



**Department of Defence**  
Orchard Hills Offset Area  
Offset Plan

June 2022

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# Executive summary

The Department of Defence has set aside 978.83 hectares of land at Defence Establishment Orchard Hills to provide biodiversity offsets for the development of the Western Sydney International (Nancy Bird-Walton) Airport (WSI). This 'Offset Area', comprises 938.48 hectares of managed vegetation and 40.35 hectares of supporting land uses such as tracks and easements. These arrangements have been formalised through a Memorandum of Understanding (MOU) between the Department of Defence (Defence) and the Department of Infrastructure, Transport, Regional Development and Communications (Infrastructure), and align with the requirements of the Airport Plan, and the Biodiversity Offset Delivery Plan for WSI.

Biodiversity offsets are required for significant residual impacts of the development of WSI on:

- certain threatened species and communities listed under the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act) (affected threatened biota); and
- plants, animals and their habitat, including threatened biota listed under the New South Wales (NSW) *Biodiversity Conservation Act 2017* (BC Act).

An Initial Ecological Survey report (GHD 2020) has been prepared to describe the biodiversity values of the Offset Area and the quantum of direct offset associated with its conservation and management.

This Offset Plan provides the framework for the management of the Offset Area by Defence as a direct offset for WSI in order to achieve the following Offset Objectives:

- a. 'Future quality with offset' score that is two (2) greater than the 'Start quality' score that is defined in the Initial Ecological Survey for the area of Cumberland Plain Woodland;
- b. 'Future quality with offset' score that is one (1) greater than the 'Start quality' score that is defined in the Initial Ecological Survey for the area of habitat for the Swift Parrot and Grey-headed Flying-fox in the Offset Area;
- c. 'Future quality with offset' score for the area of poorer quality Cumberland Plain Woodland in the Offset Area that is at least:
  - i) as high as the quality score for the Cumberland Plain Woodland in the Stage 1 Construction Impact Zone (6 out of 10), and
  - ii) two (2) greater than the 'Start quality' score that is defined in the Initial Ecological Survey for the area of poorer quality Cumberland Plain Woodland in the Offset Area.
- d. Site value scores with active restoration and management at least equal to the scores defined in the Initial Ecological Survey to confirm the quantum of offset for plants, animals and their habitat;
- e. Averted risk, management of threats and site context score improvements that would contribute to achieving the Offset Objectives a-d listed above.

This Offset Plan describes the core requirements for delivery of the offsets by Defence, and includes the baseline quality, target quality and the management actions that will be performed across the Offset Area to achieve the Offset Objectives. Management actions include those that are specific to certain habitat types (e.g. installation of habitat resources in woodland; revegetation of derived grasslands) and those that will be applied to alleviate

threats or achieve restoration opportunities across the Offset Area (e.g. management of fire for conservation, control of pest fauna).

Ongoing monitoring of the Offset Area will be required including:

- Continuous monitoring of the implementation of actions to support adaptive management and to demonstrate progress against planned targets;
- Delivery and outcomes of research programs;
- Annual inspection of the Offset Area to inform audits and reporting to Infrastructure;
- Five-yearly validation of performance against Offset Objectives and review and update of the Offset Plan; and
- Completion survey, confirming delivery of the Offset Objectives.

Defence will implement this Offset Plan to achieve the required targets presented throughout this plan at the end of the 20 year period of intensive management (the Offset Improvement Period). Confirmation that the offsets have been delivered will be via a completion survey at the end of the 20 year period. Defence will maintain the Offset Area so as to retain long-term benefits of the quality improvements following implementation of the Offset Plan.

This Offset Plan is subject to, and must be read in conjunction with, the limitations, assumptions and qualifications contained throughout the Report.

# Glossary of terms and acronyms

Term	Definition
Affected threatened biota	Threatened species or communities listed under the EPBC Act, which are likely to suffer a significant impact as a result of a proposal and which require biodiversity offsets having regard to the EPBC Act Offset Policy. In this report it is as defined in the BODP and comprises: <ul style="list-style-type: none"> <li>• Cumberland Plain Woodland</li> <li>• Grey-headed Flying-fox (<i>Pteropus poliocephalus</i>)</li> <li>• Swift Parrot (<i>Lathamus discolor</i>) foraging habitat</li> <li>• Spiked Rice-flower (<i>Pimelea spicata</i>)</li> </ul>
BAM	Biodiversity Assessment Method
BAR	BioBanking Assessment Report
BBAM	The NSW BioBanking Assessment Methodology (OEH 2014).
BC Act	<i>Biodiversity Conservation Act 2017 (NSW)</i>
BCD	Biodiversity Conservation Division of NSW Department of Planning, Industry and Environment, formerly NSW Office of Environment and Heritage (OEH). Note that data maintained by the current BCD appears on the internet as published by OEH and is referenced as such in this report.
BCT	NSW Biodiversity Conservation Trust (BCT, formerly Nature Conservation Trust)
Biodiversity credit	A unit of biodiversity value to measure specific development impacts or conservation gains in accordance with the FBA, the BBAM or the BAM. Includes ecosystem credits or species credits.
Biodiversity credit report	Specifies the number and type of biodiversity credits required to offset the impacts of a Major Project in accordance with the FBA or that would be generated through conservation and management of an offset site under a BioBanking agreement or a BSA.
Biodiversity offset delivery plan (BODP)	The plan prepared to compensate for residual significant impacts associated with Western Sydney International development. The BODP was prepared in accordance with condition 30 of the Airport Plan and approved by the Environment Minister on 25 August 2018.
Biodiversity offsets	Specific measures that are put in place to compensate for impacts on biodiversity values.
Biodiversity Stewardship Agreement (BSA)	An agreement entered into between the landowner and the Minister under Part 5 of the Biodiversity Conservation Act 2016 (BC Act) for establishing a Biodiversity Stewardship Site.
Biodiversity Stewardship Site (BSS)	Land that is designated by a Biodiversity Stewardship Agreement to be a Biodiversity Stewardship Site. Equivalent to the former 'biobank site'.
Biodiversity values	The composition, structure and function of ecosystems, including native species, populations and ecological communities, and their habitats.
BOS	NSW Biodiversity Offset Scheme
BVT	Biometric vegetation type
CEEC	Critically endangered ecological community.
Confidence in result	Means the assessor's estimated percentage confidence in the data entered in the offsets assessment guide that supports the Environmental Offsets Policy.
Defence	The Australian Government Department of Defence, responsible for preparing and implementing this plan.
DoEE	The former Australian Government Department of the Environment and Energy (now Department of Agriculture, Water and the Environment, abbreviated to 'Environment Department').
DPI	The NSW Department of Primary Industries.
DSEWPac	The former Department of Sustainability, Environment, Water, Populations and Communities (now Department of Agriculture, Water and the Environment, abbreviated to '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, FBA and BAM.
EEC	Endangered ecological community
EIS	Environmental Impact Statement
Environment Department	The Australian Government Department of Agriculture, Water and the Environment, formerly the Department of the Environment and Energy. The Department responsible for the EPBC Act.
EPBC Act	The Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i> (Cth)
EPBC Act-listed biota	Threatened species and communities and migratory species listed under the EPBC Act.
FBA	The Framework for Biodiversity Assessment (OEH 2014a). The methodology to assess impacts on biodiversity that is used to assess all biodiversity values on the development site for a Major Project under the NSW <i>Environmental Planning and Assessment Act 1979</i> (EPA Act) and in accordance with The NSW Biodiversity Offsets Policy for Major Projects (OEH 2014a).

Term	Definition
Food tree	A tree species that is recognised as being of value as a foraging resource for a given fauna species.
GIS	Geographic information systems
Habitat tree	A tree that is recognised as being of value as a shelter, roosting and/or nesting resource for fauna species. Includes hollow-bearing trees, snags (standing dead trees) and trees with nests or other signs of fauna occupancy.
Infrastructure	Department of Infrastructure, Transport, Regional Development and Communications, responsible for preparing and implementing the BODP.
Main Construction Works	Substantial physical works on a particular part of the WSI site (including large-scale vegetation clearance, bulk earthworks and the carrying out of other physical works, and the erection of buildings and structures) described in Part 3 of the Airport Plan, other than TransGrid Relocation Works or Preparatory Activities.
Maintenance weed control	Weed control comprising ongoing treatment of minor or localised weed infestations in areas of higher quality native vegetation as required
Migratory species	Species that are listed as migratory under the EPBC Act.
Monitoring exception	An exception to the achievement of the Offset Objectives revealed by data collected at a monitoring location (e.g. a total tree species richness of 1 recorded in a plot/transect when compared with an Offset Objective of total tree species richness of 2+ in each plot/transect sampled).
NPW Act	<i>The National Parks and Wildlife Act 1974 (NSW)</i>
NPWS	The NSW National Parks and Wildlife Service
NSW-listed biota	Threatened species, populations and communities listed under the NSW BC Act or FM Act.
OEH	Former NSW Office of Environment and Heritage now Biodiversity Conservation Division of NSW Department of Planning, Industry and Environment. Note that data maintained by the current BCD appears on the internet as published by OEH and is referenced as such in this report.
Offset Area	The area of land of no less than 900 hectares at Orchard Hills that is the subject of the MOU between Defence and Infrastructure that functions as a biodiversity offset for WSI and that is the subject of this plan.
Offset Improvement Period	means the period commencing when the Offset Plan is approved and ending when the improvements provided for in the plan have been completed and all related monitoring, reporting and auditing requirements have been finalised.
Orchard Hills, DEOH	Defence Establishment Orchard Hills
PCT	Plant community type
Pest fauna	Predator or competitor species that pose a tangible threat to the achievement of the objectives of the fauna reintroduction strategy or other Offset Objectives. May include exotic fauna or overabundant native fauna.
Primary to maintenance weed control	Weed control comprising primary treatment of severe weed infestations and follow-up treatment round(s) as required to reach maintenance level
Quality Score, site quality	The site quality score of habitat within an impact area or offset area measured under the offsets assessment guide that supports the Environmental Offsets Policy.
Regeneration	Restoration of natural vegetation structure and species richness, mainly relying on plant material already growing on site and/or in the soil seed bank. May include supplementary plant material introduced to the site as seed or nursery-grown plants.
Revegetation	Restoration of natural vegetation structure and species richness, mainly relying on plant material introduced to the site as topsoil, seed or nursery-grown plants.
Site value	The condition of native vegetation assessed for each vegetation zone against the benchmark for the PCT.
Site value score	The quantitative measure of vegetation condition calculated in accordance with the BBAM and/or the FBA.
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, FBA and BAM.
Species-credit type threatened species	Threatened species that are linked to species credits according to the BBAM (rather than ecosystem credits) because they cannot be reliably predicted to use an area of land based on habitat surrogates according to the BBAM.
Stage 1 Construction Impact Zone (CIZ)	The disturbance footprint for construction of the Stage 1 development of WSI, including the anticipated extent of vegetation clearing and grubbing, earthworks, drainage works and the permanent infrastructure that would be constructed for Stage 1 of the airport.

Term	Definition
Stage 1 development	The initial stage in the development of WSI, including a single runway and facilities for 10 million annual passengers.
Suppress weeds	Weed control defined in this plan as treatment of weed infestations to the level required to ensure that they do not spread including, as a minimum, removal of flowering or fruiting material.
TEC	Threatened ecological community listed under the EPBC Act and/or the BC Act.
The EPBC Act Offsets Policy	The <i>Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy October 2012</i> (DSEWPac 2012)
The locality	Land within a 10 km radius of the Offset Area.
The MOU	The Memorandum of Understanding (MOU) that was entered into between Defence and Infrastructure that <i>inter alia</i> provides for the definition of an Offset Area of no less than 900 hectares at Orchard Hills and its conservation and management to function as a biodiversity offset for WSI.
The offsets assessment guide	The spreadsheet offset calculator that accompanies the EPBC Act Offsets Policy (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, BC Act or FM Act.
TSC Act	The <i>Threatened Species Conservation Act 1995</i> (NSW), which was repealed and replaced by the BC Act in August 2017.
Weed control	Implementation of management measures to reduce the extent or cover of exotic or non-indigenous native plants that are having a negative effect on native vegetation.
Western Sydney International (Nancy-Bird Walton) Airport (WSI).	The airport project that is the subject of the BODP. The airport is referred to as Sydney West Airport under the Airports Act.
WSI site	The site for Sydney West Airport as defined in the Airports Act, now known as Western Sydney International (Nancy-Bird Walton) Airport (WSI).

