditing of offset performance in perpetuity in accordance with the EIS guidelines. The remainder of the biodiversity credit price is set in negotiation between the landowner and the credit purchaser and reflects the original cost of the land, opportunity costs and a profit margin for the landowner.

As stated in Section 6.1 above, the precise number and type of biodiversity credits that would be purchased and retired to offset the impacts of the proposed airport would not be confirmed until detailed BioBanking assessments have been conducted at each of the offset sites that will be included in the final offset package. The same assessment would also need to be applied for additional offset sites identified in accordance with Section 6.2. The quantum of offsets required in the offset package may change based on the final offset assessment guide calculations. Further, the total biodiversity credit sale price would only be confirmed once sale terms have been finalised with individual offset site owners. Therefore it is not possible to accurately calculate the cost of delivery of biodiversity offsets at this stage of the assessment and approval process for the airport.

It is possible to broadly estimate the cost of delivering the offset package based on the BioBanking credit calculations included in Section 6.1 and recent biodiversity credit sales for equivalent vegetation types and species in the Western Sydney region. Based on these estimates it would cost between \$100,000,000 and \$140,000,000 to deliver the biodiversity offset package for the Stage 1 development. As stated above, the cost would vary depending on the outcome of supplementary BioBanking assessments at offset sites and negotiations with landowners. The total cost of delivering direct offsets would be confirmed once the biodiversity offset package is finalised after approval of the proposed airport.

The total cost of delivering direct offsets would be used by DotE to calculate the cost of delivering up to 10% indirect offsets for the proposed airport (if required). The aim of the offset package is to meet 100% of the proposed airport's offset requirements as direct offsets, subject to the identification and assessment of suitable offset sites within the timeframe for delivery of offsets that would be nominated in the conditions of approval.



## 6.4 Finalisation of the offset package

The Minister for the Environment would advise the final quantum of biodiversity offsets required for the proposed airport based on the information presented in this offset package, technical review by DotE and consultation with DIRD. The requirement for biodiversity offsets would be provided as part of the process of obtaining the Minister's advice that the airport plan may be determined.

Additional information required to support EPBC Act offset calculations may include the requirement for additional site specific information such as proposed management, current risk of development and the security of title proposed for individual offset sites. These additional data would be entered in the offset assessment guide and the final calculations and details regarding data and assumptions underlying the results would be compiled and collectively comprise the EPBC Act offset package for the airport.

Additional information required to finalise offset calculations for impacts on the environment would include an approved BioBanking assessment and final credit calculations for each proposed biobank site. Unless alternative matching biodiversity credits become available on the open market this would include plot/transect surveys to accurately calculate ecosystem credits and targeted surveys to calculate species credits.

Based on the approach outlined in this offset package, the next steps involved in finalising the delivery of offsets for the proposed airport would be to:

- identify additional offset areas to address the shortfall in the offset areas for EPBC Act Cumberland Plain Woodland, biodiversity credits for impacts on the environment and/or any additional offset requirements required by the Minister for the Environment;
- compile any additional information required to finalise offset assessment guide and/or BioBanking credit calculations;
- agree on the number and type of biodiversity credits to be purchased to finalise the offset package;
- purchase the number and type of biodiversity credits required to finalise the offset package from the biobank site owners; and
- retire to the NSW OEH the biodiversity credits that are included in the offset package.

There are a variety of alternative conservation mechanisms to BioBanking, including Voluntary Conservation Agreements or dedication of land to the National Parks estate. These alternative options may be appropriate under certain circumstances such as if DotE, NSW OEH or other body has a specific parcel of land available for this purpose. Consultation with these agencies and bodies such as the Western Sydney Parklands Trust would continue and may identify more effective options.

Any alternative options would be presented in accordance with the EPBC Act offset policy and would be supported by offset assessment guide calculations. Alternative options would need to meet the criteria specified in Section 4.2 to ensure that they are an appropriate 'like for like' match for the proposed airport's impacts. As described above, in reviewing the EIS the Minister for the Environment is expected to specify the quantum of offsets required and the steps involved in their delivery.

## 6.5 Consistency with EPBC Act offset policy

The EIS guidelines for the proposed airport require an analysis of how the offset package meets the requirements of the EPBC Act Offsets Policy. Table 17 provides a summary of how this offset package meets each of the overarching principles included in the EPBC Act Offsets Policy that are applied in determining the suitability of offsets.

**Table 17 Consistency with the EPBC Act offset principals**

Offset principals (DSEWPac 2012, box 1)	Western Sydney Airport offset package
Suitable offsets must:	
1. deliver an overall conservation outcome that improves or maintains the viability of the aspect of the environment that is protected by national environment law and affected by the proposed action	<p>This offset package has been developed in accordance with biodiversity offset assessment methodologies that have been developed by Government Agencies in order to ensure that appropriate biodiversity offsets would improve or maintain the viability of the affected protected matters. The conservation outcomes that would be delivered by this offset package are based on:</p> <ul style="list-style-type: none"> <li>an estimate of the quantum of biodiversity offsets required for affected threatened biota listed under the EPBC Act as calculated with the offset assessment guide; and</li> <li>an estimate of the quantum of biodiversity offsets required for residual impacts on the environment as calculated using the BioBanking assessment methodology (BBAM) for a major project.</li> </ul>
2. be built around direct offsets but may include other compensatory measures	<p>The offset package is based on direct offsets for each of the protected matters affected by the proposal. Direct biodiversity offsets would be delivered through conservation of suitable offset sites. The offset sites will be secured by registration of a BioBanking agreement on title to the sites. This approach would require the purchase of the number and type of biodiversity credits that match:</p> <ul style="list-style-type: none"> <li>the offset area which is required to offset the proposal's impacts on specific EPBC Act-listed biota and deliver appropriate direct offsets as calculated in accordance with the EPBC Act offsets policy.</li> <li>the ecosystem and species credits which are required to offset the proposal's impacts on the environment (including NSW-listed biota) and deliver appropriate direct offsets as calculated using the BioBanking assessment methodology for a major project.</li> </ul>
3. be in proportion to the level of statutory protection that applies to the protected matter	<p>Offsets for impacts on EPBC Act-listed biota have been calculated using the offset assessment guide which includes International Union for Conservation of Nature data on the probability of annual extinction for different categories of threatened species as a multiplier in the offset calculations (DSEWPac 2012). The higher the level of statutory protection and associated probability of annual extinction the greater the quantum of biodiversity offset required.</p> <p>Offsets for impacts on the environment have been calculated using the BBAM which includes a 'threatened species offset multiplier' that feeds into the biodiversity credit calculations. The level of statutory protection of threatened biota as well as the expected response of threatened biota to management actions at a biobank site determine the multiplier that applies to credit calculations.</p>
4. be of a size and scale proportionate to the residual impacts on the protected matter	<p>This offset package has been developed in accordance with biodiversity offset assessment methodologies that have been developed by Government Agencies in order to ensure that biodiversity offsets are of a size and scale proportionate to the residual impacts on the protected matter.</p> <p>The quantum of biodiversity offsets required for affected threatened biota listed under the EPBC Act has been calculated with the offset assessment guide, which includes factors for the: area and quality of the impact area; area and improvement in quality of the offset site; averted risk of loss of the offset site; the time it will take for conservation gains to be achieved; and risk of the offset not succeeding (DSEWPac 2012).</p> <p>The quantum of biodiversity offsets required for residual impacts on the environment has been calculated using the BBAM, which includes factors for for the extent and condition of the impact area; landscape-scale impacts on habitat connectivity; extent and improvement in condition of the offset; and averted risk of loss of the offset (OEI 2014a).</p>
5. effectively account for and manage	Offset sites will be secured by registration of a BioBanking agreement on title to

Offset principals (DSEWPac 2012, box 1)	Western Sydney Airport offset package
the risks of the offset not succeeding	<p>the sites. A BioBanking agreement is the strongest conservation covenant available on private land in NSW and extinguishes all land uses other than conservation unless the BioBanking agreement is varied or terminated by the NSW Minister for the Environment to permit alternative uses. Certain mining rights may be granted over a biobank site, and certain development can be carried out by public authorities on a biobank site, but any impacts from these activities must be offset again as an addition to any offsetting activities required by a given project in its own right.</p> <p>A BioBanking agreement confers an obligation on the landowner to conserve and manage the biodiversity values of the biobank site in order to ensure that the offsets would improve or maintain the viability of the affected protected matters. The BioBanking Trust Fund ensures that sufficient funds are available to perform the required management actions in perpetuity. BioBanking requires preparation of an annual monitoring report to ensure compliance with the requirements of the agreement and the effectiveness of management actions. BioBanking also includes periodic inspections by OEH to ensure compliance and enforcement measures up to and including compulsory acquisition of the biobank by OEH.</p> <p>The security of titling and management and monitoring framework afforded by BioBanking effectively account for and substantially reduce the risks of the offset not succeeding.</p>
6. be additional to what is already required, determined by law or planning regulations or agreed to under other schemes or programs (this does not preclude the recognition of state or territory offsets that may be suitable as offsets under the EPBC Act for the same action)	<p>The biodiversity offsets presented in this offset package are the sole requirement of the EIS and are not the result of any other legal requirement that applies to the proposed airport.</p> <p>The offset areas and associated biodiversity credits included in this offset package are not linked to any other conservation covenant or set aside as an offset for another development. Some of the biobank sites included in this offset package are associated with biodiversity credits that have been used to offset the impacts of another development. These credits and associated areas of land at the biobank sites have been excluded from this offset package.</p>
7. be efficient, effective, timely, transparent, scientifically robust and reasonable	<p>As stated above, this offset package has been developed in accordance with biodiversity offset assessment methodologies that have been developed by Government Agencies in order to ensure that biodiversity offsets are efficient, effective, transparent, scientifically robust and reasonable.</p> <p>This offset package includes direct offsets for the majority of protected matters affected by the proposal at the time of public exhibition of the EIS. Direct biodiversity offsets would continue to be identified and secured according to the criteria and process outlined in this offset package. Direct offsets would be delivered prior to the impact occurring as far as is possible (subject to the availability of suitable 'like for like' offset sites). This approach is likely to ensure the timely delivery of offsets for the majority of the protected matters affected by the proposal.</p>
8. have transparent governance arrangements including being able to be readily measured, monitored, audited and enforced.	<p>Offset sites will be secured by registration of a BioBanking agreement on title to the sites. A BioBanking agreement confers an obligation on the landowner to conserve and manage the biodiversity values of the biobank site in order to ensure that the offsets would improve or maintain the viability of the affected protected matters. BioBanking requires preparation of an annual monitoring report to ensure compliance with the requirements of the agreement and the effectiveness of management actions. BioBanking also includes periodic inspections by OEH to ensure compliance and enforcement measures up to and including compulsory acquisition of the biobank by OEH.</p> <p>These governance arrangements are transparent, in that they are specified in the BBAM and the individual BioBanking agreements which will be available on the the biodiversity credits and BioBanking agreements register (OEH 2015b).</p>

## 7. Conclusions

The Biodiversity Assessment for the airport has concluded that biodiversity offsets would be required to compensate for significant residual impacts on Cumberland Plain Woodland, the Grey-headed Flying-fox and the environment in accordance with the EPBC Act offset policy (DSEWPaC 2012a). The offset policy requires offsets for significant impacts on threatened species and communities listed under the EPBC Act, calculated using the 'offset assessment guide' spreadsheet. Consultation with DotE has confirmed that BioBanking is their preferred approach for estimating offsets for the significant residual impacts on the environment. The proposed biodiversity offset package for the proposed airport has been prepared in accordance with the offset policy and will conserve habitat for the affected threatened biota, threatened species and communities listed under NSW legislation and other and other features of the environment in suitable offset sites.

The biodiversity offsets for the project would be secured by registration of a BioBanking agreement on the title of offset sites that would ensure they would be securely titled and managed for conservation as a biobank in perpetuity. The number and type of biodiversity credits would be purchased and retired from offset sites to match the proposed airport's impacts as calculated by the offset assessment guide. Additional biodiversity credits would be purchased to offset impacts on the natural environment. This would secure the conservation covenant over the area of land that is linked to the biodiversity credits and provide funds for management in perpetuity.

Suitable offset sites have been identified that contain Cumberland Plain Woodland and/or Grey-headed Flying-fox habitat and biodiversity credits appropriate to match the proposed airport's impacts on the natural environment. The potential offset sites include established biobank sites with suitable biodiversity credits for sale and proposed biobank sites that are at various stages of the assessment and approval process for obtaining a BioBanking agreement. Portions of four of these potential offset sites are located in Cumberland Plain Priority Conservation Lands identified in the recovery plan for Cumberland Plain Woodland (DECCW 2010, 2011).

Offset assessment guide calculations were performed for the affected threatened biota based on the following:

- removal of 88.9 hectares of Cumberland Plain Woodland;
- removal of 120.4 hectares of habitat for the Grey-headed Flying-fox;
- the conservation and management of proposed offset sites to achieve increased site quality, containing:
  - 180 hectares Cumberland Plain Woodland that is in moderate condition and comprises the EPBC Act-listed form of the community;
  - 79 hectares of poorer quality Cumberland Plain Woodland that would be actively managed so that it would reach the same site quality as the airport site and comprise a functioning occurrence of the EPBC Act-listed form of the community over the medium-term; and
  - Up to 401 hectares of Grey-headed Flying-fox habitat.

The outcome of these offset assessment guide calculations is that:

- the proposed offset areas containing around 180 hectares of EPBC Act Cumberland Plain Woodland would offset 59 per cent of the airport's impacts on the community;



- the proposed offset areas containing around 79 hectares of poorer condition Cumberland Plain Woodland would offset around 15 per cent of the proposed airport's impacts on the ecological community, resulting in a total offset contribution of 74 per cent of the proposed airport's impacts; and
- the proposed offset areas containing up to 401 hectares of habitat for the Grey-headed Flying-fox would offset around 136 per cent of the proposal's impacts on habitat for this vulnerable species.

Based on these preliminary calculations, the proposed offset sites could not meet all of the proposed airport's EPBC Act offsetting requirements as direct offsets. Additional offset sites containing Cumberland Plain Woodland will be identified throughout the environmental assessment process for the proposed airport and will be included in the final delivery of offsets.

BioBanking credit calculations using the assessment methodology for a major project in NSW have been used to estimate offsets for impacts on the environment, including species and communities listed under NSW legislation. The estimated offset requirement for impacts on the natural environment substantially overlaps with that required for EPBC Act-listed biota but involves a considerably greater quantum because of the inclusion of additional matters that are not protected under the EPBC Act. Notably, offsets would be required for poorer condition vegetation that does not comprise EPBC Act-listed Cumberland Plain Woodland.

DotE is expected to confirm the specific offset requirements for residual impacts arising from the proposed airport. Offset calculations would be finalised with additional site specific information such as proposed management, current risk of development and the security of title proposed for individual offset sites. These additional data would be entered in the offset assessment guide by specialists within DotE to confirm the quantum of offsets that would be delivered for threatened biota listed under the EPBC Act. The quantum of offsets required for impacts on the environment would be determined by DotE based on the Biobanking calculations included in this offset package.

This offset package satisfies the EIS guidelines for biodiversity offsets including: an estimate of the quantum of offsets that may be required for the significant residual impacts on Cumberland Plain Woodland, the Grey-headed Flying-fox and the environment that are likely to arise from the proposed airport; evidence that access is possible to offset sites that could substantially meet this offsetting requirement; and an approach to delivering the remaining offset requirement. When implemented the offset package would improve or maintain the viability of the protected matters that would be affected by the proposed airport.

## 8. References

Avisure 2015, *Western Sydney Airport Bird and Bat Strike Risk Assessment*. Report prepared for Department of Infrastructure and Regional Development, Western Sydney Unit.

Biosis Research 1999, Proposal for a Second Sydney Airport at Badgerys Creek or Holsworthy Military Area Technical Paper 8: Flora and Fauna. Report prepared for PPK.

Churchill, S 2008, *Australian Bats*, Allen and Unwin, Australia.

DECCW 2009, *Draft National Recovery Plan for the Grey-headed Flying-fox* (*Pteropus poliocephalus*). Department of Environment, Climate Change and Water, NSW  
<http://www.environment.nsw.gov.au/resources/threatenedspecies/08214dnrpflyingfox.pdf>

DECCW 2010, *Cumberland Plain Recovery Plan*. Department of Environment, Climate Change and Water (NSW), Sydney.

DECCW 2011, *Cumberland Plain Priority Conservation Lands*. GIS dataset.

DEWHA 2010, *Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest A guide to identifying and protecting the nationally threatened ecological community Environment Protection and Biodiversity Conservation Act 1999 Policy Statement 3.31*. Department of Environment, Water, Heritage and the Arts, Commonwealth of Australia, Canberra, ACT.

DIRD 2014, *Western Sydney Airport referral of proposal action*. Department of Infrastructure and Regional Development.

DotE 2013a, *Matters of National Environmental Significance Significant impact guidelines 1.1 Environment Protection and Biodiversity Conservation Act 1999*. Department of the Environment, Commonwealth of Australia.

DSEWPac 2012a, *Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy*. Department of Sustainability, Environment, Water, Population and Communities, Canberra.

DSEWPac 2012b, *How to Use the Offsets Assessment Guide*. Department of Sustainability, Environment, Water, Population and Communities, Canberra.

DSEWPac 2013, *Description of EPBC Act offsets assessment guide functionality for fictional offset scenarios – Industry Training*. Department of Sustainability, Environment, Water, Population and Communities, Canberra.

Eby, P. and Law, B. 2008, *Ranking the feeding habitats of Grey-headed flying foxes for conservation management*. A report for The Department of Environment and Climate Change (NSW) & the Department of Environment, Water, Heritage and the Arts.

GHD 2014a, *Williamswood Biobank BioBanking Assessment*. Report prepared for a private client.

GHD 2015b, *Western Sydney Airport Environmental Impact Statement*. Report prepared for Department of Infrastructure and Regional Development, Western Sydney Unit.

GHD 2015a, *Western Sydney Airport Biodiversity Assessment*. Report prepared for Department of Infrastructure and Regional Development.

GHD 2015c, *Ropes and South Creek Preliminary BioBanking Assessment Report*. Report prepared for the NSW Department of Planning and Environment.

GHD 2015d, *Stage 1 Montpellier Biobank BioBanking Assessment*. Report prepared for a private client.

GHD in prep *Stage 2 Montpellier Biobank BioBanking Assessment*. Report prepared for a private client.

GHD 2015e, *Menangle Road Biobank BioBanking Assessment*. Report prepared for a private client.

GHD 2015f, *Bruelle biobank site Draft Biobank agreement assessment*. Report prepared for a private client.

GHD 2015g, *The Oaks Biobank BioBanking Assessment*. Report prepared for a private client.

NSW Scientific committee 2009, *Cumberland Plain Woodland in the Sydney Basin Bioregion - critically endangered ecological community listing NSW Scientific Committee - Final determination*. Accessed at <http://www.environment.nsw.gov.au/determinations/cumberlandwoodlandsFD.htm>

OEH 2014c, *NSW vegetation types database*, Office of Environment and Heritage. Accessed at <http://www.environment.nsw.gov.au/biobanking/VegTypeDatabase.htm>

OEH 2014b, *Framework for Biodiversity Assessment*. Office of Environment and Heritage. Accessed at: <http://www.environment.nsw.gov.au/biodivoffsets/1482fba.htm>

OEH 2014a *BioBanking Assessment Methodology 2014*. Accessed at <http://www.environment.nsw.gov.au/biobanking/140661BBAM.htm>.

OEH 2015a *NSW BioNet: The Website for the Atlas of NSW Wildlife*. Office of Environment and Heritage. Accessed at <http://www.bionet.nsw.gov.au/>

OEH 2015b, *Search for biobanking agreements*, Office of Environment and Heritage. Accessed at <http://www.environment.nsw.gov.au/bimsprapp/SearchBiobankingAgreement.aspx?Start=1>

OEH 2015c, *Search for biobank site expressions of interest*, Office of Environment and Heritage. Accessed at <http://www.environment.nsw.gov.au/bimsprapp/SearchBiobankingEOI.aspx?Start=1>

OEH 2015d, *NSW Vegetation Information System: Classification 2.1*. Accessed at: <http://www.environment.nsw.gov.au/NSWVCA20PRapp/default.aspx>

PB 2013, *Greening Western Sydney - South and Ropes Creek Ecological Monitoring - Baseline Monitoring Report*, Parsons Brinkerhoff, Sydney. Prepared for the Department of Planning and Infrastructure. February 2013.

PPK Environment and Infrastructure 1999, *Environmental Impact Assessment*.

Royal Botanic Gardens & Domain Trust (undated), *Monitoring change in the woodland*. Royal Botanic Gardens & Domain Trust. Accessed at: [https://www.rbgsyd.nsw.gov.au/science/Evolutionary\\_Ecology\\_Research/Ecology\\_of\\_Cumberland\\_Plain\\_Woodland/woodland\\_at\\_mount\\_annan/monitoring\\_change\\_in\\_the\\_woodland](https://www.rbgsyd.nsw.gov.au/science/Evolutionary_Ecology_Research/Ecology_of_Cumberland_Plain_Woodland/woodland_at_mount_annan/monitoring_change_in_the_woodland)

Toolijooa (various dates) *Quarterly bush regeneration reports for Ropes and South Creeks riparian corridors*. Reports prepared for Department of Planning and Environment.

TSSC 2008, *Commonwealth Listing Advice on Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest*. Threatened Species Scientific Committee, Department of the Environment, Water, Heritage and the Arts. Canberra, ACT. Accessed at <http://www.environment.gov.au/biodiversity/threatened/communities/pubs/112-listing-advice.pdf>.

Webb N.J. and Tidemann C.R. 1996. Mobility of Australian flying-foxes, *Pteropus* spp. (Megachiroptera): evidence from genetic variation. *Proceeding of the Royal Society London Series B* 263, pp497–502.

## Appendices



## **Appendix A** – Potential offset sites

## Williamstown biobank

The 'Williamstown biobank' offset site is a biobank that has been subject to a detailed field survey and BioBanking assessment and has already been set aside for conservation under a BioBanking agreement. The description of the site presented below is based on the information presented in the BioBanking assessment report for the site (GHD 2014a).

The Williamstown biobank includes 104.4 hectares of land and is located at Mount Hunter within the Wollondilly Local Government Area (LGA). It falls within the Cumberland subregion of the Hawkesbury Nepean Catchment Management Authority (CMA), and within the Sydney Basin Bioregion. The biobank is currently zoned RU2 Rural Landscape under the *Wollondilly Local Environment Plan 2011* and was grazed by cattle prior to being set aside as a biobank.

There are three NSW vegetation types at the biobank. Each of these vegetation types have been cleared, grazed and subject to weed infestation to varying degrees with areas of Moderate/good-medium, Moderate/good – poor and Low condition vegetation. Vegetation types were split into broad condition classes yielding six vegetation zones. The distribution of vegetation zones at the biobank is closely tied to soil type, underlying geology and geomorphic position. The biobank site includes vegetation zones which qualify as the EPBC Act listed form of Cumberland Plain Woodland, and Grey-headed Flying-fox habitat (specifically vegetation zones with native over storey cover greater than 10 per cent). There are also areas of poorer quality Cumberland Plain Woodland that comprises derived grassland or scrub which could be managed to improve in quality and become EPBC Act Cumberland Plain Woodland. These areas have minimal canopy cover and contain minimal foraging resources for the Grey-headed Flying Fox. Only vegetation zones in Moderate/good- medium condition comprise Grey-headed Flying-fox habitat. The extent of available habitat for the affected threatened biota has been further refined based on the number of biodiversity credits currently available for sale (see Table 18). Matching biodiversity credits from all vegetation zones, including Low condition vegetation, would be suitable for offsetting impacts on the environment.

More exposed slopes and ridges on shale support Grey Box – Forest Red Gum grassy woodland (HN529). This vegetation zone comprises an occurrence of the EPBC Act listed form of Cumberland Plain Woodland.

Grey Box – Forest Red Gum grassy woodland grades into Moderate/good condition Forest Red Gum – Grey Box shrubby woodland (HN524) on sheltered slopes with a fine grained volcanic substrate, which is distinguished from adjoining grassy woodlands on shale by the presence of mesic small trees, a denser shrub layer and mesic understorey species. These vegetation types give way to Forest Red Gum – Rough-barked Apple grassy woodland (HN526) in riparian areas and adjoining alluvial flats.