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# 1. Introduction

## 1.1 Introduction

The Western Sydney International (Nancy Bird-Walton) Airport (WSI) is currently under construction at Badgerys Creek. The construction and operation of the airport was assessed in accordance with the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act). Approval for the construction and operation of the airport is controlled by the *Airports Act 1996* (Cth) (Airports Act). An Airport Plan was developed in accordance with the Airports Act and contains a number of biodiversity conditions, which require mitigation and management measures to be implemented to reduce the potential impacts on biodiversity and to offset unavoidable residual impacts.

The Airport Plan conditions required the Department of Infrastructure, Transport, Regional Development and Communications (Infrastructure) to prepare for approval a Biodiversity Offset Delivery Plan (BODP) to compensate for significant residual impacts associated with WSI in accordance with the *EPBC Act 1999 Environmental Offsets Policy October 2012* (EPBC Act Offsets Policy) (DSEWPaC 2012a).

Biodiversity offsets are required for significant residual impacts of the development of WSI on:

- certain threatened species and communities listed under the EPBC Act (affected threatened biota); and
- plants, animals and their habitat, including threatened biota listed under the New South Wales (NSW) *Biodiversity Conservation Act 2017* (BC Act).

A large component of the direct offsets to be implemented under the BODP are associated with an offset site at the Defence Establishment Orchard Hills (DEOH). The Orchard Hills Offset Area (Offset Area) is owned by the Commonwealth and entered on the Commonwealth Heritage List. It is subject to the comprehensive environmental protection framework set out in the EPBC Act under the control of the Environment Minister.

A Memorandum of Understanding (MOU) was entered into between the Department of Defence (Defence) and Infrastructure that includes provisions that are additional to any Commonwealth Heritage Listing requirements relating to the Offset Area. The MOU provides for:

- the area and boundaries of the Offset Area to be formalised, including a core Offset Area of no less than 900 hectares and any other additional areas agreed between Defence and Infrastructure;
- the preparation of an Initial Ecological Survey report (GHD 2020) to describe the biodiversity values of the Offset Area and the quantum of direct offset associated with its conservation and management;
- the development of the Offset Plan and its funding and implementation by Defence over a period of 20 years to provide measurable ecological improvements to the quality of habitat for the affected threatened biota and other biodiversity values at the Offset Area, consistent with the EPBC Act Offsets Policy and through the implementation of biodiversity management actions;
- various monitoring, record keeping, reporting and auditing arrangements to be put in place, consistent with the BODP and the Airport Plan; and

- the Offset Area to be maintained following completion of the improvements, so as to retain long-term benefits of the quality improvements following implementation of the Offset Plan.

This Offset Plan provides the framework for the management of the Offset Area by Defence as a direct offset for WSI in accordance with the MOU.

The Initial Ecological Survey report (GHD 2020) and Offset Plan have been verified by a suitably qualified expert selected by Infrastructure, in consultation with the Commonwealth Department of Agriculture, Water and the Environment (the Environment Department).

## 1.2 Site context and Offset Area

Defence Establishment Orchard Hills (DEOH) is an explosive ordnance depot located approximately 50 kilometres west of central Sydney that is owned, used and managed by Defence. DEOH is managed for Defence capability purposes, Defence training activities and the use and safe storage of explosives (see [Figure 1](#)). Approximately 1370 hectares of DEOH is recorded on the Commonwealth Heritage List as a Commonwealth Heritage Place for its natural heritage values, including remnants and regenerating areas of the Threatened Ecological Communities (TECs) Cumberland Plain Woodland and River Flat Forest Eucalypt Forest on Coastal Floodplains.

The Offset Area includes the following cadastral Lots:

- Part Lot 1 and part Lot 3 DP 238092;
- Lot 6 DP578629; and
- Lots 1 and 2 DP586093.

The Offset Area has been defined based on biodiversity values and current and proposed land uses (see [Figure 2](#)). The Offset Area lies within the Commonwealth Heritage List area within the Northern Buffer Area and Southern Buffer Area at DEOH, also known as Sector B and Sector H in the Defence site plan. The Offset Area includes a core area of no less than 900 hectares with the potential for additional suitable areas to be agreed. Throughout this Offset plan, references to the 'Offset Area' are references to the core offset area, as shown on [Figure 2](#) and each subsequent figure in this report, which comprises 978.83 hectares of land, including 938.48 hectares of managed vegetation at the time of preparation of the Offset Plan. This area differs from the area of 951.08 hectares presented in the Initial Ecological Survey report (GHD 2020) because of a 2021 addition of land to the Offset Area.

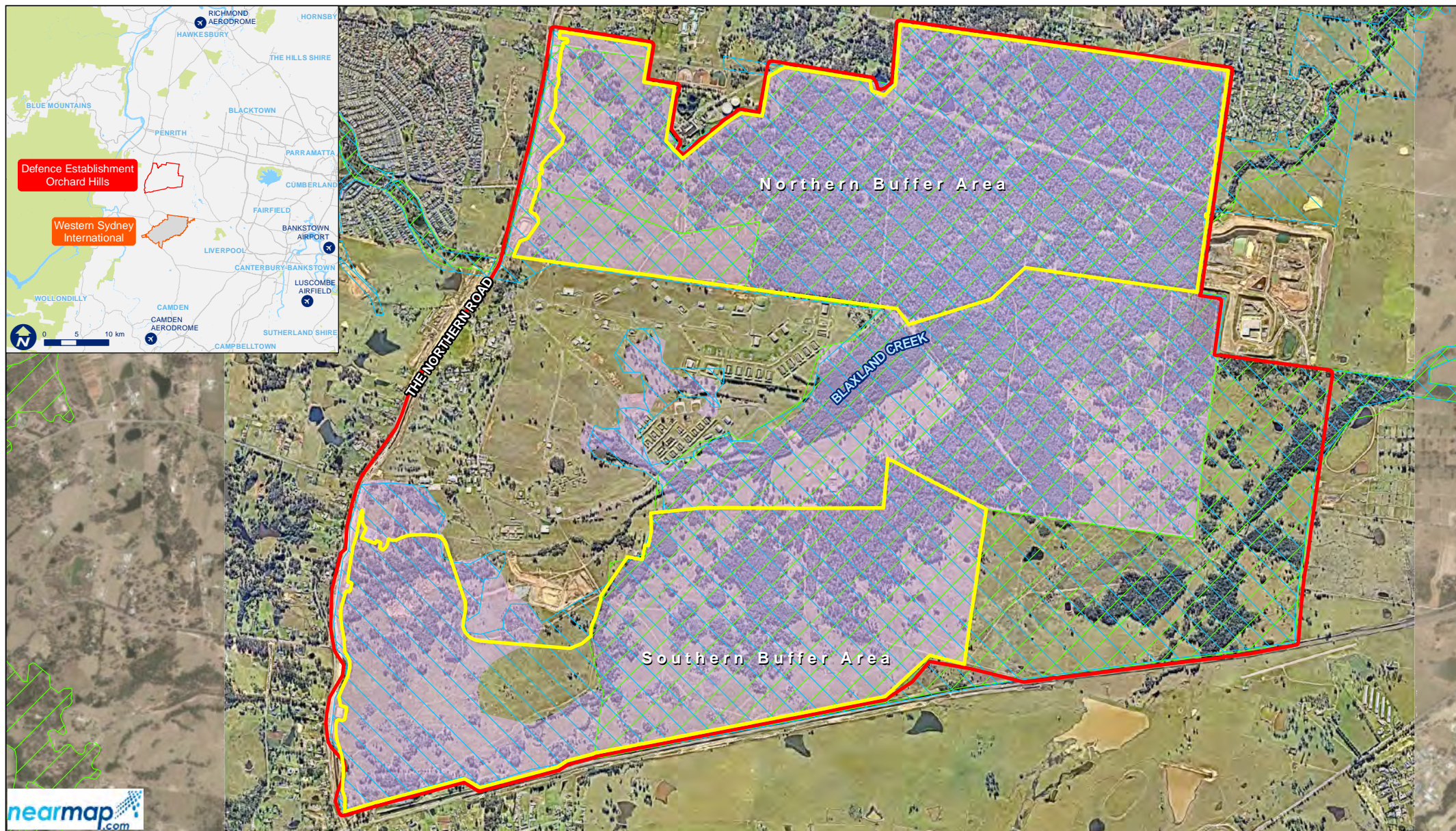
There is 40.35 hectares of land that has not been mapped as vegetation zones or habitat types or included in offset calculations because it is set aside for larger access tracks or utility easements and would not be actively regenerated. Land associated with access tracks will be managed with reference to the Offset Plan as required to maintain its suitability for current land uses as well as to help mitigate threats to adjoining areas of habitat, including through treatment of weeds and control of pest fauna. Threats posed by land within utility easements and other areas managed by third party interests will be similarly managed with reference to the Offset Plan either through coordinated management or buffer or intensive management around potential sources of threat.

The majority of the Offset Area contains remnant or regenerating native woodland and forest. There are areas of former agricultural land that feature less advanced regeneration and currently contain derived native grassland or scrub as well as small areas of exotic grassland and disturbed, cleared land. There is occasional evidence of former agricultural land uses throughout the Offset Area, such as stockyards and fencing. There are no occupied or standing



buildings in the Offset Area. There is a network of fire trails and access tracks as shown on [Figure 2](#) and associated bridges, culverts, and drains.