There are moderate to severe infestations of noxious weeds, such as Lantana (*Lantana camara*), Blackberry (*Rubus fruticosus* spp. agg.) and especially African Olive (*Olea europea* subsp. *cuspidata*) at the site. These weeds are most prevalent on the cleared low lying areas and on more sheltered slopes.

Much of the site has been grazed and canopy vegetation has been extensively cleared or thinned historically. Mid storey vegetation has since re-established across the majority of the biobank though there are very few over storey species in areas of poor or low condition vegetation. There are mature hollow-bearing trees in moderate densities throughout areas of Moderate/good – medium condition vegetation at the biobank.

One threatened fauna species was recorded at the biobank site during field surveys: the Little Eagle (*Hieraaetus morphnoides*) which is listed as a vulnerable species under the TSC Act. One threatened plant has been recorded at the site: Spiked Rice-flower (*Pimelea spicata*) which is listed as an endangered species under the EPBC Act and the TSC Act. A single Spiked Rice-flower was recorded

at the site during field surveys by GHD ecologists and a number of other individuals were observed by OEH staff during a site inspection. This species has not been formally included in the BioBanking assessment and no species credits have been created. Systematic targeted surveys for the Spiked Rice-flower will be conducted and species credits will be created based on the results of that survey.

**Table 18 Vegetation zones, habitat for the affected threatened biota and available biodiversity credits at the Williamswood biobank (GHD 2014a)**

Vegetation Zone	Veg Type ID	Condition	Area (ha)	EPBC Act Status	TSC Act Status	Area of EPBC Act Cumberland Plain Woodland <sup>1</sup> (ha)	Area of poorer quality Cumberland Plain Woodland <sup>2</sup> (ha)	Area of Habitat for Grey-headed Flying fox <sup>3</sup> (ha)	Available biodiversity credits
1 -Grey Box - Forest Red Gum grassy woodland on hills (Moderate/good - medium)	HN529	Moderate/ good - medium	31.9	CEEC	CEEC	31.9		31.9	367
2 -Grey Box - Forest Red Gum grassy woodland on hills (Moderate/good - poor)	HN529	Moderate/ good - poor	28		CEEC	0	28	0	322
3 -Grey Box - Forest Red Gum grassy woodland on hills (Low)	HN529	Low	12.6			0		0	5
4 -Forest Red Gum - Rough-barked Apple grassy woodland (Moderate/good - medium)	HN526	Moderate/ good - medium	14.3		EEC	0		14.3	144
5 -Forest Red Gum - Rough-barked Apple grassy woodland (Low)	HN526	Low	13.5			0		0	136
6 - Forest Red Gum - Grey Box shrubby woodland (Moderate/good - high)	HN524	Moderate/ good - high	4.2	CEEC	EEC	0		4.2	38
		<b>Total</b>	<b>104.5</b>			<b>31.9</b>	<b>28</b>	<b>50.4</b>	<b>1012</b>

Notes: 1) Features >10 per cent native canopy cover and predominantly native understorey in accordance with the conservation advice for the community (DEWHA 2010) and is linked to biodiversity credits that are available for sale. 2) Derived native scrub or grassland with <10 per cent native canopy cover and predominantly native understorey that does not comprise EPBC Act Cumberland Plain Woodland in accordance with the conservation advice for the community (DEWHA 2010) and that is linked to biodiversity credits that are available for sale. 3) Comprises critical foraging habitat as defined in the recovery plan for the species (DECCW 2009) and is linked to biodiversity credits that are available for sale.



## The Oaks Biobank

The 'Oaks biobank' offset site is a biobank that has been subject to a detailed field survey and BioBanking assessment and has already been set aside for conservation under a BioBanking agreement. The description of the site presented below is based on the information presented in the BioBanking assessment report for the site (GHD 2014g).

The Oaks biobank includes 40 hectares of land and is located at Mowbray Park within the Wollondilly Local Government Area (LGA). It falls within the Cumberland subregion of the Hawkesbury Nepean Catchment Management Authority (CMA), and within the Sydney Basin Bioregion. The biobank is currently zoned RU2 Rural Landscape under the *Wollondilly Local Environment Plan 2011* and was grazed by cattle prior to being set aside as a biobank.

There are four NSW vegetation types at the biobank. The stands of these vegetation types are in varying condition (according to the BBAM) and were split into broad condition classes yielding six vegetation zones. The distribution of vegetation zones at the biobank is closely tied to soil type, underlying geology and geomorphic position.

The biobank site includes vegetation zones which qualify as the EPBC Act listed form of Cumberland Plain Woodland and/or Grey-headed Flying-fox habitat (specifically only vegetation zones with native over storey cover greater than 10 per cent). There are also areas of poorer quality Cumberland Plain Woodland that comprises derived grassland or scrub which could be managed to improve in quality and become EPBC Act Cumberland Plain Woodland. These areas have minimal canopy cover and contain minimal foraging resources for the Grey-headed Flying Fox. Available habitat for these affected threatened biota has been calculated based on the number of biodiversity credits currently available for sale (see Table 19). Matching biodiversity credits from all vegetation zones, including Low condition vegetation, would be suitable for offsetting impacts on the environment.

More exposed slopes and ridges on shale support Grey Box – Forest Red Gum grassy woodland (HN529). Moderate/good-medium condition patches of this vegetation type comprise an occurrence of the EPBC Act listed form of Cumberland Plain Woodland.

Grey Box – Forest Red Gum grassy woodland grades into Moderate/good condition Forest Red Gum – Grey Box shrubby woodland (HN524) on sheltered slopes with a fine grained volcanic substrate, which is distinguished from adjoining grassy woodlands on shale by the presence of a mid-storey of mesic small trees, a denser shrub layer and mesic understorey species. These vegetation types give way to Forest Red Gum – Rough-barked Apple grassy woodland (HN526) in riparian areas and adjoining alluvial flats. Each of these vegetation types have been cleared, grazed and subject to weed infestation to varying degrees with areas of Moderate/good- medium, Moderate/good – poor and Low condition vegetation. Moderate/good- medium condition vegetation zones comprise Grey-headed Flying-fox habitat.

There are moderate to severe infestations of noxious weeds, such as Lantana (*Lantana camara*), Blackberry (*Rubus fruticosus* spp. agg.) and especially African Olive (*Olea europea* subsp. *cuspidata*) at the site. These weeds are most prevalent on the cleared low lying areas and on more sheltered slopes.

Much of the site has been grazed and canopy vegetation has been extensively cleared or thinned historically. Mid storey vegetation has since re-established across the majority of the biobank though there are very few over storey species in areas of poor or low condition vegetation. There are mature hollow-bearing trees in moderate densities throughout areas of Moderate/good – medium condition vegetation at the biobank.

**Table 19 Vegetation zones, habitat for the affected threatened biota and available biodiversity credits at the Oaks biobank (GHD 2014g)**

Vegetation Zone	Veg Type ID	Condition	Area (ha)	EPBC Act Status	TSC Act Status	Area of EPBC Act Cumberland Plain Woodland <sup>1</sup> (ha)	Area of poorer quality Cumberland Plain Woodland <sup>2</sup> (ha)	Area of Habitat for Grey-headed Flying fox <sup>3</sup> (ha)	Available biodiversity credits
Forest Red Gum - Grey Box shrubby woodland (Low)	HN524	Low	8.2		EEC				69
Grey Box - Forest Red Gum grassy woodland (medium)	HN529	Moderate/good - medium	13.9	CEEC	CEEC	10		10	121
Grey Box - Forest Red Gum grassy woodland (poor)	HN529	Moderate/good - poor	5.5	CEEC	EEC		3		48
Grey Box - Forest Red Gum grassy woodland (Low)	HN529	Low	10.7		EEC				93
Grey Myrtle dry rainforest (poor)	HN538	Moderate/good - poor	0.4	CEEC	EEC			0.4	5
Forest Red Gum - Rough-barked Apple grassy woodland (Low)	HN526	Low	1.3		EEC				11
		<b>Total</b>	<b>40</b>			<b>10</b>	<b>3</b>	<b>10.4</b>	<b>346</b>

Notes: 1) Features >10 per cent native canopy cover and predominantly native understorey in accordance with the conservation advice for the community (DEWHA 2010) and is linked to biodiversity credits that are available for sale.

2) Derived native scrub or grassland with <10 per cent native canopy cover and predominantly native understorey that does not comprise EPBC Act Cumberland Plain Woodland in accordance with the conservation advice for the community (DEWHA 2010) and that is linked to biodiversity credits that are available for sale.

3) Comprises critical foraging habitat as defined in the recovery plan for the species (DECCW 2009) and is linked to biodiversity credits that are available for sale.

## Durham biobank

The 'Durham biobank' offset site is a proposed biobank on land owned by the NSW Department of Planning and Environment (DPE) at Oxley Park in the Ropes Creek riparian corridor. The site has been subject to a detailed field survey and a preliminary BioBanking assessment but has not yet been set aside for conservation under a BioBanking agreement. The remaining steps involved with finalising the BioBanking assessment include definition of site boundaries, BioBanking credit calculations and preparation of a management actions plan (MAP). The description of the site presented below is based on the information presented in the preliminary BioBanking assessment report for the site (GHD 2015c). The description of the biodiversity values at the site that is included below is unlikely to substantially change as a result of later stages of the BioBanking assessment. The area of habitat for the affected MNES that is present at the site will be reassessed based on any additional information obtained prior to the final delivery of the offset package for the proposed airport and the total quantum of offset will be adjusted if required.

The Durham biobank includes 46.85 hectares of land and is located along the riparian corridor of Ropes Creek within the Hawkesbury Nepean CMA, and within the Sydney Basin Bioregion. The Durham biobank is located within the Penrith and Blacktown LGAs.

The site is dominated by Forest Red Gum - Rough-barked Apple grassy woodland (HN526) in varying conditions, which intergrades with Swamp Oak - Prickly Tea-tree - Swamp Paperbark swamp forest (HN594) in several locations along Ropes Creek, presumably where soil salt content is greater. There is a small section of Grey Box - Forest Red Gum grassy woodland on shale (HN528) in the south east corner of the site, associated with a slight increase in topography. There are relatively abundant populations of the threatened plant Juniper-leaved Grevillea (*Grevillea juniperina* subsp. *juniperina*) at the site. A Grey-headed Flying-fox roost camp has been recorded in the Ropes Creek riparian corridor less than 500 metres to the south of the Durham biobank (PB 2013). Mother flying-foxes were recorded suckling young at this roost camp (PB 2013).

The biobank includes vegetation zones which qualify as the EPBC Act listed form of Cumberland Plain Woodland, and Grey-headed Flying-fox habitat (specifically only vegetation zones with native over storey cover greater than 10 per cent). At this site 'Moderate/good – poor' condition vegetation comprises regrowth vegetation with moderate native over storey cover that would qualify as Cumberland Plain Woodland and that does contain foraging resources for the Grey-headed Flying Fox. The Commonwealth listing advice for Cumberland Plain Woodland notes that the canopy in regrowth stands of EPBC Act Cumberland Plain Woodland may be shorter than 10 m tall (TSSC 2008). Vegetation zones and habitat for the affected threatened biota at the Durham biobank site are presented in Table 20. Additional biodiversity credits associated with Low condition vegetation would be available to offset impacts on the environment.

There is considerable scope to improve the biodiversity values of the site if it is included in a biobank through treatment of weed infestations, removal of rubbish from drainage lines and development of vegetation structure and habitat resources.

**Table 20 Vegetation zones, habitat for the affected threatened biota and estimated biodiversity credits at the Durham biobank (GHD 2014a)**

Vegetation Zone	Veg Type ID	Condition	Area (ha)	EPBC Act Status	TSC Act Status	Area of EPBC Act Cumberland Plain Woodland <sup>1</sup> (ha)	Area of poorer quality Cumberland Plain Woodland (ha)	Area of Habitat for Grey-headed Flying fox <sup>2</sup> (ha)	Estimated biodiversity credits <sup>3</sup>
Forest Red Gum - Rough-barked Apple grassy woodland (Moderate/good – medium)	HN526	Moderate/good – medium	10.42		EEC	0		10.42	73
Forest Red Gum - Rough-barked Apple grassy woodland (Moderate/good – poor)	HN526	Moderate/good – poor	7.8		EEC	0		7.8	55
Forest Red Gum - Rough-barked Apple grassy woodland (Low)	HN526	Low	16.95			0		0	119
Swamp Oak - Prickly Tea-tree - Swamp Paperbark swamp forest (Moderate/good)	HN594	Moderate/good	3.01		EEC	0		3.01	21
Grey Box - Forest Red Gum grassy woodland on shale (Moderate/good – high)	HN528	Moderate/good – high	1.55	CEEC	CEEC	1.55		1.55	11
Grey Box - Forest Red Gum grassy woodland on shale (Moderate/good – poor)	HN528	Moderate/good – poor	1.3	CEEC	CEEC	1.3		1.3	9
Grey Box - Forest Red Gum grassy woodland on shale (Low)	HN528	Low	1.63			0		0	11
		<b>Total</b>	<b>42.66</b>			<b>2.85</b>		<b>24.08</b>	<b>299</b>

Notes: 1) Features >10 per cent native canopy cover and predominantly native understorey in accordance with the conservation advice for the community (DEWHA 2010).

2) Comprises critical foraging habitat as defined in the recovery plan for the species (DECCW 2009).

3) Estimate based on a credit generation rate of seven credits per hectare.



### **8.1.1 Mamre biobank**

The 'Mamre biobank' offset site is a proposed biobank on a 172 hectare parcel of land owned by DPE at Mamre Park connected to the South Creek riparian corridor. The site has been subject to a detailed field survey and a preliminary BioBanking assessment but has not yet been set aside for conservation under a BioBanking agreement. The description of the site presented below is based on the information presented in the preliminary BioBanking assessment report for the site (GHD 2015c). As noted for the Durham biobank above, the description of the biodiversity values at the site is unlikely to substantially change but prior to the final delivery of the offset package for the airport the total quantum of offset will be reassessed and adjusted if required.

Forest Red Gum - Rough-barked Apple grassy woodland (HN526) occupies the majority of the site, in varying condition. There are several areas that have been revegetated along the boundary of the site, typically mapped as Moderate/good – poor condition vegetation.

Vegetation closest to areas of disturbance (e.g. in areas close to cleared land or land used for horse agistment) is dominated by exotic species. There are several informal tracks throughout vegetated areas of the site that appear to be used on a regular basis as horse trails, despite the presence of fences and gates. There are low to moderate densities of exotic herbaceous and grass species along many of these tracks.

There are extensive planted areas around the site, most of which have been mapped as Moderate/good – poor condition. These areas typically lack a midstorey, having been primarily revegetated with canopy species. There are low to moderate infestations of exotic species in the understorey, and some areas also support moderate to severe infestations of woody weeds and climbers in the midstorey.

Only vegetation zones which qualify as the EPBC Act listed form of Cumberland Plain Woodland and/or Grey-headed Flying-fox habitat would be included in this offset package (specifically only vegetation zones with native over storey cover greater than 10%). At this site 'Moderate/good – poor' condition vegetation comprises planted or regrowth vegetation with moderate native over storey cover that contains foraging resources for the Grey-headed Flying Fox. Vegetation zones and habitat for the affected threatened biota at the Mamre biobank site are presented in Table 21. Matching biodiversity credits from all vegetation zones, including Low condition vegetation, would be suitable for offsetting impacts on the environment..

There is considerable scope to improve the biodiversity values of the site through treatment of weed infestations, removal of rubbish from drainage lines and development of vegetation structure and habitat resources. Preventing use of bushland areas as horse trails would assist in improving the condition of vegetation on site, through a reduction in the spread of weed species seeds, as well as halting the spread of nutrients into bushland areas.

**Table 21 Vegetation zones, habitat for the affected threatened biota and estimated biodiversity credits at the Mamre biobank (GHD 2014a)**

Vegetation Zone	Veg Type ID	Condition	Area (ha)	EPBC Act Status	TSC Act Status	Area of Cumberland Plain Woodland <sup>1</sup> (ha)	Area of Habitat for Grey-headed Flying fox <sup>2</sup> (ha)	Estimated biodiversity credits <sup>3</sup>
Forest Red Gum - Rough-barked Apple grassy woodland (Moderate/good – medium)	HN526	Moderate/good – medium	26.86		EEC		26.86	188
Forest Red Gum - Rough-barked Apple grassy woodland (Moderate/good – poor)	HN526	Moderate/good – poor	25.61		EEC		25.61	179
Forest Red Gum - Rough-barked Apple grassy woodland (Low)	HN526	Low	44.62					312
Phragmites australis and Typha orientalis coastal freshwater wetlands (Moderate/good)	HN630	Moderate/good	1.04		EEC			7
		<b>Total</b>	<b>98.13</b>			<b>0</b>	<b>52.47</b>	<b>687</b>

Notes: 1) Features >10% native canopy cover and predominantly native understorey in accordance with the conservation advice for the community (DEWHA 2010).

2) Comprises critical foraging habitat as defined in the recovery plan for the species (DECCW 2009).

3) Estimate based on a credit generation rate of seven credits per hectare.

### **Forrester biobank**

The 'Forrester biobank' offset site is a proposed biobank on a 9 hectare parcel of land owned by DPE at Tregear, connected to the Ropes Creek riparian corridor. The site has been subject to a detailed field survey and a preliminary BioBanking assessment but has not yet been set aside for conservation under a BioBanking agreement. The description of the site presented below is based on the information presented in the preliminary BioBanking assessment report for the site (GHD 2015c). As noted for the Durham biobank above, the description of the biodiversity values at the site is unlikely to substantially change but prior to the final delivery of the offset package for the airport the total quantum of offset will be reassessed and adjusted if required.

The majority of the site contains Forest Red Gum - Rough-barked Apple grassy woodland (HN526) on alluvial flats. There is a narrow linear corridor of Swamp Oak - Prickly Tea-tree - Swamp Paperbark swamp forest (HN594) along Ropes Creek.

Only vegetation zones which qualify as the EPBC Act listed form of Cumberland Plain Woodland and/or Grey-headed Flying-fox habitat would be included in this offset package (specifically only vegetation zones with native over storey cover greater than 10%). At this site 'Moderate/good – poor' or 'Low' condition vegetation comprises derived native grassland or sub-mature planted vegetation and does not contain foraging resources for the Grey-headed Flying Fox. Vegetation zones and habitat for the affected threatened biota at the Forrester biobank site are presented in Table 22. Matching biodiversity credits from all vegetation zones, including Low condition vegetation, would be suitable for offsetting impacts on the environment..

There are severe infestations of exotic woody weed and vine species along the riparian strip of Ropes Creek in the north east of the site, as well as infestations of invasive grass species along an electricity easement in the east.

There is considerable scope to improve the biodiversity values of the site if it included in a biobank through treatment of weed infestations, removal of rubbish from drainage lines and accessible portions of the site, securing the site to prevent access by recreational vehicles including 4WD vehicles, dirt bikes and mountain bikes and development of vegetation structure and habitat resources.

**Table 22 Vegetation zones, habitat for the affected threatened biota and estimated biodiversity credits at the Forrester biobank (GHD 2014a)**

Vegetation Zone	Veg Type ID	Condition	Area (ha)	EPBC Act Status	TSC Act Status	Area of Cumberland Plain Woodland <sup>1</sup> (ha)	Area of Habitat for Grey-headed Flying fox <sup>2</sup> (ha)	Estimated biodiversity credits <sup>3</sup>
Forest Red Gum - Rough-barked Apple grassy woodland (Moderate/ good – medium)	HN526	Moderate/ good – medium	4.74		EEC		4.74	33
Forest Red Gum - Rough-barked Apple grassy woodland (Moderate/ good – poor)	HN526	Moderate/ good – poor	1.96		EEC			14
Forest Red Gum - Rough-barked Apple grassy woodland (Low)	HN526	Low	1.31					9
Swamp Oak - Prickly Tea-tree - Swamp Paperbark swamp forest (HN594)	HN594	Moderate/good condition	1.16		EEC		1.16	8
		<b>Total</b>	<b>9.17</b>				<b>5.9</b>	<b>64</b>

- Notes: 1) Features >10% native canopy cover and predominantly native understorey in accordance with the conservation advice for the community (DEWHA 2010).  
2) Comprises critical foraging habitat as defined in the recovery plan for the species (DECCW 2009).  
3) Estimate based on a credit generation rate of seven credits per hectare.



## **Luddenham biobank**

The 'Luddenham biobank' offset site is a proposed biobank on a 42 hectare parcel of land owned by DPE at Mamre Park, connected to the South Creek riparian corridor. The site has been subject to a detailed field survey and a preliminary BioBanking assessment but has not yet been set aside for conservation under a BioBanking agreement. The description of the site presented below is based on the information presented in the preliminary BioBanking assessment report for the site (GHD 2015c). As noted for the Durham biobank above, the description of the biodiversity values at the site is unlikely to substantially change but prior to the final delivery of the offset package for the proposed airport the total quantum of offset will be reassessed and adjusted if required.

Forest Red Gum - Rough-barked Apple grassy woodland (HN526) occupies the majority of the site, in varying condition. There are several areas that have been revegetated along the boundary of the site, typically mapped as Moderate/good – poor condition vegetation and some low condition vegetation with immature regrowth. There is a small portion of cleared land in the south of the site within an electricity easement.

There is around five hectares of Grey Box - Forest Red Gum grassy woodland on shale (HN528) on higher ground.

Revegetated portions of the site appear to have been planted with a mixture of canopy, midstorey and understorey species. The understorey in these areas is typically dominated by exotic herbaceous and grass species, with several small and localised exceptions. Several areas that have been revegetated have moderate to high levels of woody weed infestation as well as low to moderate infestations with Blackberry (*Rubus fruticosus* sp. agg.)

The biobank includes vegetation zones which qualify as the EPBC Act listed form of Cumberland Plain Woodland, and Grey-headed Flying-fox habitat (specifically only vegetation zones with native over storey cover greater than 10 per cent). There are also areas of poorer quality Cumberland Plain Woodland that comprises planted or regrowth vegetation which could be managed to improve in quality and become EPBC Act Cumberland Plain Woodland. These areas have moderate native over storey cover and contain foraging resources for the Grey-headed Flying Fox. Vegetation zones and habitat for the affected threatened biota at the Luddenham biobank site are presented in Table 23. Matching biodiversity credits from all vegetation zones, including Low condition vegetation, would be suitable for offsetting impacts on the environment..

There is considerable scope to improve the biodiversity values of the site through treatment of weed infestations, removal of rubbish from drainage lines and development of vegetation structure and habitat resources. Preventing use of bushland areas as horse trails would assist in improving the condition of vegetation on site, through a reduction in the spread of weed species seeds, as well as halting the spread of nutrients into bushland areas.

One threatened fauna species was recorded at the biobank site during field surveys: the Little Eagle.

There is considerable scope to improve the biodiversity values of the site if it is included in a biobank through treatment of weed infestations, removal of rubbish from drainage lines and accessible portions of the site and development of vegetation structure and habitat resources.

**Table 23 Vegetation zones, habitat for the affected threatened biota and estimated biodiversity credits at the Luddenham biobank (GHD 2014a)**

Vegetation Zone	Veg Type ID	Condition	Area (ha)	EPBC Act Status	TSC Act Status	Area of EPBC Act Cumberland Plain Woodland <sup>1</sup> (ha)	Area of poorer quality Cumberland Plain Woodland (ha) <sup>2</sup>	Area of Habitat for Grey-headed Flying fox <sup>3</sup> (ha)	Estimated biodiversity credits <sup>4</sup>
Forest Red Gum - Rough-barked Apple grassy woodland (Moderate/good – medium)	HN526	Moderate/good – medium	20.46		EEC	0		20.46	143
Forest Red Gum - Rough-barked Apple grassy woodland (Moderate/good – poor)	HN526	Moderate/good – poor	9.26		EEC	0		9.26	65
Forest Red Gum - Rough-barked Apple grassy woodland (Low)	HN526	Low	5.38			0		0	38
Grey Box - Forest Red Gum grassy woodland on shale (Moderate/good – high)	HN528	Moderate/good – high	4.14	CEEC	CEEC	4.14		4.14	29
Grey Box - Forest Red Gum grassy woodland on shale (Moderate/good – poor)	HN528	Moderate/good – poor	0.73		CEEC	0	0.73	0.73	5
		<b>Total</b>	<b>39.97</b>			<b>4.14</b>	<b>0.73</b>	<b>34.59</b>	<b>280</b>

Notes: 1) Features >10 per cent native canopy cover and predominantly native understorey in accordance with the conservation advice for the community (DEWHA 2010).