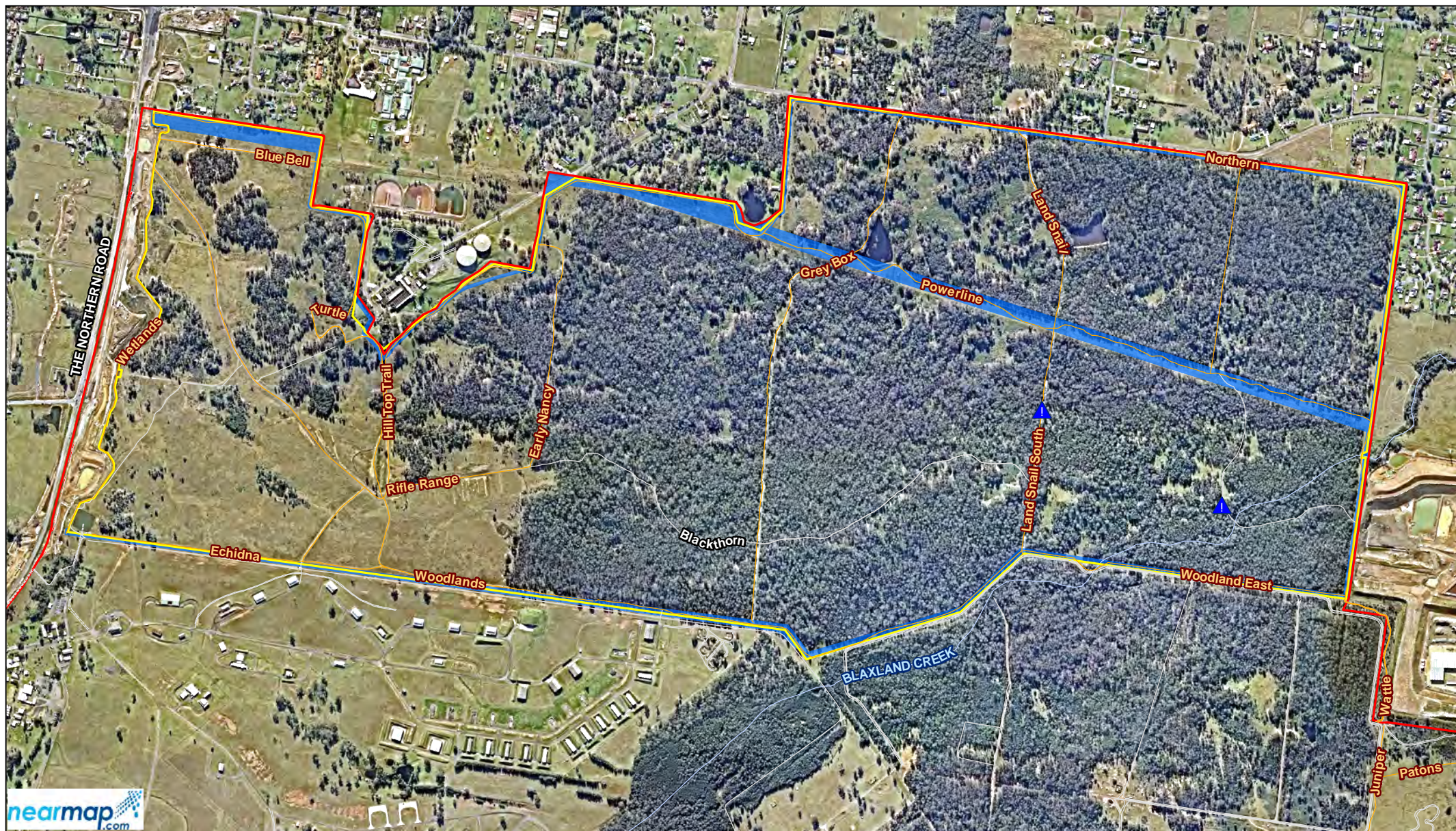
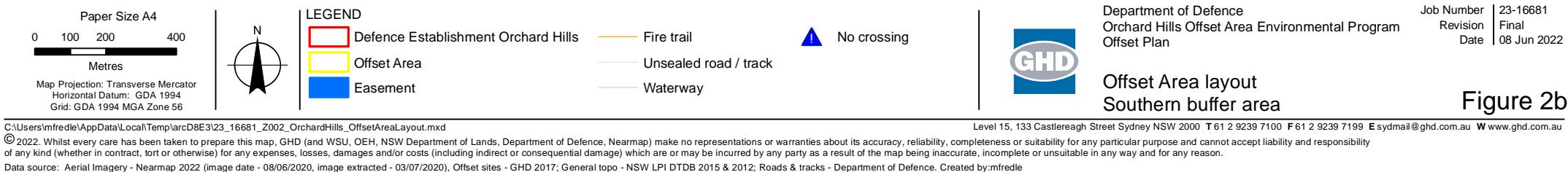
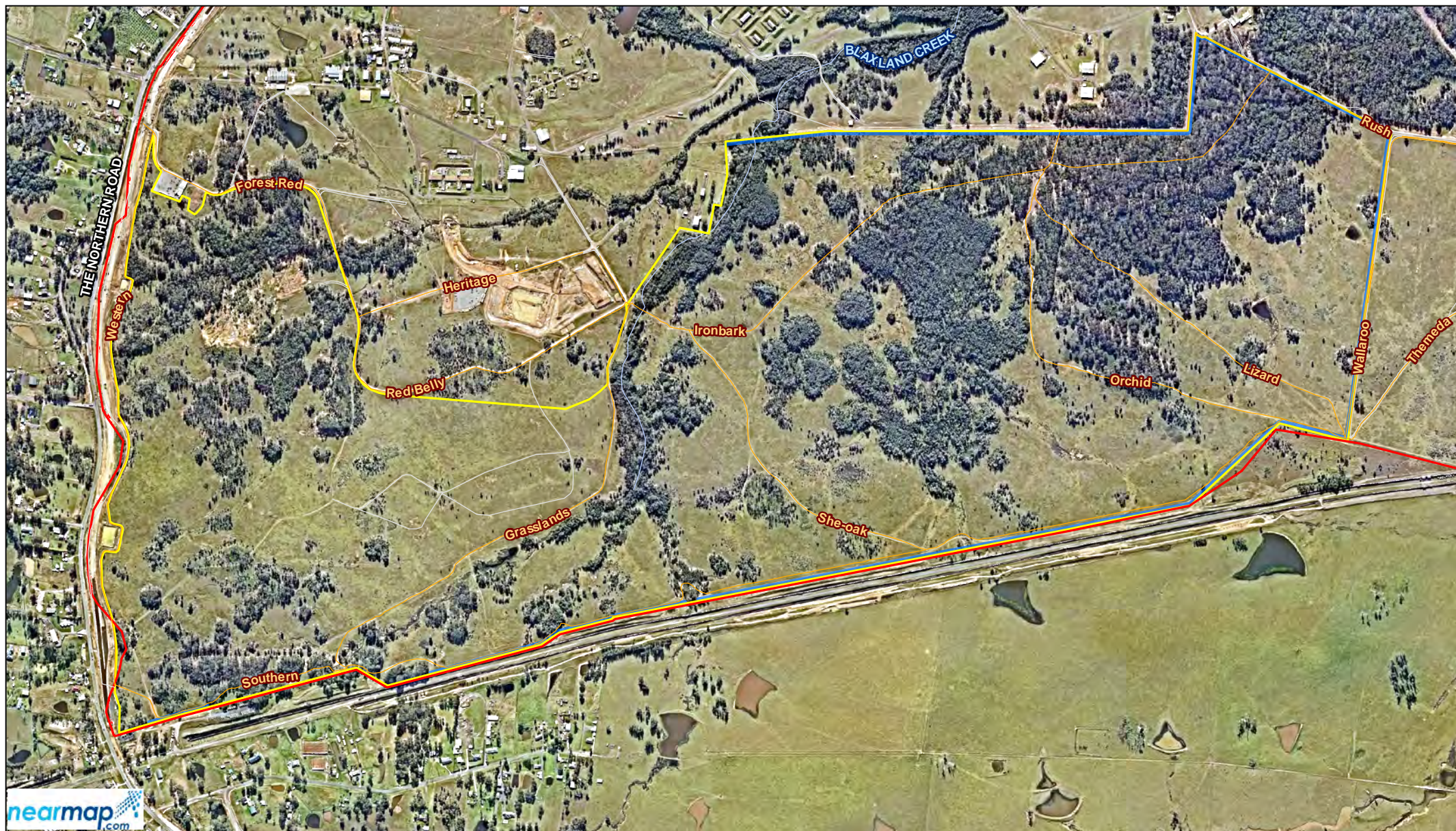


Figure 2a







## 1.3 Project context

### 1.3.1 The BODP

This Offset Plan builds upon commitments made by the Commonwealth through the *Western Sydney Airport Biodiversity Offset Delivery Plan* (BODP) (DIRD 2018). The BODP was prepared in accordance with condition 30 of the Airport Plan, including requirements that the BODP takes into account:

- the biodiversity assessment and offset package in the airport EIS (GHD 2016a, 2016b);
- the updated biodiversity survey of the WSI site and impact calculations presented in the *Western Sydney Airport Stage 1 Biodiversity Assessment Report Addendum* (GHD 2018); and
- the EPBC Act Offsets Policy (DSEWPaC 2012a).

The BODP outlines the:

- impact area and quality of habitat for the affected threatened biota in the WSI construction impact zone;
- number and type of biodiversity credits required to offset impacts of the development of WSI on plants, animals and their habitat;
- consultation activities and advice of the Biodiversity Experts Group that helped identify potential biodiversity offsets;
- direct offsets that would be delivered, including the Orchard Hills Offset Area and the process for identifying and securing other offset sites;
- preliminary assessment of the Orchard Hills Offset Area, including description of the existing environment of the site, an outline of the management approach and preliminary offset calculations; and
- approach and indicative timing for implementation of the BODP.

The BODP was approved by the Environment Minister's delegate on 25 August 2018. This commenced the BODP implementation phase with Infrastructure identifying and securing biodiversity offsets in accordance with the BODP and the Airport Plan conditions. The conservation and management of the DEOH Offset Area in accordance with this Offset Plan contributes to the implementation of the BODP.

### 1.3.2 Memorandum of Understanding

In September 2018, Defence and Infrastructure signed a Memorandum of Understanding – *Agreement to conserve and manage a biodiversity offset area at Defence Establishment Orchard Hills* (the MOU). This MOU assigns part of DEOH as the Offset Area to facilitate the development of WSI under the BODP (described in section 1.3.1 above). Although designated as an Offset Area, DEOH remains a Defence property and a Commonwealth Place for operational Defence purposes. The MOU defines the specific objectives of this Offset Plan which are detailed in section 1.4.

The MOU sets Offset Objectives for increases in the site quality scores of habitat for the affected threatened biota consistent with the Environmental Offsets Policy and as required by the BODP.

The MOU represents a biodiversity conservation agreement which will be delivered according to the following main stages:

1. An Initial Ecological Survey to set baseline biodiversity values and site quality improvement targets (see GHD 2020);

2. An Offset Improvement Period of up to 20 years in which the Offset Area will be managed to provide measurable ecological improvements in line with this Offset Plan;
3. A Completion Ecological Survey to demonstrate completion of the Offset Objectives;
4. Maintenance of the Offset Area in perpetuity to retain long-term benefits of the ecological improvements achieved in the Offset Improvement Period.

The MOU defines the roles, responsibilities and governance arrangements to deliver the biodiversity offset required under the Airport Plan, the main vehicle of which is this Offset Plan. These governance arrangements are reflected in the management framework described in chapter 3, and throughout this Offset Plan as applicable. Although valid for the Offset Improvement Period, the MOU also provides for the conservation of the Offset Area (in the state achieved by the end of the Improvement Period) in perpetuity.

### 1.3.3 Initial Ecological Survey report

The *Orchard Hills Offset Area Initial Ecological Survey Report* (GHD 2020) was prepared in accordance with Section 5.2 of the MOU to support development of the Offset Plan and quantify the value of the Offset Area for the implementation of the BODP.

The EPBC Act Offsets Policy requires the calculation of offsets for impacts on affected threatened biota using the 'offsets assessment guide' spreadsheet. The guide calculates the percentage of the total offset requirement for the individual protected matter that would be delivered by an offset proposal. Further to this, offsets for significant residual impacts on plants, animals and their habitat were calculated with reference to the NSW Framework for Biodiversity Assessment (FBA) methodology (OEH 2014a). The FBA is based on the NSW Biodiversity Banking and Offsets Scheme (BioBanking) credit calculator and assessment methodology (the BBAM) (OEH 2014b), which was the methodology used to calculate offsets for major projects in NSW at the time that the airport EIS was prepared.

The purpose of the Initial Ecological Survey report was to:

- describe the existing environment of the Offset Area, including the extent and condition of native plant communities and fauna habitat;
- confirm the extent and quality of habitat for the affected threatened biota with regard to the EPBC Act Environmental Offset Policy and specifically the key diagnostic characteristics and condition thresholds specified in the *Commonwealth Listing Advice on Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest* (TSSC 2008);
- set baseline site quality scores for the affected threatened biota and future quality with offset scores in line with the Offset Objectives;
- calculate the biodiversity credits that would be generated at the Offset Area to help to offset the impacts of WSI on plants, animals and their habitat, including threatened biota listed under the BC Act, as determined in accordance with the FBA and BBAM; and
- demonstrate that the Offset Area would help deliver an overall conservation outcome that improves or maintains the viability of the EPBC Act protected matters consistent with the Environmental Offsets Policy as required by the BODP.

The outcomes of the Initial Ecological Survey have determined the baseline conditions and targets set in chapter 4 and informed the management actions described in chapter 5 of this Offset Plan<sup>1</sup>.

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<sup>1</sup> Note that the offset area as detailed in this plan was expanded slightly from earlier documents due to inclusion of an additional area considered "potential future offset area" in the south-western buffer under the terms of the MoU between Defence and Infrastructure.

#### 1.3.4 Commonwealth Heritage listing

Land at DEOH has been entered on the Commonwealth Heritage List as a place with Commonwealth Heritage values. The Commonwealth Heritage List is a list of Indigenous, historic and natural heritage places owned or controlled by the Australian Government. These include places connected to Defence, maritime safety, communications, customs and other government activities that also reflect Australia's development as a nation (DoEE 2019a). The Commonwealth Heritage List Area at DEOH is shown on [Figure 1](#) and was listed as 'Orchard Hills Cumberland Plain Woodland, The Northern Rd, Orchard Hills, NSW, Australia' in 2004 (DoEE 2019b).

The Commonwealth Heritage List Area was recognised for its natural heritage values, especially large remnant and regenerating areas of Cumberland Plain Woodland and River Flat Eucalypt Forest on Coastal Floodplains, as well as the presence of relict trees in these communities, threatened flora populations, extensive areas of fauna habitat and relatively undisturbed aquatic habitat. The listing also notes the presence of cultural heritage values associated with the Mulgoa Irrigation Scheme dating from the 1890s, including remnants of an irrigation canal (DoEE 2019b).

Defence manages DEOH and as the manager seeks to protect and maintain natural heritage values. There are a collection of heritage values that are additional to those in the 2004 listing, including Indigenous cultural heritage values, a collection of World War II and post-war prefabricated huts and evidence of the development of explosive ordnance storage in Australia (GML 2013).

The objective of the Offset Plan is to achieve an intensification of the level of management of biodiversity values at the Offset Area beyond that required under the Commonwealth Heritage listing and EPBC Act. The specific objectives of the Offset Plan are described in section 1.4 below and are mainly related to improving the quality of habitat for threatened biota listed under the EPBC Act. The requirement to improve the site quality of poorer quality Cumberland Plain Woodland is a particularly notable increase in the current degree of management, as the Draft Heritage Management Plan only requires the maintenance and avoidance of significant impacts to Cumberland Plain Woodland and other values in the Heritage List Area and does not require the restoration of degraded areas (GML 2013).

### 1.4 Objectives of the Offset Plan

The MOU includes a requirement for management actions to be implemented to achieve improvements in the quality of habitat for the affected threatened biota at the Offset Area. These actions are specified in this Offset Plan.

The objectives of the Offset Plan (the Offset Objectives) are to improve the quality of habitat for the affected threatened biota and plants, animals and their habitat in the Offset Area in order to help meet the requirements of the BODP. Specifically, the Offset Plan management actions will be designed to achieve the following objectives:

- a. 'Future quality with offset' score that is two (2) greater than the 'Start quality' score that is defined in the Initial Ecological Survey for the area of Cumberland Plain Woodland;
- b. 'Future quality with offset' score that is one (1) greater than the 'Start quality' score that is defined in the Initial Ecological Survey for the area of habitat for the Swift Parrot and Grey-headed Flying-fox in the Offset Area;
- c. 'Future quality with offset' score for the area of poorer quality Cumberland Plain Woodland in the Offset Area that is at least:

- i) as high as the quality score for the Cumberland Plain Woodland in the Stage 1 Construction Impact Zone (6 out of 10), and
  - ii) two (2) greater than the 'Start quality' score that is defined in the Initial Ecological Survey for the area of poorer quality Cumberland Plain Woodland in the Offset Area.
- d. Site value scores with active restoration and management at least equal to the scores defined in the Initial Ecological Survey to confirm the quantum of offset for plants, animals and their habitat as calculated with the BBAM (OEH 2014b);
- e. Averted risk, management of threats and site context score improvements that would contribute to achieving the Offset Objectives a-d listed above.

The Offset Area and any other agreed areas will be actively managed as an offset for WSI for the period required to achieve the Offset Objectives outlined above and discussed in section 3, which is expected to be up to 20 years from September 2018, the date that delivery of the offset commenced. The baseline site quality scores for affected threatened biota and start and future site value scores for plants, animals and their habitat are defined in the Initial Ecological Survey report (GHD 2020) and summarised in chapter 4. Standards, guidelines and required outcomes for management actions are presented in chapter 5. Once the quality improvements have been achieved, Defence would continue to manage the Offset Area so as to maintain the long-term benefits of the quality improvements.

The following activities are excluded from the implementation of the Offset Plan, but form part of overall environmental improvement of the site or are activities coordinated by Defence to ensure compatibility with implementation of the Offset Plan:

- a. remediation of contaminated sites;
- b. preparation of bushfire management plans;
- c. removal of Unexploded Ordnance, Suspected Unexploded Ordnance or other hazards;
- d. conservation and land management services on DEOH but outside offset areas;
- e. non-conservation land management services within the offset area (drainage, roadworks, maintenance of security fencing etc)
- f. direct reporting to or communication with Infrastructure; and
- g. vegetation management and removal in easement areas being managed by other parties.



## 2. Existing environment

### 2.1 Physical environment

The majority of the DEOH site is drained by Blaxland Creek, which flows in a generally south-west to north-easterly direction through the central portion of the site. Blaxland Creek is a third order stream in its upper reaches in the south-west of the site, is fed by an unnamed third order stream in the central portion of the site and is a fourth order stream downstream of this point until it discharges at the eastern boundary of the site. It is fed by numerous first and second order tributaries along its length.

The north-west portion of the DEOH site is drained by an unnamed tributary of Surveyors Creek, which discharges to the north through a culvert beneath The Northern Road. At the time of developing the Offset Plan this drainage system was undergoing substantial modification associated with earthworks for The Northern Road upgrade.

The majority of the Offset Area contains the Blacktown soil landscape, which comprises gently undulating low hills and flats on Wianamatta Group shales. Local relief is 10 to 30 m with slopes generally less than 5% but occasionally up to 10%. Crests and ridges are broad (200 to 600 m) and rounded with convex upper slopes grading into concave lower slopes. Soils are deep, moderately fertile clay loams and clays (Bannerman and Hazelton 1990).

The lower slopes and alluvial flats adjoining Blaxland Creek contain the South Creek soil landscape, which comprises floodplains, valley flats and drainage depressions of the channels on the Cumberland Plain. This landscape is made up of Quaternary alluvium derived from Wianamatta Group shales and Hawkesbury Sandstone. It is flat apart from incised channels and occasional terraces or levees providing low relief. Soils are deep, moderately fertile sandy clay loams and clay loams over clays (Bannerman and Hazelton 1990).

There is a small, unmapped area of the Berkshire Park soil landscape in the Southern Buffer Area as evident from the vegetation associations, surface soils and geomorphology. This landscape comprises gently undulating low rises on the Tertiary terraces of the Hawkesbury/Nepean River system. The soils of this landscape are the result of three depositional phases of Tertiary alluvial/colluvial origin and at the Offset Area comprise deep, moderately fertile clay and gravelly clay soils (Bannerman and Hazelton 1990).

### 2.2 Land uses

Commonwealth use of DEOH has primarily been for explosives storage, weapons storage and ordnance demolition, with some fire training activities (AECOM 2019). These activities have necessitated the maintenance of buffer areas around areas supporting hazardous activities which in turn has allowed the conservation and regeneration of ecological communities. The history of land uses, particularly during World War II means that portions of DEOH are likely to contain materials of concern, including unexploded ordnance (UXO). DEOH is divided into sectors based on the operational activities that occur within each sector. Development has largely focussed on the central-western portion of DEOH (see [Figure 1](#)). The Northern Buffer is otherwise known as Sector B, and the Southern Buffer as Sector H. Sectors B and H have been used as a natural environment to undertake scenario-based military training and will continue to be used for activities that do not prevent achievement of the Offset Objectives.

The Offset Area is shown on [Figure 2](#), and comprises 978.83 hectares of land, including 938.48 hectares of managed vegetation at the time of preparation of the Offset Plan. There is 40.35 hectares of land in tracks or utility easements that would not be actively regenerated. This land would be managed under the Offset Plan as required to maintain its suitability for current land uses as well as to help mitigate threats to adjoining areas of habitat.

Defence's strategic aim is to deliver a sustainable estate across Defence maritime, land and aerospace areas through management of biodiversity conservation, biosecurity, feral animals, weeds, overabundant species, bushfire and soils (Defence 2016b). Management plans, policies and frameworks are in place and have been used to manage the Offset Area prior to the formal agreement for its use as a biodiversity offset site in September 2018.

### 2.3 Vegetation zones

The Initial Ecological Survey confirmed the presence and distribution of five Plant Community Types (PCTs) which were further split according to broad condition states to yield vegetation zones and associated management zones. Stands of these PCTs include near-intact vegetation in 'moderate/good - high' condition, partially cleared or regrowth vegetation in 'moderate/good - poor' condition and highly modified areas in 'low' condition (according to the BBAM). Vegetation zones are shown on [Figure 3](#) and summarised in [Table 2-1](#).

Grey Box – Forest Red Gum grassy woodland on flats (PCT 849 / HN528) is associated with mid and lower slopes, on shale-derived soils across Orchard Hills and is the most extensive native PCT. It comprises an open forest or woodland of Forest Red Gum (*Eucalyptus tereticornis*) and Grey Box (*E. moluccana*) with a grassy ground cover and extensive dense patches of the shrub species Native Blackthorn (*Bursaria spinosa* subsp. *spinosa*). Vegetation zone 2, 'Poor condition Grey Box – Forest Red Gum grassy woodland on flats', comprises a derived Swamp Oak (*Casuarina glauca*) scrub, Native Blackthorn shrubland or grassland form of this PCT.

There is an isolated patch of tertiary clay and gravel influenced soils in the Southern Buffer Area that supports 'Broad-leaved Ironbark – Grey Box – *Melaleuca decora* forest on clay' (PCT 725 / HN513) with an over-storey of Broad-leaved Ironbark (*Eucalyptus fibrosa*) and occasional Woollybutt (*E. longifolia*) along with a characteristic mid-storey of Honey Myrtle (*Melaleuca decora*) and Bracelet Honey Myrtle (*M. nodosa*) and an open shrubby ground cover. This community grades into 'Broad-leaved Ironbark – Grey Box – *Melaleuca decora* grassy open forest on clay/gravel soils' (PCT 724 / HN512) with a similar over-storey of Broad-leaved Ironbark along with Grey Box, mid-storey of Honey Myrtle and a denser shrub and grass ground cover. Vegetation zone 8, 'Poor condition Broad-leaved Ironbark – *Melaleuca decora* grassy open forest', comprises a derived *Daviesia ulicifolia* shrubland or mixed grassland form of this plant community type ([Figure 3](#)).

Forest Red Gum – Rough-barked Apple grassy woodland (PC835 / HN526) occurs along the riparian corridors of Blaxland Creek and other drainage lines through the site. This community is a closed woodland or forest of Forest Red Gum, Grey Box and Cabbage Gum (*Eucalyptus amplifolia*) along with Swamp Oak, Broad-leaved Apple (*Angophora subvelutina*) and paperbarks (*Melaleuca* spp.). Ground cover vegetation is similar to Grey Box – Forest Red Gum grassy woodland on flats along with additional moisture loving species such as rushes and sedges. Vegetation zone 6, 'Poor condition Forest Red Gum – Rough-barked Apple grassy woodland', comprises a derived Swamp Oak scrub, sedge land or grassland form of this plant community type ([Figure 3](#)).

There are a number of dams and flooded depressions throughout the site formed by the construction of barriers across small drainage lines. These water bodies contain a moderate diversity and abundance of native wetland plants. They are not natural features, however they contain native wetland and aquatic plant species and the PCT '*Phragmites australis* and *Typha orientalis* coastal freshwater wetlands of the Sydney Basin (PCT 1071 / HN630) is the best fit for this vegetation zone. These areas support a well-established wetland community and would provide foraging habitat and a water source for many native fauna species notably including the threatened Southern Myotis (*Myotis macropus*). In this context it would not be appropriate to attempt to restore these areas to their original dryland vegetation structure

and so the baseline description and management described in the Initial Ecological Survey (GHD 2020) and the Offset Plan is based on maintaining the current PCT.

Table 2-1 Vegetation zones

Zone ID	Vegetation zone	PCT	BVT	Condition	BC Act Status	EPBC Act Status	Area (hectares)	Plot/ transects required <sup>2</sup>	Plot/transects sampled
1	Good condition Grey Box - Forest Red Gum grassy woodland on flats (HN528, Moderate/good -high)	849	HN528	Moderate/good - high	Cumberland Plain Woodland (CEEC under the BC Act)	Cumberland Plain Woodland and Shale-gravel Transition Forest (CEEC under the EPBC Act) <sup>1</sup>	340.83	7	Plots 4, 5, 7, 12, 20, 36, 38, 39
2	Poor condition Grey Box - Forest Red Gum grassy woodland on flats (HN528, Moderate/good - poor)	849	HN528	Moderate/good - poor	Cumberland Plain Woodland (CEEC under the BC Act)		309.91	7	Plots 9, 10, 13, 19, 24 35, 40
5	Good condition Forest Red Gum - Rough-barked Apple grassy woodland (HN526, Moderate/good - high)	835	HN526	Moderate/good - high	River Flat Eucalypt Forest (EEC under the BC Act)		118.65	6	Plots 1, 17, 21, 25, 37b, 42
6	Poor condition Forest Red Gum - Rough-barked Apple grassy woodland (HN526, Moderate/good - poor)	835	HN526	Moderate/good - poor			47.86	4	Plots 15, 23, 26, 37a
7	Good condition Broad-leaved Ironbark - Grey Box - <i>Melaleuca decora</i> grassy open forest on clay/gravel soils (HN512 Moderate/good-high)	724	HN512	Moderate/good - high	Shale Gravel Transition Forest (EEC under the BC Act)	Cumberland Plain Woodland and Shale-gravel Transition Forest (CEEC under the EPBC Act) <sup>1</sup>	30.98	4	Plots 3,16, 28, 32
8	Poor condition Broad-leaved Ironbark - Grey Box - <i>Melaleuca decora</i> grassy open forest on clay/gravel soils (HN512 Moderate/good-poor)	724	HN512	Moderate/good - poor	Shale Gravel Transition Forest (EEC under the BC Act)		8.03	3	Plots 29, 30, 33
9	Freshwater wetland on floodplain (HN630, Moderate/good)	1071	HN630	Moderate/good			3.79	3	Plots 18, 31, 41