2) Derived native scrub or grassland with <10 per cent native canopy cover and predominantly native understorey that does not comprise EPBC Act Cumberland Plain Woodland in accordance with the conservation advice for the community (DEWHA 2010) and that is linked to biodiversity credits that are available for sale.

3) Comprises critical foraging habitat as defined in the recovery plan for the species (DECCW 2009).

4) Estimate based on a credit generation rate of seven credits per hectare.

## Roper biobank

The 'Roper biobank' offset site is a proposed biobank on a 14 hectare parcel of land owned by DPE at Minchinbury, connected to the Ropes Creek riparian corridor. The site has been subject to a detailed field survey and a preliminary BioBanking assessment but has not yet been set aside for conservation under a BioBanking agreement. The description of the site presented below is based on the information presented in the preliminary BioBanking assessment report for the site (GHD 2015c). As noted for the Durham biobank above, the description of the biodiversity values at the site is unlikely to substantially change but prior to the final delivery of the offset package for the proposed airport the total quantum of offset will be reassessed and adjusted if required.

Close to Ropes Creek, the vegetation is made up of Forest Red Gum - Rough-barked Apple grassy woodland (HN526) in varying condition, including some areas of planted vegetation. Further away from the creek line, the site features Grey Box - Forest Red Gum grassy woodland on shale (HN28). There is a patch of Broad-leaved Ironbark - Grey Box - *Melaleuca decora* grassy open forest (HN512) associated with an area of shale/gravel soil on slightly higher ground.

Only vegetation zones which qualify as the EPBC Act listed form of Cumberland Plain Woodland and/or Grey-headed Flying-fox habitat would be included in this offset package (specifically only vegetation zones with native over storey cover greater than 10 per cent). At this site 'Moderate/good – poor' condition vegetation comprises planted or regrowth vegetation with moderate native over storey cover that contains foraging resources for the Grey-headed Flying Fox as well as comprising poorer quality Cumberland Plain Woodland. Vegetation zones and habitat for the affected threatened biota at the Roper biobank site are presented in Table 15. Matching biodiversity credits from all vegetation zones, including Low condition vegetation, would be suitable for offsetting impacts on the environment..

One threatened fauna species was recorded at the biobank site during field surveys: the Little Eagle. Two threatened flora species are present at the site: *Grevillea juniperina* subsp. *juniperina* and *Dilwynia tenuifolia*.

There are several cleared areas within the site with abandoned buildings and exotic gardens and farm infrastructure. There are also several paddocks that appear to have been used for intensive grazing in the past within these cleared areas.

There is evidence of bush regeneration activities across the site, with some areas of revegetation as well as the presence of silt fences that appear to have been placed in an attempt to protect revegetated areas from grazing by feral herbivores such as rabbits.

There is considerable scope to improve the biodiversity values of the site if it is included in a biobank through treatment of weed infestations, removal of rubbish from drainage lines and unsecured parts of the site (i.e. in areas that are accessible by members of the public such as those lacking secured gates or fences) and development of vegetation structure and habitat resources.

**Table 24 Vegetation zones, habitat for the affected threatened biota and estimated biodiversity credits at the Roper biobank (GHD 2014a)**

Vegetation Zone	Veg Type ID	Condition	Area (ha)	EPBC Act Status	TSC Act Status	Area of EPBC Act Cumberland Plain Woodland <sup>1</sup> (ha)	Area of poorer quality Cumberland Plain Woodland (ha)	Area of Habitat for Grey-headed Flying fox <sup>2</sup> (ha)	Estimated biodiversity credits <sup>4</sup>
Forest Red Gum - Rough-barked Apple grassy woodland (Moderate/good – medium)	HN526	Moderate/ good – medium	0.98		EEC	0		0.98	7
Forest Red Gum - Rough-barked Apple grassy woodland (Moderate/good – poor)	HN526	Moderate/ good – poor	1.05		EEC	0		1.05	7
Forest Red Gum - Rough-barked Apple grassy woodland (Low)	HN526	Low	0.87			0		0	6
Grey Box - Forest Red Gum grassy woodland on shale (Moderate/good – poor)	HN528	Moderate/ good – poor	1.65		CEEC	0	1.65	1.65	12
Grey Box - Forest Red Gum grassy woodland on shale (Low)	HN528	Low	5.22		CEEC	0		0	37
Broad-leaved Ironbark - Grey Box - <i>Melaleuca decora</i> grassy open forest (Moderate/good – medium)	HN512	Moderate/ good – medium	3.04	CEEC	CEEC	3.04		3.04	21
Broad-leaved Ironbark - Grey Box - <i>Melaleuca decora</i> grassy open forest (Low)	HN512	Low	0.47		CEEC	0		0	3
		<b>Total</b>	<b>13.28</b>			<b>3.04</b>	<b>1.65</b>	<b>6.72</b>	<b>93</b>

Notes: 1) Features >10 per cent native canopy cover and predominantly native understorey in accordance with the conservation advice for the community (DEWHA 2010). 2) Derived native scrub or grassland with <10 per cent native canopy cover and predominantly native understorey that does not comprise EPBC Act Cumberland Plain Woodland in accordance with the conservation advice for the community (DEWHA 2010) and that is linked to biodiversity credits that are available for sale. 3) Comprises critical foraging habitat as defined in the recovery plan for the species (DECCW 2009). 4) Estimate based on a credit generation rate of seven credits per hectare.



## Caddens biobank

The 'Caddens biobank' offset site is a proposed biobank on a 36 hectare parcel of land owned by DPE at Claremont Meadows, connected to the South Creek riparian corridor. The site has been subject to a detailed field survey and a preliminary BioBanking assessment but has not yet been set aside for conservation under a BioBanking agreement. The description of the site presented below is based on the information presented in the preliminary BioBanking assessment report for the site (GHD 2015c). As noted for the Durham biobank above, the description of the biodiversity values at the site is unlikely to substantially change but prior to the final delivery of the offset package for the proposed airport the total quantum of offset will be reassessed and adjusted if required.

The site includes Grey Box - Forest Red Gum grassy woodland on shale (HN528) in varying conditions on higher ground and Forest Red Gum - Rough-barked Apple grassy woodland (HN526) on alluvial flats. Much of the Forest Red Gum - Rough-barked Apple grassy woodland is subject to very severe Privet (*Ligustrum* species) infestation and would require relatively intense and expensive management.

The biobank site includes vegetation zones which qualify as the EPBC Act listed form of Cumberland Plain Woodland and Grey-headed Flying-fox habitat (specifically only vegetation zones with native over storey cover greater than 10 per cent). There are also areas of poorer quality Cumberland Plain Woodland vegetation that comprises derived native grassland or planted or regrowth vegetation which could be managed to improve in quality and become EPBC Act Cumberland Plain Woodland. These areas of planted or regrowth vegetation have moderate mid and over storey cover that contains contain foraging resources for the Grey-headed Flying Fox. Vegetation zones and habitat for the affected threatened biota at the Caddens biobank site are presented in Table 25. Matching biodiversity credits from all vegetation zones, including Low condition vegetation, would be suitable for offsetting impacts on the environment..

There are also substantial freshwater wetlands in the site that would have considerable fauna habitat value, including for a potential population of the Green and Golden Bell Frog (*Litoria aurea*). The Green and Golden Bell Frog has been recorded in the vicinity of the site (OEH 2015d).

There is considerable scope to improve the biodiversity values of the site if it is included in a biobank through treatment of weed infestations, removal of rubbish from drainage lines and development of vegetation structure and habitat resources.

**Table 25 Vegetation zones, habitat for the affected threatened biota and estimated biodiversity credits at the Caddens biobank (GHD 2014a)**

Vegetation Zone	Veg Type ID	Condition	Area (ha)	EPBC Act Status	TSC Act Status	Area of EPBC Act Cumberland Plain Woodland <sup>1</sup> (ha)	Area of poorer quality Cumberland Plain Woodland (ha) <sup>2</sup>	Area of Habitat for Grey-headed Flying fox <sup>3</sup> (ha)	Estimated biodiversity credits <sup>4</sup>
Forest Red Gum - Rough-barked Apple grassy woodland (Moderate/good – medium)	HN526	Moderate/good – medium	6.35		EEC	0		6.35	44
Forest Red Gum - Rough-barked Apple grassy woodland (Moderate/good – poor)	HN526	Moderate/good – poor	6.19		EEC	0		6.19	43
Forest Red Gum - Rough-barked Apple grassy woodland (Low)	HN526	Low	13.28			0		0	93
<i>Phragmites australis</i> and <i>Typha orientalis</i> coastal freshwater wetlands (Moderate/good condition)	HN630	Moderate/good condition	0.71			0		0	5
Grey Box - Forest Red Gum grassy woodland on shale (Moderate/good – high)	HN528	Moderate/good – high	4.75	CEEC	CEEC	4.75		4.75	33
Grey Box - Forest Red Gum grassy woodland on shale (Moderate/good – poor)	HN528	Moderate/good – poor	1.17		CEEC	0	1.17	0	8
Grey Box - Forest Red Gum grassy woodland on shale (Low)	HN528	Low	0.85			0		0	6
		<b>Total</b>	<b>33.3</b>			<b>4.75</b>	<b>1.17</b>	<b>17.29</b>	<b>233</b>

Notes: 1) Features >10 per cent native canopy cover and predominantly native understorey in accordance with the conservation advice for the community (DEWHA 2010).

2) Derived native scrub or grassland with <10 per cent native canopy cover and predominantly native understorey that does not comprise EPBC Act Cumberland Plain Woodland in accordance with the conservation advice for the community (DEWHA 2010) and that is linked to biodiversity credits that are available for sale.

3) Comprises critical foraging habitat as defined in the recovery plan for the species (DECCW 2009).

4) Estimate based on a credit generation rate of seven credits per hectare.

## Dunheved biobank

The 'Dunheved biobank' offset site is a proposed biobank on a 90 hectare parcel of land owned by DPE at Werrington County, connected to the South Creek riparian corridor. The site has been subject to a detailed field survey and a preliminary BioBanking assessment but has not yet been set aside for conservation under a BioBanking agreement. The description of the site presented below is based on the information presented in the preliminary BioBanking assessment report for the site (GHD 2015c). As noted for the Durham biobank above, the description of the biodiversity values at the site is unlikely to substantially change but prior to the final delivery of the offset package for the proposed airport the total quantum of offset will be reassessed and adjusted if required.

The majority of the site contains Forest Red Gum - Rough-barked Apple grassy woodland (HN526) on alluvial flats. There are some patches of Grey Box - Forest Red Gum grassy woodland on shale (HN528) along the western boundary and in the central portion of the site.

The biobank site includes vegetation zones which qualify as the EPBC Act listed form of Cumberland Plain Woodland, and Grey-headed Flying-fox habitat (specifically only vegetation zones with native over storey cover greater than 10 per cent). There are also areas of poorer quality Cumberland Plain Woodland that comprises derived native grassland or scrub which could be managed to improve in quality and become EPBC Act Cumberland Plain Woodland. These areas do not contain foraging resources for the Grey-headed Flying Fox. Vegetation zones and habitat for the affected threatened biota at the Dunheved biobank site are presented in Table 26. Matching biodiversity credits from all vegetation zones, including Low condition vegetation, would be suitable for offsetting impacts on the environment..

Around 100 individual *Pultenaea parviflora* were recorded at the site (GHD 2014a). These could generate species credits that would offset the proposed airport's impacts on this species as calculated with the BioBanking methodology for major projects (see Section 3.3 )

There are substantial freshwater wetlands in the site that would have considerable fauna habitat value, including for a potential population of the Green and Golden Bell Frog (*Litoria aurea*). The Green and Golden Bell Frog has been recorded in the vicinity of the site (OEH 2015a).

There is considerable scope to improve the biodiversity values of the site if it is included in a biobank through treatment of weed infestations, removal of rubbish from drainage lines and development of vegetation structure and habitat resources.