Zone ID	Vegetation zone	PCT	BVT	Condition	BC Act Status	EPBC Act Status	Area (hectares)	Plot/ transects required <sup>2</sup>	Plot/transects sampled
10	Low condition Grey Box - Forest Red Gum grassy woodland on flats (HN528, Low)	849	HN528	Low			60.75	5	Plots 6, 8, 14, 22, 34
11	Good condition Broad-leaved Ironbark - <i>Melaleuca decora</i> grassy open forest on clay soils (HN513 Moderate/good-high)	725	HN513	Moderate/good - high	Cooks River/Castlereagh Ironbark Forest (EEC)	Cooks River/Castlereagh Ironbark Forest (CEEC)	17.67	3	Plots 2, 11, 27
	<b>Total vegetation</b>						<b>938.48</b>		
	Unmapped land <sup>3</sup>						40.35	0	0
	<b>Total Offset Area</b>						<b>978.83</b>		

Notes:

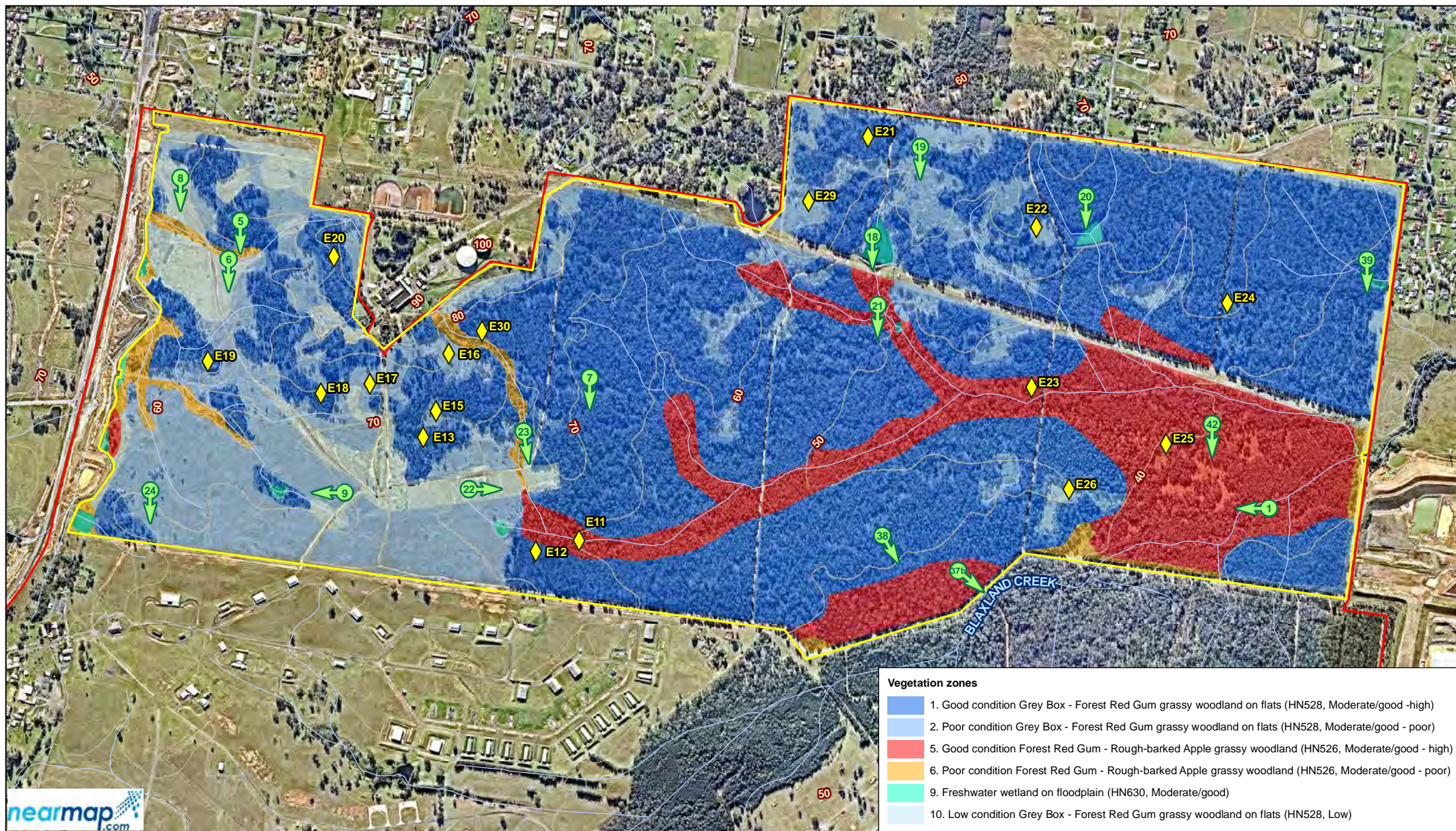
EEC – endangered ecological community. CEEC – critically endangered ecological community.

1. Subject to patch size and condition according to the criteria in the listing advice for the community (TSSC 2009).

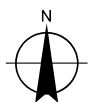
2. <2 ha = 1 plot. >2-5 ha = 2 plots. >5-20 ha = 3 plots. >20-50 ha = 4 plots. >50-100 ha = 5 plots. >100-250 ha = 6 plots. >250-1000 ha = 7 plots. >1000 ha = 8 plots.

3. Land that has not been mapped as vegetation zones or habitat types and included in offset calculations because it is set aside for larger access tracks or utility easements and would not be actively regenerated. This land would be managed as required to maintain its suitability for current land uses as well as to help mitigate threats to adjoining areas of habitat, including through treatment of weeds and control of pest fauna.





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Grid: GDA 1994 MGA Zone 56



#### LEGEND

- Defence Establishment Orchard Hills
- Offset Area
- Waterways
- Contours (10m)



Rapid site quality plot



Plot/transect



Department of Defence  
Orchard Hills Offset Area Environmental Program  
Offset Plan

Job Number 23-16681  
Revision Final  
Date 13 Sep 2021

Vegetation zones  
Northern buffer area

Figure 3a

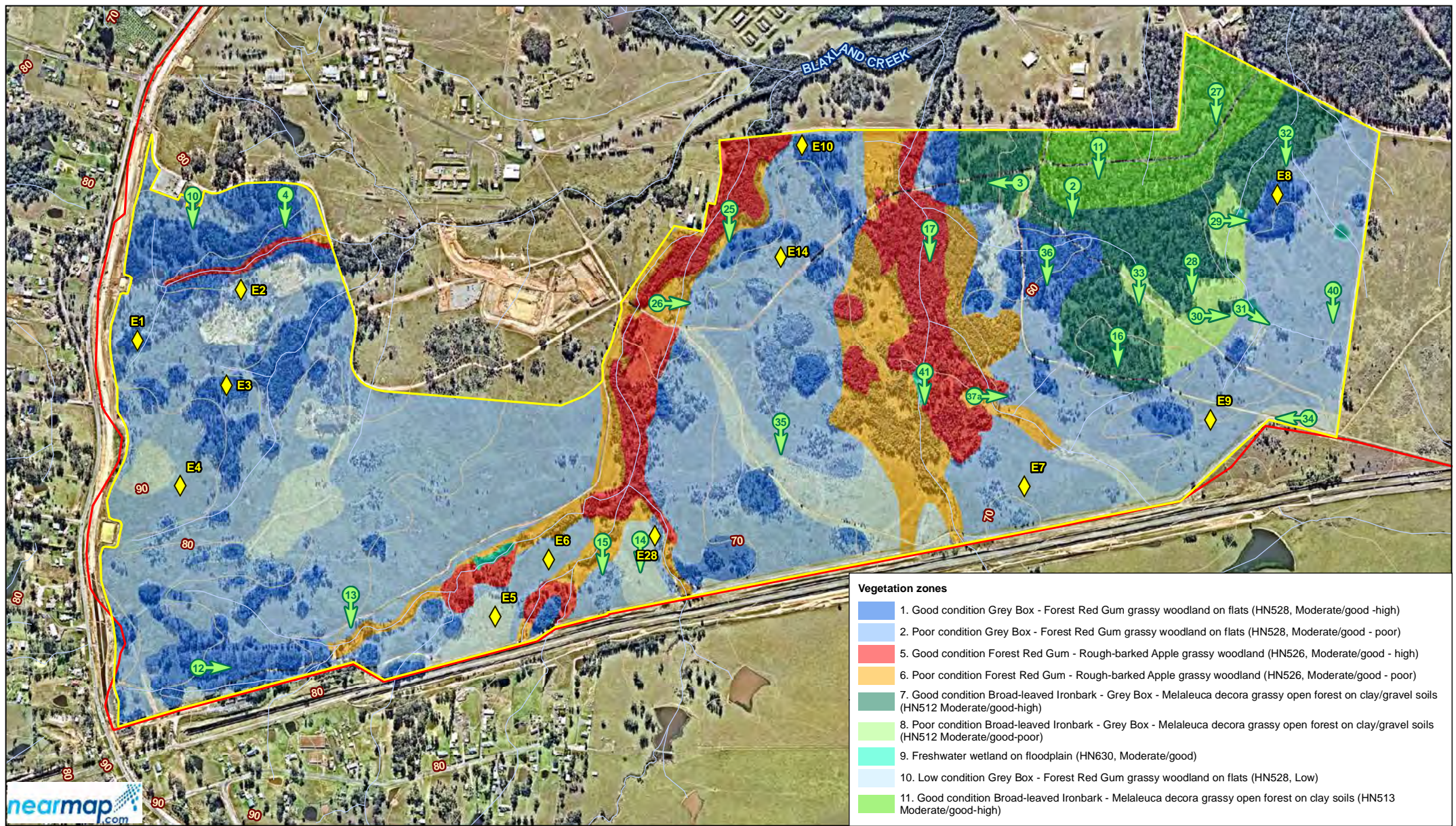
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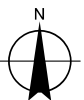
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Data source: Aerial Imagery - Nearmap 2021 (image date - 08/06/2020, image extracted - 03/07/2020, Offset sites - GHD 2017, Cumberland Plain Conservation - OEH 2016; General topo - NSW LPI DTDB 2015 & 2012. Created by:jprice





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Grid: GDA 1994 MGA Zone 56



#### LEGEND

- Defence Establishment Orchard Hills
- Offset Area
- Waterways
- Contours (10m)



Rapid site quality plot



Plot/transect



Department of Defence  
Orchard Hills Offset Area Environmental Program  
Offset Plan

Job Number 23-16681  
Revision Final  
Date 13 Sep 2021

Vegetation zones  
Southern buffer area

Figure 3b

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Data source: Aerial Imagery - Nearmap 2021 (image date - 08/06/2020, image extracted - 03/07/2020, Offset sites - GHD 2017, Cumberland Plain Conservation - OEH 2016; General topo - NSW LPI DTDB 2015 & 2012. Created by:jprice



## 2.4 Threatened biota

### 2.4.1 Threatened flora species

The Offset Area contained populations of the following threatened flora species at the time of the Initial Ecological Survey (GHD 2020):

- *Pultenaea parviflora*, which is listed as a vulnerable species under the EPBC Act and an endangered species under the BC Act and was recorded in woodland on shale-gravel transitional soils in the Southern Buffer area;
- *Dillwynia tenuifolia*, which is listed as a vulnerable species under the BC Act and was recorded in Broad-leaved Ironbark - *Melaleuca decora* grassy open forest on clay soils in the Southern Buffer area;
- *Grevillea juniperina* subsp. *juniperina*, which is listed as a vulnerable species under the BC Act and was recorded in woodland and forest throughout the eastern portion of the Offset Area; and
- individuals within the endangered *Marsdenia viridiflora* R. Br. subsp. *viridiflora* population in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas listed under the BC Act which was recorded in woodland and forest at various locations, with the greatest abundance in Broad-leaved Ironbark - *Melaleuca decora* grassy open forest on clay soils in the Southern Buffer area.

Threatened flora populations at the site are shown on [Figure 4](#).

Specific mitigation of threats within the area of occupied threatened plant habitat and monitoring of the populations of these species will be a particular focus of the implementation of the Offset Plan.

### 2.4.2 Threatened fauna species

The following threatened fauna species were recorded at the Offset Area during the Initial Ecological Survey (GHD 2020):

- Cumberland Plain Land Snail (*Meridolum corneovirens*), which is listed as an endangered species under the BC Act. This species was recorded at multiple locations in woodland and riparian forest;
- Dusky Woodswallow (*Artamus cyanopterus*), which is listed as a vulnerable species under the BC Act and was recorded at multiple locations in the grassy woodland and shrubby woodland;
- Scarlet Robin (*Petroica boodang*), which is listed as a vulnerable species under the BC Act and was recorded at multiple locations in the grassy woodland and shrubby woodland;
- Varied Sitella (*Daphoenositta chrysoptera*), which is listed as a vulnerable species under the BC Act and was recorded at multiple locations in the grassy woodland and shrubby woodland;
- Little Lorikeet (*Glossopsitta pusilla*), which is listed as a vulnerable species under the BC Act and was recorded flying over the site. There are seasonally abundant foraging resources and potential nest hollows for the species in grassy woodland and shrubby woodland;
- Little Eagle (*Hieraaetus morphnoides*) which is listed as a vulnerable species under the BC Act and was recorded at a single location in the Northern Buffer Area but would forage over woodland and grassland vegetation throughout the site and may nest at the Offset Area;

- Grey-headed Flying-fox (*Pteropus poliocephalus*) which is listed as a vulnerable species under the BC Act and EPBC Acts and was recorded flying over the Offset Area, and foraging on *Eucalyptus* species and *Melaleuca decora* on multiple occasions. No roost camps were observed;
- Eastern Freetail Bat (*Mormopterus norfolkensis*) which is listed as a vulnerable species under the BC Act. There is foraging habitat for the species at the Offset Area as well as roosting habitat in hollow-bearing trees, loose bark and fissures, bridges and culverts;
- Southern Myotis (*Myotis macropus*) which is listed as a vulnerable species under the BC Act. There is foraging habitat for the species at the Offset Area as well as roosting habitat in hollow-bearing trees, bridges and culverts;
- Little Bentwing Bat (*Miniopterus australis*) which is listed as a vulnerable species under the BC Act. There is foraging habitat for the species at the Offset Area as well as shorter term roosting habitat in bridges and culverts. There are no caves at or near the area that could comprise longer term roosting habitat or breeding caves;
- Greater Broad-nosed Bat (*Scoteanax rueppellii*), which is listed as a vulnerable species under the BC Act. There is foraging habitat for the species at the Offset Area as well as roosting habitat in hollow-bearing trees, bridges and culverts; and
- Eastern Bent-wing Bat (*Miniopterus schreibersii oceanensis*), which is listed as a vulnerable species under the BC Act. There is foraging habitat for the species at the Offset Area as well as shorter term roosting habitat in bridges and culverts. There are no caves at or near the area that could comprise longer term roosting habitat or breeding caves.

Threatened fauna observed during the Initial Ecological Survey are shown on [Figure 5](#).

No additional species of threatened fauna were revealed during field surveys conducted between 4 June 2019 and 26 June 2019 by Kleinfelder (2019a).

A Spotted Harrier (*Circus assimilis*) was observed opportunistically and photographed hunting over grassland in the Northern Buffer Area during Cumberland Plain Woodland monitoring conducted between May and July 2019 (AFL 2019a). The Spotted Harrier is listed as a vulnerable species under the BC Act.

The Offset Area contains habitat for the affected threatened biota as described in section 4.1 and mapped on [Figure 5](#). All native woodland and forest at DEOH provides foraging habitat for the Grey-headed Flying-fox. Dominant over-storey species, including Forest Red Gum, Grey Box and Broad-leaved Ironbark are recognised as significant species in the blossom diet of the Grey-headed Flying-fox (Eby and Law 2008).

The Swift Parrot may occur at the DEOH on occasion during its winter migration. The Swift Parrot is listed as a critically endangered species under the EPBC Act and BC Act. Dominant over-storey species at the Offset Area, including Grey Box and Forest Red Gum would provide nectar and lerp foraging resources for the Swift Parrot.

Based on the habit resources observed during surveys the Offset Area is likely to include populations of a number of other threatened fauna species and their habitats, including woodland birds, raptors and forest owls, wetland birds and other microbat species (GHD 2020).

#### 2.4.3 Threatened ecological communities

Larger and better condition patches of Grey Box – Forest Red Gum grassy woodland on flats and Broad-leaved Ironbark – Grey Box – *Melaleuca decora* grassy open forest at the Offset Area comprise occurrences of 'Cumberland Plain Shale Woodlands and Shale-Gravel Transition

Forest' (Cumberland Plain Woodland). Cumberland Plain Woodland is listed as a CEEC under the EPBC Act. EPBC Act Cumberland Plain Woodland was identified in the Initial Ecological Survey according to the criteria in the listing advice for the community (TSSC 2009), specifically:

- Characteristic dominant tree species Grey Box, Forest Red Gum and Broad-leaved Ironbark are present with a foliage projective cover of greater than 10%;
- Part of a patch greater than 0.5 hectares in area; and
- Greater than 50% of the ground cover vegetation present comprising perennial native species, or greater than 30% of the ground cover vegetation present comprising perennial native species and part of a patch greater than five (5) hectares in area or containing at least one (1) tree per hectare that is hollow-bearing.

Patches of woodland at the Offset Area that comprise an occurrence of EPBC Act Cumberland Plain Woodland are shown on [Figure 4](#). The extent and condition of EPBC Act Cumberland Plain Woodland at the Offset Area is described further in section 4.1.

Derived native grassland and other moderate/good to poor condition vegetation at the Offset Area does not meet the condition criteria for a local occurrence of EPBC Act Cumberland Plain Woodland as defined in the listing advice for the community (TSSC 2009) and associated guidelines (DEWHA 2010a). This vegetation does not qualify because native tree species are not present with a minimum projected foliage cover of greater than 10% (DEWHA 2010a). The low projected foliage cover in these areas was confirmed through a combination of aerial photo interpretation and walked traverses (GHD 2020).

The single large patch of Broad-leaved Ironbark – Grey Box – *Melaleuca decora* forest on clay (PCT 825 / HN513) at the Offset Area comprises an occurrence of 'Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion' which is listed as a CEEC under the EPBC Act. There is no Cooks River/Castlereagh Ironbark Forest at the WSI site and so it is not an affected threatened entity for the purposes of implementing the BODP.

The majority of the native vegetation at the Offset Site, including derived native grasslands or scrub, comprises local occurrences of TECs listed under the NSW BC Act (as shown on [Figure 4](#)), as follows:

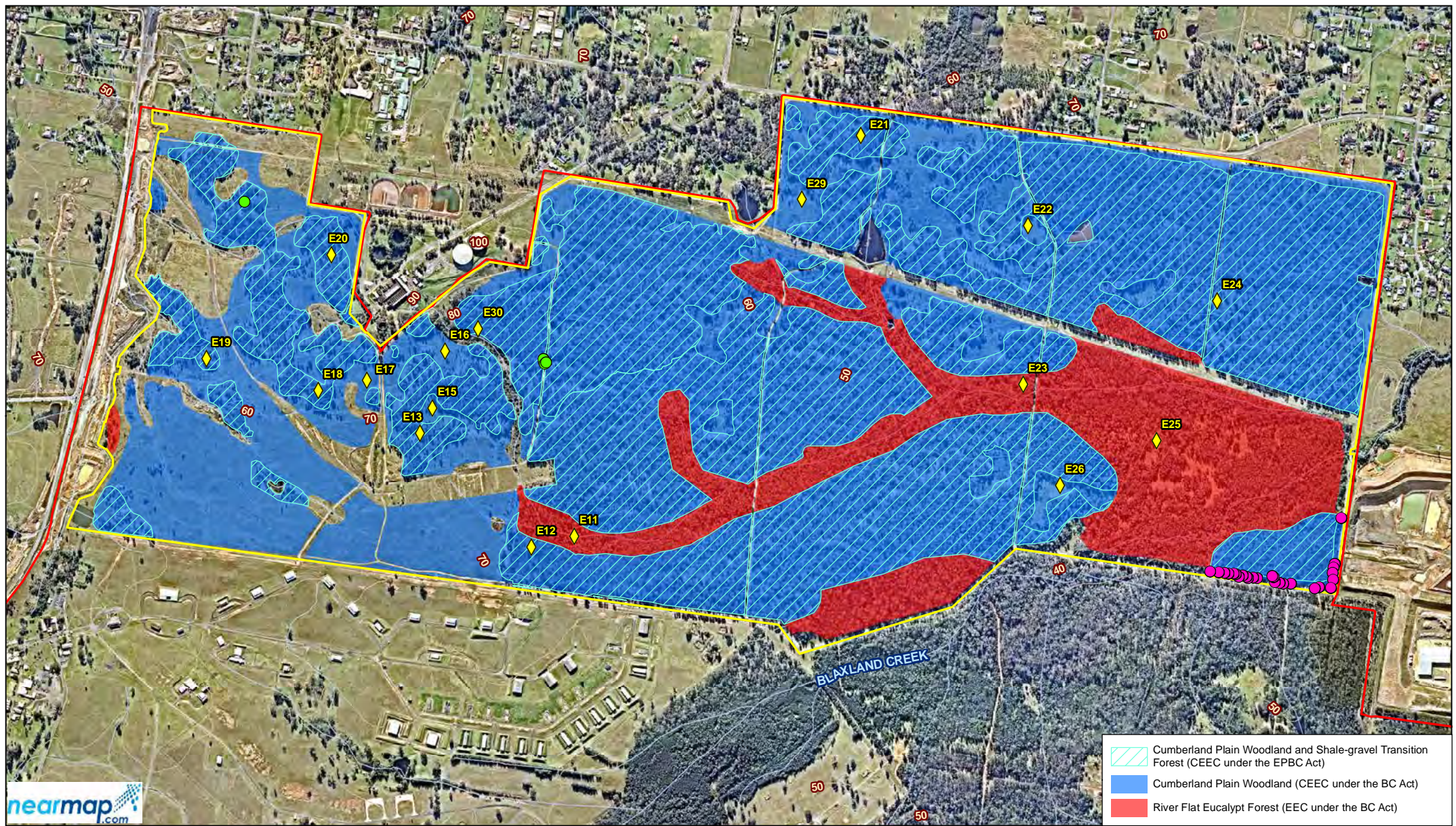
- Both good and poor condition patches of Grey Box – Forest Red Gum grassy woodland on flats (PCT849 / HN528) comprise the CEEC 'Cumberland Plain Woodland in the Sydney Basin Bioregion';
- Both good and poor condition patches of Broad-leaved Ironbark – Grey Box – *Melaleuca decora* grassy open forest (PCT824 / HN512) comprise the EEC 'Shale-Gravel Transition Forest in the Sydney Basin Bioregion';
- Both good and poor condition patches of Forest Red Gum – Rough-barked Apple grassy woodland (PCT 835 / HN526) comprise the EEC 'River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner' bioregions'; and
- Broad-leaved Ironbark – Grey Box – *Melaleuca decora* forest on clay (PCT 825 / HN513) comprises the EEC 'Cooks River Castlereagh Ironbark Forest in the Sydney Basin Bioregion'.

Areas mapped as Low condition Grey Box – Forest Red Gum grassy woodland on flats (PCT849 / HN528) are exotic grassland or bare earth and do not comprise an occurrence of Cumberland Plain Woodland because they contain predominantly native vegetation cover in any vegetation strata and would not develop into a functional occurrence of the TEC with assisted natural regeneration.

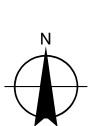


Wetlands at the Offset Area feature predominantly native plant species but are associated with dams and flooded depressions that have been formed by the construction of barriers across small drainage lines. They are clearly not natural geomorphic features. They do not comprise a local occurrence of the TEC 'Freshwater wetlands on coastal floodplains' because artificial wetlands created on previously dry land for purposes such as sewerage treatment, stormwater management and farm production are not regarded as part of this community (DECC 2008c).