**Table 26 Vegetation zones, habitat for the affected threatened biota and estimated biodiversity credits at the Dunheved biobank (GHD 2014a)**

Vegetation Zone	Veg Type ID	Condition	Area (ha)	EPBC Act Status	TSC Act Status	Area of EPBC Act Cumberland Plain Woodland <sup>1</sup> (ha)	Area of poorer quality Cumberland Plain Woodland <sup>2</sup> (ha)	Area of Habitat for Grey-headed Flying fox <sup>3</sup> (ha)	Estimated biodiversity credits <sup>4</sup>
Forest Red Gum - Rough-barked Apple grassy woodland (Moderate/ good – medium)	HN526	Moderate/ good – medium	19.18		EEC	0		19.18	134
Forest Red Gum - Rough-barked Apple grassy woodland (Moderate/ good – poor)	HN526	Moderate/ good – poor	6.84		EEC	0	0	0	48
Forest Red Gum - Rough-barked Apple grassy woodland (Low)	HN526	Low	25.64			0		0	179
Grey Box - Forest Red Gum grassy woodland on shale (Moderate/ good – high)	HN528	Moderate/ good – high	3.82	CEEC	CEEC	3.82		3.82	27
Grey Box - Forest Red Gum grassy woodland on shale (Moderate/ good – poor)	HN528	Moderate/ good – poor	8.67		CEEC	0	8.67	0	61
Grey Box - Forest Red Gum grassy woodland on shale (Low)	HN528	Low	0.86		CEEC	0		0	6
		<b>Total</b>	<b>65.01</b>			<b>3.82</b>	<b>8.67</b>	<b>23</b>	<b>455</b>

Notes: 1) Features >10 per cent native canopy cover and predominantly native understorey in accordance with the conservation advice for the community (DEWHA 2010).

2) Derived native scrub or grassland with <10 per cent native canopy cover and predominantly native understorey that does not comprise EPBC Act Cumberland Plain Woodland in accordance with the conservation advice for the community (DEWHA 2010) and that is linked to biodiversity credits that are available for sale.

3) Comprises critical foraging habitat as defined in the recovery plan for the species (DECCW 2009).

4) Estimate based on a credit generation rate of seven credits per hectare.



## Stage 1 Montpellier Biobank

The 'Stage 1 Montpellier Biobank' offset site is a proposed biobank that has been subject to a detailed field survey and BioBanking assessment and is currently awaiting issue of a BioBanking agreement from OEH (GHD, 2015d).

The proposed biobank is located around five kilometres south of village of The Oaks within the Wollondilly LGA. It falls within the Hawkesbury Nepean Catchment Management Authority CMA region, and within the Sydney Basin Bioregion. The biobank is currently zoned RU2 Rural Landscape under the *Wollondilly Local Environment Plan 2011*.

Field surveys confirmed the presence and distribution of four NSW vegetation types at the biobank. The stands of these vegetation types are in varying condition (according to the BBAM) and were split into broad condition classes yielding six vegetation zones.

The distribution of vegetation zones at the biobank is mainly tied to geomorphic position. More exposed slopes and ridges support Grey Box – Forest Red Gum grassy woodland (HN529). There are occurrences of Grey Box – Forest Red Gum grassy woodland on shale (HN528) on lower undulating slopes and flatter areas of the site. Moderate/good- medium condition patches of these vegetation types comprise an occurrence of the EPBC Act form of Cumberland Plain Woodland.

This vegetation type grades into Forest Red Gum – Grey Box shrubby woodland (HN524) in steeper or more sheltered areas, which is distinguished from adjoining grassy woodlands on shale by the presence of a denser shrub layer and mesic understorey species. These vegetation types give way to Grey Myrtle dry rainforest (HN538) on sheltered alluvial flats and in narrow gullies. Each of these vegetation types have been cleared, grazed and subject to weed infestation to varying degrees with areas of Moderate/good- medium, Moderate/good – poor and low condition vegetation. Moderate/good- medium condition patches of all vegetation types at the site contain a canopy of *Eucalyptus* and other species in the blossom diet of the Grey-headed Flying-fox (Eby and Law 2008) and comprise critical habitat for the species (DEWHA 2010).

There are moderate to severe infestations of noxious weeds, such as Lantana (*Lantana camara*) and Blackberry (*Rubus fruticosus* spp. agg.) across much of the site. These two species form a dense midstorey in many parts of the site. Other noxious weeds present on site in lower numbers include African Olive (*Olea europaea* subsp. *cuspidata*), Small-leaved Privet (*Ligustrum sinense*), Fireweed (*Senecio madagascariensis*), African Boxthorn (*Lycium ferocissimum*), Bridal Creeper (*Asparagus asparagoides*), Green Cestrum (*Cestrum parqui*), Moth Vine (*Araujia sericifera*) and Prickly Pear (*Opuntia stricta*).

The biobank site includes vegetation zones which qualify as the EPBC Act listed form of Cumberland Plain Woodland, and Grey-headed Flying-fox habitat (specifically only vegetation zones with native over storey cover greater than 10 per cent). There are also areas of poorer quality Cumberland Plain Woodland that comprises derived grassland or scrub which could be managed to improve in quality and become EPBC Act Cumberland Plain Woodland. These areas have minimal canopy cover and contain minimal foraging resources for the Grey-headed Flying Fox. Vegetation zones and habitat for the affected threatened biota at the Stage 1 Montpellier biobank site are presented in Table 27. Matching biodiversity credits from all vegetation zones, including Low condition vegetation, would be suitable for offsetting impacts on the environment.

Much of the site has been grazed and canopy vegetation has been extensively cleared or thinned historically. Mid-storey vegetation has since re-established across the majority of the biobank though there are very few over storey species in areas of poor or low condition vegetation. There are mature hollow-bearing trees in low to moderate densities throughout areas of Moderate/good – medium condition vegetation at the biobank. There are no hollow-bearing trees within areas of poor or low

condition vegetation. There is considerable scope to improve the biodiversity values of the site through treatment of weed infestations and development of vegetation structure and habitat resources.

One threatened fauna species was recorded at the biobank site during field surveys: the Little Eagle.

**Table 27 Vegetation zones, habitat for the affected threatened biota and available biodiversity credits at the Stage 1 Montpelier biobank (GHD 2015d)**

Vegetation Zone	Veg Type ID	Condition	Area (ha)	EPBC Act Status	TSC Act Status	Area of EPBC Act Cumberland Plain Woodland <sup>1</sup> (ha)	Area of poorer quality Cumberland Plain Woodland <sup>2</sup> (ha)	Area of Habitat for Grey-headed Flying fox <sup>3</sup> (ha)	Available biodiversity credits
Grey Box - Forest Red Gum grassy woodland on shale (Moderate/good – medium)	HN529	Moderate/good - medium	16.83	CEEC	CEEC	16.83		16.83	191
Grey Box - Forest Red Gum grassy woodland on shale (Low)	HN529	Low	10.67			0		0	121
Grey Box - Forest Red Gum grassy woodland on shale (Moderate/good – poor)	HN529	Moderate/good - poor	11.38		CEEC	0	11.38	0	129
Forest Red Gum - Grey Box shrubby woodland (Moderate/good – medium)	HN524	Moderate/good - medium	17.27	CEEC	EEC	17.27		17.27	153
Grey Myrtle dry rainforest	HN538	Moderate/good	6.78	CEEC	EEC	0		6.78	73
Grey Box - Forest Red Gum grassy woodland on flats (Low)	HN528	Low	13.31			0		0	119
		<b>Total</b>	<b>76.24</b>			<b>34.1</b>	<b>11.38</b>	<b>40.88</b>	<b>787</b>

Notes: 1) Features >10 per cent native canopy cover and predominantly native understorey in accordance with the conservation advice for the community (DEWHA 2010).

2) Derived native scrub or grassland with <10 per cent native canopy cover and predominantly native understorey that does not comprise EPBC Act Cumberland Plain Woodland in accordance with the conservation advice for the community (DEWHA 2010) and that is linked to biodiversity credits that are available for sale.

3) Comprises critical foraging habitat as defined in the recovery plan for the species (DECCW 2009).

## Stage 2 Montpelier Biobank

The 'Stage 2 Montpelier Biobank' offset site is a proposed biobank that has been subject to a preliminary field survey and BioBanking assessment and will be subject to a detailed BioBanking assessment as part of an application to OEH for a Biobanking agreement (GHD in prep.). The description of the site presented below is based on the information presented in the preliminary BioBanking assessment report for the site (GHD in prep.). As noted for similar sites above, the description of the biodiversity values at the site is unlikely to substantially change but prior to the final delivery of the offset package for the proposed airport the total quantum of offset will be reassessed and adjusted if required.

The proposed biobank is located immediately adjacent to the stage 1 Montpelier biobank described above. The biobank is currently zoned RU2 Rural Landscape under the *Wollondilly Local Environment Plan 2011*.

Field surveys confirmed the presence and distribution of three NSW vegetation types at the biobank. The stands of these vegetation types are in varying condition (according to the BBAM) and were split into broad condition classes yielding five vegetation zones.

The distribution of vegetation zones at the biobank is mainly tied to geomorphic position. More exposed slopes and ridges support Grey Box – Forest Red Gum grassy woodland (HN529). Moderate/good- medium condition patches of this vegetation type comprise an occurrence of the EPBC Act form of Cumberland Plain Woodland. This vegetation type grades into Forest Red Gum – Grey Box shrubby woodland (HN524) in steeper or more sheltered areas. These vegetation types give way to Grey Myrtle dry rainforest (HN538) in narrow gullies. Each of these vegetation types have been cleared, grazed and subject to weed infestation to varying degrees with areas of Moderate/good-medium, Moderate/good – poor and Low condition vegetation. Moderate/good- medium condition patches of all vegetation types at the site contain a canopy of *Eucalyptus* and other species in the blossom diet of the Grey-headed Flying-fox (Eby and Law 2008) and comprise critical habitat for the species (DEWHA 2010).

There are moderate to severe infestations of noxious weeds, such as Lantana, Blackberry and especially African Olive which form a dense mid storey in many parts of the site. Other noxious weeds present on site include Privet (*Ligustrum* species), Fireweed (*Senecio madagascariensis*), Bridal Creeper (*Asparagus asparagoides*), Green Cestrum (*Cestrum parqui*) and Moth Vine (*Araujia sericifera*).

The biobank site includes vegetation zones which qualify as the EPBC Act listed form of Cumberland Plain Woodland, and Grey-headed Flying-fox habitat (specifically only vegetation zones with native over storey cover greater than 10 per cent). There are also areas of poorer quality Cumberland Plain Woodland that comprises derived grassland or scrub with minimal canopy cover that does not qualify as Cumberland Plain Woodland but which could be managed to improve in quality and become EPBC Act Cumberland Plain Woodland. These areas contain minimal foraging resources for the Grey-headed Flying Fox. Vegetation zones and habitat for the affected threatened biota at the Stage 2 Montpelier biobank site are presented in



Table 28. Matching biodiversity credits from all vegetation zones, including Low condition vegetation, would be suitable for offsetting impacts on the environment..

There is considerable scope to improve the biodiversity values of the site through treatment of weed infestations and development of vegetation structure and habitat resources.

One threatened fauna species was recorded at the biobank site during field surveys: the Little Eagle.

**Table 28 Vegetation zones, habitat for the affected threatened biota and estimated biodiversity credits at the Stage 2 Montpelier biobank (GHD in prep.)**

Vegetation Zone	Veg Type ID	Condition	Area (ha)	EPBC Act Status	TSC Act Status	Area of EPBC Act Cumberland Plain Woodland <sup>1</sup> (ha)	Area of poorer quality Cumberland Plain Woodland (ha) <sup>2</sup>	Area of Habitat for Grey-headed Flying fox <sup>3</sup> (ha)	Estimated biodiversity credits <sup>4</sup>
Grey Box - Forest Red Gum grassy woodland on shale (Moderate/good – medium)	HN529	Moderate/good - medium	20.9	CEEC	CEEC	20.9		20.9	146
Grey Box - Forest Red Gum grassy woodland on shale (Low)	HN529	Low	21.8						153
Grey Box - Forest Red Gum grassy woodland on shale (Moderate/good – poor)	HN529	Moderate/good - poor	9.2		CEEC		9.2		64
Forest Red Gum - Grey Box shrubby woodland (Moderate/good – medium)	HN524	Moderate/good - medium	16.9	CEEC	EEC			16.9	118
Grey Myrtle dry rainforest	HN538	Moderate/good	10.7	CEEC	EEC			10.7	75
		<b>Total</b>	<b>79.5</b>			<b>20.9</b>	<b>9.2</b>	<b>48.5</b>	<b>557</b>

Notes: 1) Features >10 per cent native canopy cover and predominantly native understorey in accordance with the conservation advice for the community (DEWHA 2010).