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



#### LEGEND

- Defence Establishment Orchard Hills
- Offset Area
- Waterways
- Contours (10m)
- ◆ Rapid site quality plot

- *Grevillea juniperina* subsp. *juniperina* (vulnerable species under the BC Act)
- *Marsdenia viridiflora* subsp. *viridiflora* (endangered population under the BC Act)



Department of Defence  
Orchard Hills Offset Area Environmental Program  
Offset Plan

Job Number	23-16681
Revision	Final
Date	26 Jul 2021

Threatened flora and ecological  
communities - Northern buffer area

Figure 4a

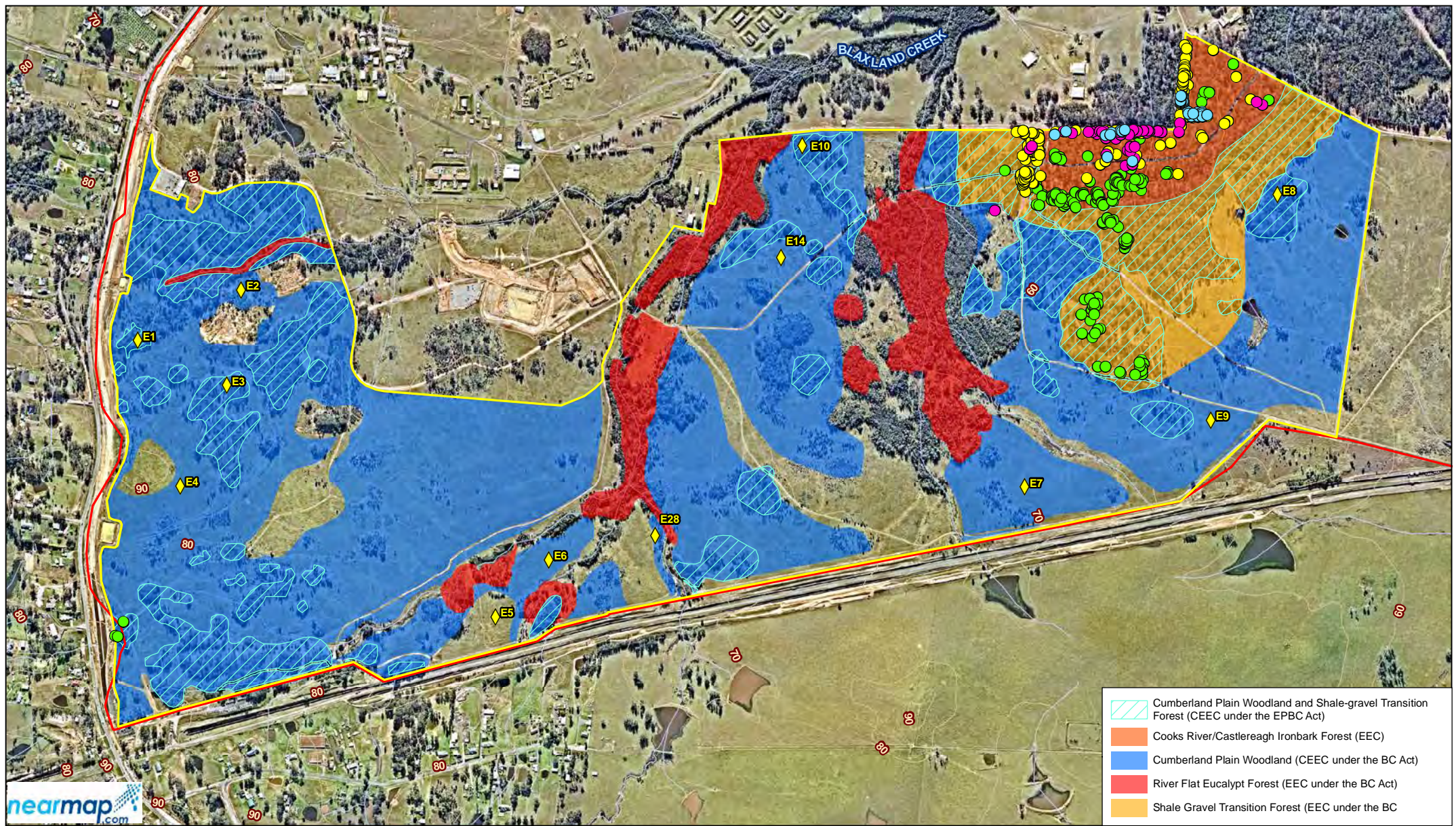
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Data source: Aerial Imagery - Nearmap 2021 (image date - 08/06/2020, image extracted - 03/07/2020), Offset sites - GHD 2017, Cumberland Plain Conservation - OEH 2016; General topo - NSW LPI DTDB 2015 & 2012. Created by:jprice





**Figure 4b**



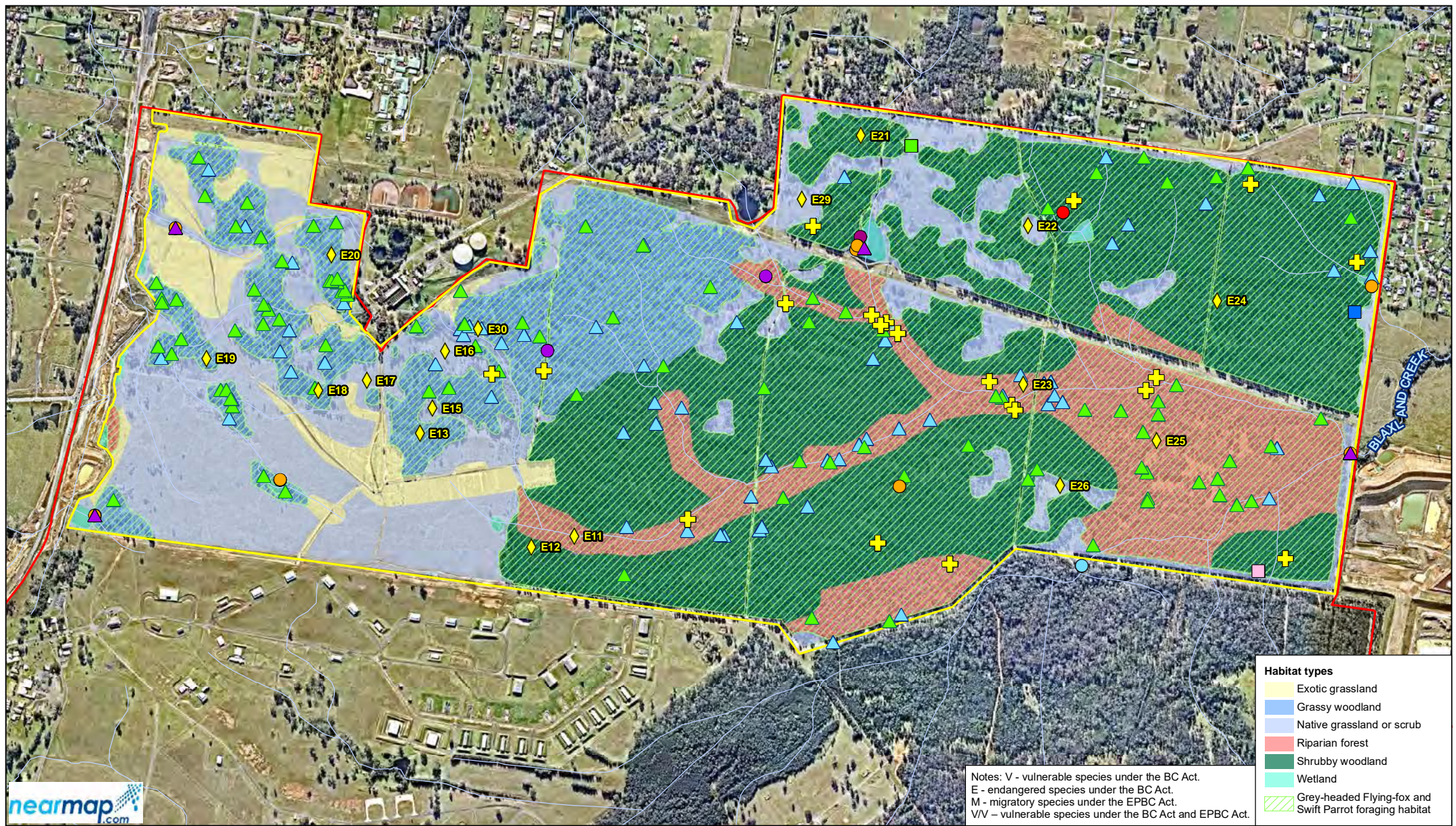
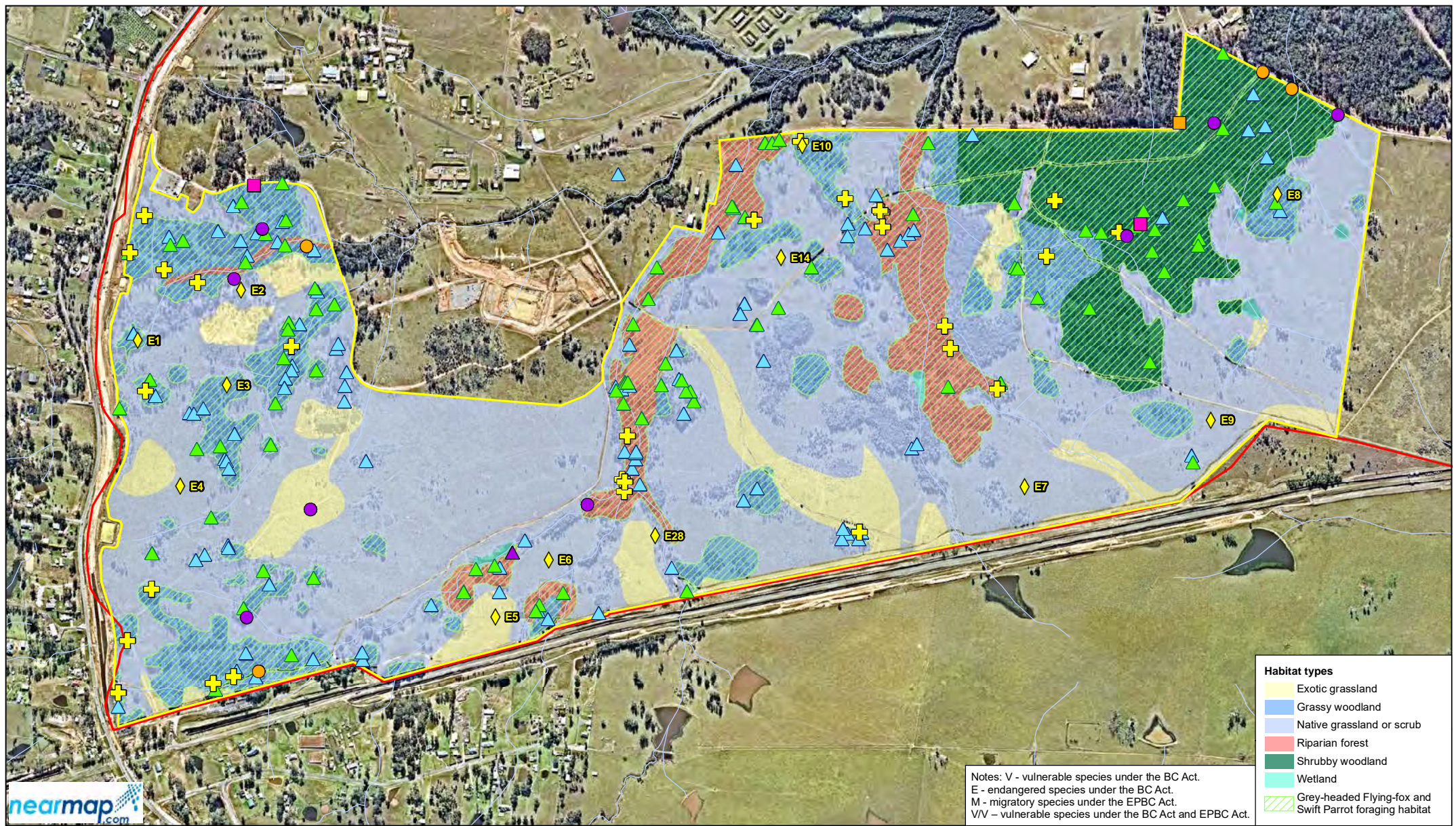
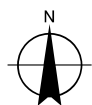


Figure 5a





Paper Size A4  
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 Metres  
 Map Projection: Transverse Mercator  
 Horizontal Datum: GDA 1994  
 Grid: GDA 1994 MGA Zone 56



#### LEGEND

- Defence Establishment Orchard Hills
- Offset Area
- Waterways
- Rapid site quality plot
- Hollow-bearing Tree

- Dead Stag
- Cumberland Plain Land Snail (E)
- Eastern Freetail Bat (V)
- Grey-headed Flying-fox (V/V)

- Scarlet Robin (V)
- Southern Myotis (V)
- Varied Sittella (V)



Department of Defence  
 Orchard Hills Offset Area  
 Environmental Program  
 Offset Plan

Threatened fauna and habitat  
 resources - Southern buffer area

Job Number 23-16681  
 Revision Final  
 Date 26 Jul 2021

Figure 5b

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Data source: Aerial Imagery -Nearmap 2021 (image date - 08/06/2020, image extracted - 03/07/2020), Offset sites - GHD 2017, Cumberland Plain Conservation - OEH 2016; General topo - NSW LPI DTDB 2015 & 2012; Relic native trees - GML (2013) DEOH, NSW Heritage Management Plan; Habitat trees - DEOH 2019. Created by:jprice



## 3. Management framework

### 3.1 Adaptive management approach

Environmental management frameworks should be designed such that continual feedback directs the activities that are undertaken to promote continual improvement. This method represents adaptive management, and is described in AS/NZS ISO 14001:2016 *Environmental management systems – Requirements with guidance for use* (ISO 2016) as the ‘Plan-Do-Check-Act model’ summarised as follows:

- **Plan:** establish the necessary environmental objectives and processes;
- **Do:** implement the processes as planned;
- **Check:** monitor and measure processes, and report against the objectives; and
- **Act:** take actions to continually improve.