2) Derived native scrub or grassland with <10 per cent native canopy cover and predominantly native understorey that does not comprise EPBC Act Cumberland Plain Woodland in accordance with the conservation advice for the community (DEWHA 2010) and that is linked to biodiversity credits that are available for sale.

3) Comprises critical foraging habitat as defined in the recovery plan for the species (DECCW 2009).

4) Estimate based on a credit generation rate of seven credits per hectare.

## Menangle Road Biobank

The 'Menangle Road biobank' offset site is a proposed biobank on privately owned land that has been subject to a detailed field survey and BioBanking assessment will be included in an application for a BioBanking agreement from OEH. The site has been subject to a detailed field survey and a preliminary BioBanking assessment but has not yet been set aside for conservation under a BioBanking agreement. The description of the site presented below is based on the information presented in the BioBanking assessment report for the site (GHD 2015e).

The remaining steps involved with finalising the BioBanking assessment include definition of site boundaries, BioBanking credit calculations and preparation of a MAP. As discussed for similar proposed biobanks above, the description of the biodiversity values at the site that is included below is unlikely to substantially change but will be reassessed prior to the final delivery of the offset package for the proposed airport and the total quantum of offset will be adjusted if required.

The proposed biobank is located on around 57 hectares of land about 3.6 kilometres south-east of Picton within the Wollondilly LGA. It falls within the Hawkesbury Nepean CMA region, and within the Sydney Basin Bioregion. The biobank is currently zoned RU2 Rural Landscape under the *Wollondilly Local Environment Plan 2011*.

Field surveys confirmed the presence and distribution of four NSW vegetation types at the biobank. The stands of these vegetation types are in varying condition (according to the BBAM) and were split into broad condition classes yielding eight vegetation zones.

The distribution of vegetation zones at the biobank is mainly tied to geomorphic position. More exposed slopes and ridges support Grey Box – Forest Red Gum grassy woodland (HN529). This vegetation type grades into Forest Red Gum – Grey Box shrubby woodland (HN524) in steeper, south facing and more sheltered areas, which is distinguished from adjoining grassy woodlands on shale by the presence of a denser shrub layer and mesic understorey species. There is a small isolated patch of Grey Myrtle dry rainforest (HN538) on a sheltered alluvial slope and linear strips of Forest Red Gum - Rough-barked Apple grassy woodland (HN526) associated with drainage lines. Each of these vegetation types have been cleared, grazed and subject to weed infestation to varying degrees with areas of moderate/good and moderate/good – poor condition vegetation.

There are moderate infestations of noxious weeds, such as African Olive (*Olea europaea* subsp. *cuspidata*) and Blackberry (*Rubus fruticosus* spp. agg.) across sections of the site. Other weeds present on site in lower numbers include Lantana (*Lantana camara*), Small-leaved Privet (*Ligustrum sinense*), Fireweed (*Senecio madagascariensis*), African Boxthorn (*Lycium ferocissimum*), Bridal Creeper (*Asparagus asparagoides*), Green Cestrum (*Cestrum parqui*), Moth Vine (*Araujia sericifera*) and Prickly Pear (*Opuntia stricta*).

Portions of the site have been grazed and canopy vegetation has been extensively cleared or thinned historically. Much of the biobank is now covered with native vegetation, with areas of 'low' condition (namely those that lack a native understorey, midstorey or canopy) being excluded from the site. Mid-storey vegetation has established across the majority of the biobank though there are very few over storey species in areas of poor condition vegetation. There are mature hollow-bearing trees in low densities throughout areas of moderate/good condition vegetation at the biobank. There are no hollow-bearing trees within areas of poor condition vegetation.

The biobank site includes vegetation zones which qualify as the EPBC Act listed form of Cumberland Plain Woodland, and Grey-headed Flying-fox habitat (specifically only vegetation zones with native over storey cover greater than 10 per cent). There are also areas of poorer quality Cumberland Plain Woodland that comprises derived grassland but which could be managed to improve in quality and become EPBC Act Cumberland Plain Woodland. These areas have minimal canopy cover and do not

contain foraging resources for the Grey-headed Flying Fox. Vegetation zones and habitat for the affected threatened biota at the Stage 1 Montpelier biobank site are presented in Table 29. Matching biodiversity credits from all vegetation zones, including Low condition vegetation, would be suitable for offsetting impacts on the environment.



**Table 29 Vegetation zones, habitat for the affected threatened biota and available biodiversity credits at the Menangle Road biobank (GHD 2015e)**

Vegetation Zone	Veg Type ID	Condition	Area (ha)	EPBC Act Status	TSC Act Status	Area of EPBC Act Cumberland Plain Woodland <sup>1</sup> (ha)	Area of poorer quality Cumberland Plain Woodland <sup>2</sup> (ha)	Area of Habitat for Grey-headed Flying fox <sup>3</sup> (ha)	Available biodiversity credits
Forest Red Gum - Grey Box shrubby woodland	HN524	Moderate/good	3.44	CEEC	EEC	0		3.44	29
Forest Red Gum - Rough-barked Apple grassy woodland	HN526	Moderate/good	5.01		EEC	0		5.01	36
Grey Box - Forest Red Gum grassy woodland on shale	HN529	Moderate/good	26.96	CEEC	CEEC	26.96		26.96	255
Grey Box - Forest Red Gum grassy woodland on shale (poor)	HN529	Moderate/good - poor	21.08		CEEC	0	21.08	0	199
Grey Myrtle dry rainforest	HN538	Moderate/good	0.58	CEEC	EEC	0		0.58	6
		<b>Total</b>	<b>57.07</b>			<b>26.96</b>	<b>21.08</b>	<b>35.99</b>	<b>525</b>

Notes: 1) Features >10 per cent native canopy cover and predominantly native understorey in accordance with the conservation advice for the community (DEWHA 2010).

2) Derived native scrub or grassland with <10 per cent native canopy cover and predominantly native understorey that does not comprise EPBC Act Cumberland Plain Woodland in accordance with the conservation advice for the community (DEWHA 2010) and that is linked to biodiversity credits that are available for sale.

3) Comprises critical foraging habitat as defined in the recovery plan for the species (DECCW 2009).

## **Bruelle biobank**

The 'Bruelle biobank' offset site is a proposed biobank on privately owned land that has been subject to a detailed field survey and BioBanking assessment and has already been set aside for conservation under a BioBanking agreement. The site has been subject to a detailed field survey and a preliminary BioBanking assessment but has not yet been set aside for conservation under a BioBanking agreement. The description of the site presented below is based on the information presented in the BioBanking assessment report for the site (GHD 2015f). The remaining steps involved with finalising the BioBanking assessment include definition of site boundaries, BioBanking credit calculations and preparation of a MAP. As discussed for similar proposed biobanks above, the description of the biodiversity values at the site that is included below is unlikely to substantially change but will be reassessed prior to the final delivery of the offset package for the proposed airport and the total quantum of offset will be adjusted if required.

The Bruelle biobank includes 28 hectares of land and is located at Mulgoa within Penrith LGA. It falls within the Hawkesbury Nepean CMA region and within the Sydney Basin Bioregion. The biobank is currently zoned E2 Environmental Conservation under the *Penrith City Council Local Environment Plan 2010* and was grazed by cattle prior to being set aside as a biobank.

The Bruelle biobank is bound to the west by the Notre Dame estate and to the north, east and south by rural residential adjoining properties. The biobank site is approximately 1 km to the east of the Nepean River and lies on the northern edge of the village of Mulgoa and approximately 10 km south of Penrith town centre.

There are four NSW vegetation types at the biobank. The biobank site comprises undulating hills on shale substrate which are dissected by a deeply incised gully that exposes the underlying lithic sandstone substrate. The ridge and upper slopes of this gully support Red Bloodwood - Grey Gum woodland (HN564), which is dominated by Grey Gum (*Eucalyptus punctata*) and Smooth-barked Apple (*Angophora costata*). HN564 transitions into Grey Myrtle dry rainforest (HN538) at lower elevations, where the gully becomes steeper and more sheltered. HN538 is dominated by Grey Myrtle (*Backhousia myrtifolia*) and Rusty Fig (*Ficus rubiginosa*).

The slopes of the north east and southern extents of the site feature Grey Box - Forest Red Gum grassy woodland (HN529), which comprises an occurrence of Cumberland Plain Woodland. HN529 features a canopy of Forest Red Gum) and Narrow-leaved Ironbark. The mid-slopes that occupy the central region of the site are influenced by the shale derived soils above the lithic sandstone substrate. Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest (HN556) dominates this area and displays a canopy of Narrow-leaved Ironbark, Grey Gum and Forest Red Gum. This vegetation type is an occurrence of Shale/Sandstone Transition Forest, which is listed as an EEC under the TSC Act and EPBC Act.

The biobank site includes vegetation zones which qualify as the EPBC Act listed form of Cumberland Plain Woodland, and Grey-headed Flying-fox habitat (specifically only vegetation zones with native over storey cover greater than 10 per cent). Vegetation zones and habitat for the affected threatened biota at the Stage 1 Bruelle biobank site are presented in Table 30. Matching biodiversity credits from all vegetation zones would be suitable for offsetting impacts on the environment.

**Table 30 Vegetation zones, habitat for the affected threatened biota and available biodiversity credits at the Bruelle biobank (GHD 2015f)**

Vegetation Zone	Veg Type ID	Condition	Area (ha)	EPBC Act Status	TSC Act Status	Area of EPBC Act Cumberland Plain Woodland <sup>1</sup> (ha)	Area of poorer quality Cumberland Plain Woodland (ha)	Area of Habitat for Grey-headed Flying fox <sup>2</sup> (ha)	Available biodiversity credits
Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest	HN556	Moderate/ good	11.6	CEEC	EEC	0	0	11.6	129
Grey Box - Forest Red Gum grassy woodland on shale	HN529	Moderate/ good	14.4	CEEC	CEEC	14.4	0	14.4	141
Red Bloodwood - Grey Gum woodland	HN564	Moderate/ good	1.2			0	0	1.2	10
Grey Myrtle dry rainforest	HN538	Moderate/ good	0.3			0	0	0.3	3
		<b>Total</b>	<b>27.5</b>			<b>14.4</b>	<b>0</b>	<b>27.5</b>	<b>283</b>

Notes: 1) Features >10 per cent native canopy cover and predominantly native understorey in accordance with the conservation advice for the community (DEWHA 2010).

2) Comprises critical foraging habitat as defined in the recovery plan for the species (DECCW 2009).

## **Appendix B** – BioBanking Credit Calculations



## Assessment of geographic / habitat features

Impact?¹	Common name	Scientific name	Feature
<input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/>	Cumberland Plain Land Snail	<i>Meridolum corneovirens</i>	land containing bark or leaf litter accumulation
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	Large-eared Pied Bat	<i>Chalinolobus dwyeri</i>	land containing escarpments, cliffs, caves, deep crevices, old mine shafts or tunnels
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	Matted Bush-pea	<i>Pultenaea pedunculata</i>	land within 5 km of coast in South East Coastal Plains CMA subregion
<input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/>	Camden White Gum	<i>Eucalyptus benthamii</i>	alluvial soils
<input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/>	Green and Golden Bell Frog	<i>Litoria aurea</i>	land within 100 m of emergent aquatic or riparian vegetation
<input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/>	<i>Hypsela sessiliflora</i>	<i>Hypsela sessiliflora</i>	Wet and damp areas only.
<input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/>	<i>Wahlenbergia multicaulis</i> (Tadgells Bluebell) population, Auburn, Bankstown, Baulkham Hills, Canterbury, Hornsby, Parramatta and Strathfield local government areas	<i>Wahlenbergia multicaulis</i> - endangered population	land situated in damp, disturbed sites
<input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/>	Black Bittern	<i>Ixobrychus flavicollis</i>	land within 40 m of freshwater and estuarine wetlands, in areas of permanent water and dense vegetation or emergent aquatic vegetation
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	Eastern Osprey	<i>Pandion cristatus</i>	land within 40 m of fresh/brackish/saline waters of larger rivers or creeks; estuaries, coastal lagoons, lakes and/or inshore marine waters
<input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/>	Austral Pillwort	<i>Pilularia novae-hollandiae</i>	periodically waterlogged sites (including table drains and farm dams)
<input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/>	Rosenbergs Goanna	<i>Varanus rosenbergi</i>	land within 250 m of termite mounds or rock outcrops
<input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/>	Giant Burrowing Frog	<i>Heleioporus australiacus</i>	land within 40 m of heath, woodland or forest
<input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/>	Comb-crested Jacana	<i>Irediparra gallinacea</i>	land within 40 m of permanent wetlands with a good surface cover of floating vegetation
<input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/>	Australasian Bittern	<i>Botaurus poiciloptilus</i>	land containing brackish or freshwater wetlands

Note: 1) The habitat features are present at the site and would be removed by the proposed development.