The model of adaptive management means that monitoring and reporting against the targets in the Offset Plan (and any subsequent management strategies or plans that are produced) are critical to allow data and observations to inform the management of the Offset Area.

The baseline Offset Area quality scores for affected threatened biota and the start and future Offset Area value scores for plants, animals and their habitat are defined in the Initial Ecological Survey report (GHD 2020) as summarised in chapter 4. Specific targets and required outcomes for management actions are presented in chapter 5. The definition of baseline conditions and targets in the Initial Ecological Survey report (GHD 2020) has by necessity involved the extrapolation of survey data and the averaging of the quality scores across broad areas of habitat for the affected threatened biota and management zones defined according to the BBAM for plants, animals and their habitat. To achieve the overall increases in Offset Area quality scores required to meet the Offset Plan objectives, management actions and effort should be targeted to those areas where the greatest gains can be achieved and/or where effort is required to avert threats.

Broad management units and associated management objectives have been defined in Chapter 5. Implementation of management actions should be undertaken in such a way that increasingly detailed understanding of the site refines specific management approaches through better knowledge of the location of key values and threats, monitoring and research outcomes. The approach to defining these objectives should include:

- Woodland and forest stand health mapping, including observation of tree species richness and diversity of stem size classes and definition of targets appropriate to each stand;
- Fine scale weed class mapping, including type, extent and intensity of infestations and definition of targets appropriate to each weed class;
- Habitat resource mapping, including presence and abundance of habitat trees and fallen woody debris and definition of areas requiring supplementary resources;
- Macropod population monitoring and definition of trigger values for population control based on carrying capacity under prevailing climatic conditions;
- Development of a fauna reintroduction strategy with associated management objectives, monitoring programs and adaptive responses; and
- Additional specific management actions and time and area bound targets as required to achieve the Offset Objectives or to alleviate threats.

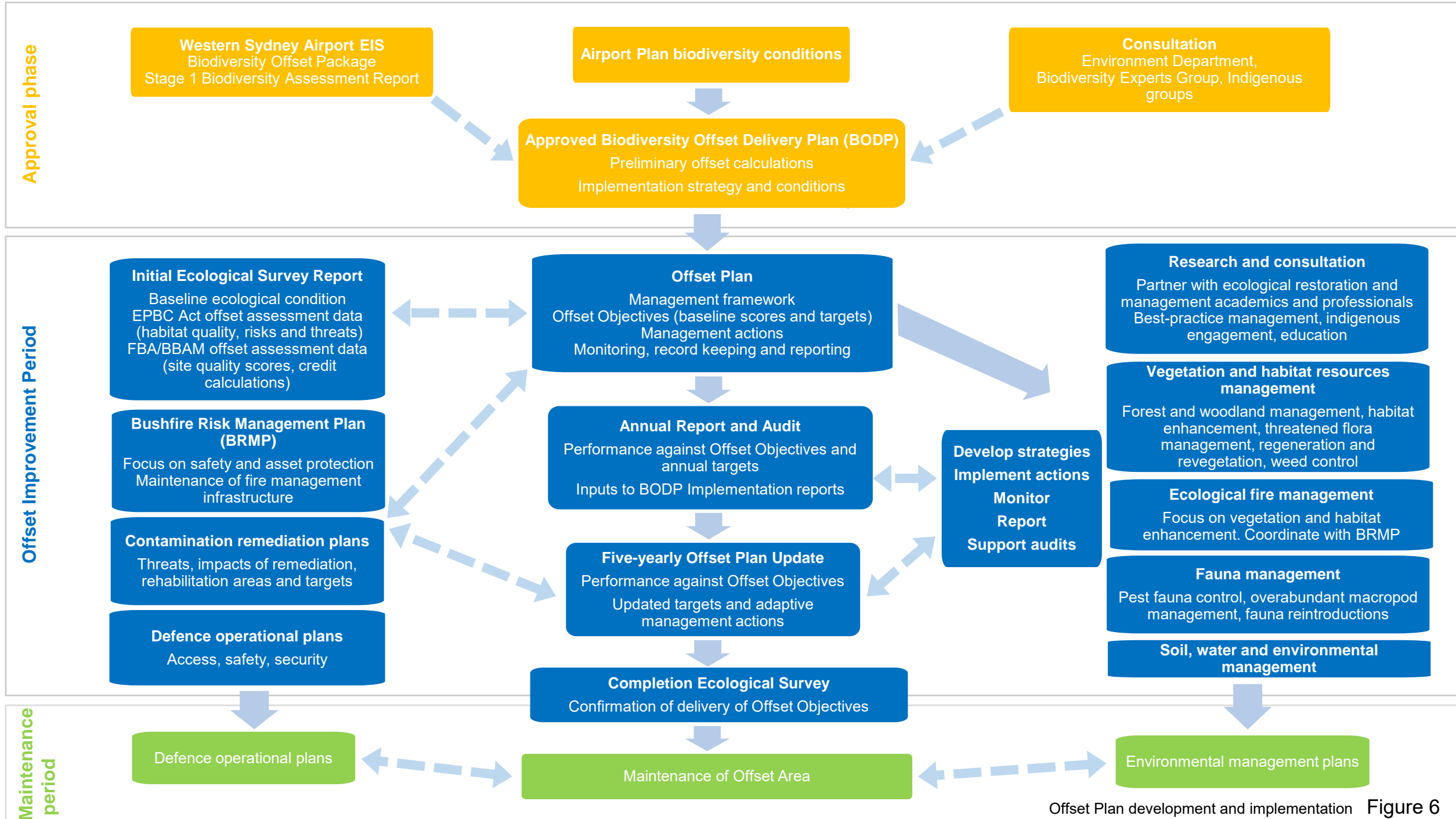


### 3.2 Management context and considerations

The roles and responsibilities of the stakeholders involved in the development and delivery of the Offset Plan are described in [Table 3-1](#) below.

**Table 3-1 Roles and responsibilities for biodiversity offset delivery at Orchard Hills**

Party	Roles and responsibilities
Infrastructure	<ul style="list-style-type: none"><li>• Implement the BODP including responsibility for delivering the offset at Orchard Hills;</li><li>• Audit the implementation of the Offset Plan; and</li><li>• Participate in working group meetings with Defence to facilitate the ongoing implementation of the Offset Plan.</li></ul>
Defence	<ul style="list-style-type: none"><li>• Control access to the Offset Area;</li><li>• Implement this Offset Plan, including to:<ul style="list-style-type: none"><li>– Design, develop and deliver targeted long-term and large-scale ecological management programs using adaptive management;</li><li>– Deliver management actions in the Offset Area in line with the Offset Plan objectives and specific targets for threats and restoration opportunities;</li><li>– Implement the monitoring, record keeping, reporting and auditing requirements of the Offset Plan;</li></ul></li><li>• Seek to promote research outcomes in the delivery of the Offset Plan;</li><li>• Establish and maintain a network of ecological restoration and management academics and professionals to advise and contribute to best-practice management of the Offset Area;</li><li>• Deliver an annual progress report to Infrastructure relating to the delivery of the Offset Plan, which will be made available to the public;</li><li>• Participate in working group meetings with Infrastructure to facilitate the ongoing implementation of the Offset Plan;</li><li>• Review and update the Offset Plan every five years; and</li><li>• Commission the Completion Ecological Survey to demonstrate achievement of Offset Objectives.</li></ul>



Offset Plan development and implementation **Figure 6**

### 3.3 Operational requirements

The Commonwealth is prioritising and setting aside the Offset Area to achieve the quality scores required by the Offset Objectives. However, DEOH is and will remain an operational base. This has a number of implications for management of the Offset Area:

- Defence has the right to access and use the Offset Area, where this does not prevent achievement of the Offset Objectives;
- Defence has the right to restrict and control access to the Offset Area and to impose restrictions on visitors to ensure the security of the base (see section 3.4);
- Due to current and past land uses, there is the potential to encounter obstacles to management activities such as sources of contamination or unexploded ordnance. These may require management of risk, including:
  - ceasing work, or
  - facilitating remediation activities where these align with the Offset Objectives.
- Defence has ongoing facilities management responsibilities for the Offset Area and surrounds, these include:
  - Defence-wide programs for contamination remediation which may require coordination with revegetation efforts (see section 5.9);
  - Defence-wide programs for bushfire risk management which may require integration with ecological burn programs and development of management plans with consideration of the DEOH Bushfire Risk Management Plan (see section 5.6);
  - Other programs of work such as track maintenance;
  - General environmental management (such as pest and weed control).

Delivery of management actions in accordance with this Offset Plan is over and above the routine facilities management works described above.

### 3.4 Site control and access

DEOH is an operational base with both current and historic activities that restrict access to the site. Public access to the DEOH Offset Area is not allowed, and Defence has ultimate discretion to permit or deny access to the Offset Area.

### 3.5 Works prioritisation and outline program

#### 3.5.1 Offset Improvement Period

The first 20 years of the biodiversity conservation agreement is termed the Offset Improvement Period, during which proactive, transformative management activities are intended to take place to ensure the Offset Objectives are achieved. This period is the focus of this Offset Plan and will require significant planning and resourcing to ensure that enough work is performed to allow appropriate monitoring, review and adaptive management at the end of each 5 year period, while staging management actions such that the program is practical to achieve.

Management actions which must be refined and implemented throughout the Offset Improvement Period are described in Chapter 5. While some works may be ongoing and incremental, others require significant effort at programmed times and should be implemented in line with planned time and area-bound goals as described in Chapter 5 and shown in [Figure 6](#). The specific monitoring, reporting and auditing requirements required to be undertaken during this period are described in Chapter 6.

The Offset Improvement Period began in 2018 and actions completed in the first two years of the Offset Improvement Period include:

- Flora monitoring surveys in mid-2019 of plots established by Sinclair, Knight & Merz in 2011 (AFL 2019a);
- Targeted treatment of weed species in the Offset Area in mid-2019 covering 171 ha of the Northern Buffer and 219 ha of the Southern Buffer, treating around 80% of target species infestations. This program included establishment of trial plots to determine the most effective means of control for some target species (AFL 2019b);
- A fauna biodiversity assessment, including habitat resource surveys and mapping and fauna surveys (Kleinfelder 2019); and
- A feral animal control program of monitoring and ground shooting of wild deer, rabbits, hares, foxes and feral cats (AVPM 2019).
- A series of follow-up intensive works focussed on weeds in 2020-21 that were not completed at time of writing the Offset Plan.

The program of the Offset Improvement Period and specific deliverables are shown in detail in [Table 6-1](#). The first five-yearly period will include activities completed in the two years described above. The completion of the Offset Improvement Period will require a Completion Ecological Survey to verify that the Offset Objectives have been met.

### 3.5.2 Maintenance period

Following the Offset Improvement Period, the Offset Area transitions to a maintenance period whereby the condition of the Offset Area must be maintained in perpetuity as agreed in the MOU. Defence must develop environmental management plans to ensure that management actions, monitoring, auditing and reporting are all scheduled appropriately to maintain the quality enhancements realised during the Offset Improvement Period. It is likely that while some management actions contained in this Offset Plan will still be appropriate to continue during the maintenance period, when some biodiversity values have been achieved they may not need any further investment. For example, the establishment of habitat resources will naturally become less important to actively manage, as hollows, woody debris and other features naturally accumulate. Management actions must be implemented such that the biodiversity enhancements are retained, however Defence will need to design and implement a management regime that is appropriate and aligns with broader operational requirements and processes at the base to ensure that it is sustainable in the long-term.

## 3.6 Research

The Offset Area represents a significant opportunity for biodiversity protection and enhancement in Western Sydney and for the generation of high-quality peer-reviewed scientific journal papers that contribute to existing conservation programs. As such, it is required that the Offset Improvement Period is used to promote and facilitate research in line with the Offset Objectives.

Defence will provide ongoing support for research programs and experimental ecosystem restoration projects in the Offset Area in support of achieving and improving the required offset outcomes. Research proposals should consider the Offset Objectives as well as the criteria in Appendix A of the EPBC