### Survey-time matrix for threatened species

Common name	Scientific name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Allocasuarina glaireicola	<i>Allocasuarina glaireicola</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Austral Pillwort	<i>Pilularia novae-hollandiae</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Australasian Bittern	<i>Botaurus poiciloptilus</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bargo Geebung	<i>Persoonia bargoensis</i>	Yes	Yes	Yes	Yes	Yes							Yes
Black Bittern	<i>Ixobrychus flavicollis</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Brown Pomaderris	<i>Pomaderris brunnea</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bynoes Wattle	<i>Acacia bynoeana</i>	Yes	Yes	Yes						Yes	Yes	Yes	Yes
Camden White Gum	<i>Eucalyptus benthamii</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Comb-crested Jacana	<i>Irediparra gallinacea</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cumberland Plain Land Snail	<i>Meridolum corneovirens</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Dillwynia tenuifolia	<i>Dillwynia tenuifolia</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Dillwynia tenuifolia (a shrub) population, Kemps Creek	<i>Dillwynia tenuifolia</i> - endangered population Kemps Creek	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Downy Wattle	<i>Acacia pubescens</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Dwarf Kerrawang	<i>Rulingia prostrata</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Eastern Pygmy-possum	<i>Cercartetus nanus</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Gang-gang Cockatoo population, Hornsby and Ku-ring-gai Local Government Areas	<i>Callocephalon fimbriatum</i> population in the Hornsby and Ku-ring-gai Local Government Areas	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Giant Burrowing Frog	<i>Heleioporus australiacus</i>	Yes	Yes	Yes	Yes	Yes				Yes	Yes	Yes	Yes
Green and Golden Bell Frog	<i>Litoria aurea</i>	Yes	Yes	Yes					Yes	Yes	Yes	Yes	Yes
Gyrostemon thesioides	<i>Gyrostemon thesioides</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Hibbertia sp. Bankstown	<i>Hibbertia</i> sp. Bankstown									Yes	Yes	Yes	Yes
Hypsela sessiliflora	<i>Hypsela sessiliflora</i>									Yes	Yes	Yes	
Juniper-leaved Grevillea	<i>Grevillea juniperina</i> subsp. <i>juniperina</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Koala	<i>Phascolarctos cinereus</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Marsdenia viridiflora subsp. <i>viridiflora</i> in the Bankstown, Blacktown,	<i>Marsdenia viridiflora</i> subsp. <i>viridiflora</i> - endangered population	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Common name	Scientific name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas													
Micromyrtus minutiflora	<i>Micromyrtus minutiflora</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Nodding Geebung	<i>Persoonia nutans</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pimelea curviflora subsp. curviflora	<i>Pimelea curviflora</i> subsp. <i>curviflora</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pultenaea parviflora	<i>Pultenaea parviflora</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Regent Honeyeater	<i>Anthochaera phrygia</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Rosenbergs Goanna	<i>Varanus rosenbergi</i>	Yes	Yes									Yes	Yes
Small-flower Grevillea	<i>Grevillea parviflora</i> subsp. <i>parviflora</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Spiked Rice-flower	<i>Pimelea spicata</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Squirrel Glider	<i>Petaurus norfolcensis</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sydney Plains Greenhood	<i>Pterostylis saxicola</i>									Yes	Yes	Yes	
Tall Knotweed	<i>Persicaria elatior</i>	Yes	Yes	Yes	Yes	Yes							Yes
Wahlenbergia multicaulis (Tadgells Bluebell) population, Auburn, Bankstown, Baulkham Hills, Canterbury, Hornsby, Parramatta and Strathfield local government areas	<i>Wahlenbergia multicaulis</i> - endangered population	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
White-flowered Wax Plant	<i>Cynanchum elegans</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: 'Yes' indicates that targeted surveys for the individual species can be conducted in that month; 'Yes' (i.e. bold type) indicates that targeted surveys for the individual species were conducted in that month as part of the biodiversity assessment.

### Likelihood of occurrence of species credit-type species not targeted by seasonal surveys

Scientific name	Common name	TSC Status	EPBC Status	Habitat association	Desktop assessment results	Habitat present in the study area	Likelihood of occurrence in the airport site	Risk of impact
<i>Hypselia sessiliflora</i> syn. <i>Isotoma sessiliflora</i>		E	X	Currently known from a single location less than 10x15m on the Cumberland Plain in western Sydney. Known to grow in damp places, on the Cumberland Plain, including freshwater wetland, grassland/alluvial woodland and an alluvial woodland/shale plains woodland (Cumberland Plain Woodland) ecotone. May be an early successional species that benefits from some disturbance. Possibly out competed when overgrown by some species such as <i>Cynodon dactylon</i> . Considered extinct under the EPBC Act and may not be a valid taxon (Leonard, G. pers. comm.).	7 records within 10km (OEH 2015a)	Potential habitat present in wetlands and adjoining moist grassland.	Unlikely	Low. Outside of the species known, limited distribution.
<i>Pterostylis saxicola</i>	Sydney Plains Greenhood	E	E	Occurs in western Sydney between Picton and Freemans Reach. Grows in small pockets of shallow soil in depressions on sandstone rock shelves above cliff lines. Associated vegetation above these rock shelves is sclerophyll forest or woodland on shale or shale/sandstone transition soils.	Species or species' habitat likely to occur within 10km (DotE 2015a)	Marginal habitat present. Not previously recorded in the locality.	Unlikely	Low
<i>Varanus rosenbergi</i>	Rosenberg's Goanna	V	-	In NSW mainly occurs on the mid coast region from Wollemi NP to Nowra; the ACT and Goulburn regions and the South-west Slopes. Inhabits coastal heathlands, wet and dry sclerophyll forests, woodlands and mallee communities. Termite mounds are an important habitat feature: eggs are laid in the mounds in summer and incubate till spring, when the young dig themselves out. Young may return to the mound as a refuge for some months, while adults shelter in burrows dug under rocks or logs, or in rock crevices, hollow logs or even rabbit burrows (Sass 2008).	No records within 10km (OEH 2015a)	Broadly suitable habitat present. Not previously recorded in the locality.	Unlikely	Low
<i>Hibbertia</i> sp. Bankstown		CE	CE	Known only from Bankstown airport. Habitat is very heavily modified, lacks canopy species and is currently a low grass/shrub association with many pasture grasses and other introduced herbaceous weeds. Soil at the site is a sandy (Tertiary) alluvium with a high silt content.	No records within 10km (OEH 2015a)	No sandy alluvial soils present. Not previously recorded in the locality.	Unlikely	Low. Outside of the species known, limited distribution.

# Biodiversity credit report



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

Date of report: 21/08/2015

Time: 5:38:33PM

Calculator version: v4.0

## Major Project details

**Proposal ID:** 073/2015/2144MP

**Proposal name:** Western Sydney Airport

**Proposal address:** The airport site Badgerys Creek NSW 2555

**Proponent name:** Western Sydney Unit Department of Infrastructure and Regional Development

**Proponent address:** GPO Box 594 Canberra ACT 2601

**Proponent phone:** 02 6210 6089

**Assessor name:** Ben Harrington

**Assessor address:** Level 15 133 Castlereagh Street Sydney NSW 2000

**Assessor phone:** 02 9239 7189

**Assessor accreditation:** 073



## Summary of ecosystem credits required

Plant Community type	Area (ha)	Credits created
Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion	2.58	181.21
Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	34.05	1,657.41
Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	179.06	6,763.37
Grey Box - Forest Red Gum grassy woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion	39.61	1,398.41
Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion	25.44	700.00
Total	280.74	10,700

## Credit profiles

**1. Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion, (HN526)**

Number of ecosystem credits created	1,657
IBRA sub-region	Cumberland - Hawkesbury/Nepean

Offset options - Plant Community types	Offset options - IBRA sub-regions
Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion, (HN526)  Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion, (HN528)	Cumberland - Hawkesbury/Nepean and any IBRA subregion that adjoins the IBRA subregion in which the development occurs

2. Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion, (HN528)

Number of ecosystem credits created	6,763
IBRA sub-region	Cumberland - Hawkesbury/Nepean

Offset options - Plant Community types	Offset options - IBRA sub-regions
Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion, (HN528)  Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion, (HN526)	Cumberland - Hawkesbury/Nepean and any IBRA subregion that adjoins the IBRA subregion in which the development occurs

3. Grey Box - Forest Red Gum grassy woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion, (HN529)

Number of ecosystem credits created	1,398
IBRA sub-region	Cumberland - Hawkesbury/Nepean

Offset options - Plant Community types	Offset options - IBRA sub-regions
Grey Box - Forest Red Gum grassy woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion, (HN529)  Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion, (HN526)  Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion, (HN528)	Cumberland - Hawkesbury/Nepean  and any IBRA subregion that adjoins the IBRA subregion in which the development occurs

**4. Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion, (HN512)**

Number of ecosystem credits created

181

IBRA sub-region

Cumberland - Hawkesbury/Nepean

Offset options - Plant Community types	Offset options - IBRA sub-regions
<p>Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion, (HN512)</p> <p>Broad-leaved Ironbark - Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion, (HN513)</p> <p>Turpentine - Grey Ironbark open forest on shale in the lower Blue Mountains, Sydney Basin Bioregion, (HN604)</p> <p>Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion, (HN556)</p>	<p>Cumberland - Hawkesbury/Nepean and any IBRA subregion that adjoins the IBRA subregion in which the development occurs</p>



5. *Phragmites australis* and *Typha orientalis* coastal freshwater wetlands of the Sydney Basin Bioregion, (HN630)

Number of ecosystem credits created	700
IBRA sub-region	Cumberland - Hawkesbury/Nepean

Offset options - Plant Community types	Offset options - IBRA sub-regions
<p>Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion, (HN630)</p> <p>Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion, (HN520)</p>	<p>Cumberland - Hawkesbury/Nepean and any IBRA subregion that adjoins the IBRA subregion in which the development occurs</p>

Summary of species credits required

Common name	Scientific name	Extent of impact Ha or individuals	Number of species credits created
Pultenaea parviflora	Pultenaea parviflora	4.00	60
Marsdenia viridiflora subsp. viridiflora in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas	Marsdenia viridiflora subsp. viridiflora - endangered population	93.00	3,720
Cumberland Plain Land Snail	Meridolum corneovirens	120.60	1,568
Black Bittern	Ixobrychus flavicollis	55.30	719
Southern Myotis	Myotis macropus	29.80	656

GHD

133 Castlereagh St Sydney NSW 2000

-

T: +61 2 9239 7100 F: +61 2 9239 7199 E: sydmail@ghd.com.au



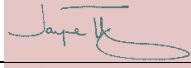
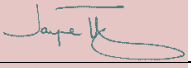




© GHD 2015

This document is and shall remain the property of GHD. The document may only be used for the purpose for which it was commissioned and in accordance with the Terms of Engagement for the commission. Unauthorised use of this document in any form whatsoever is prohibited.

17720677

\\ghdnet\ghd\AU\Sydney\Projects\21\24265\WP\209120.docx

Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	B Harrington	J Tipping		J Tipping		23/7/15
1	B Harrington	J Tipping		J Tipping		28/8/15
2	B Harrington	J Tipping		J Tipping		4/9/15
3	B Harrington	J Tipping		B Harrington		6/10/15

[www.ghd.com](http://www.ghd.com)

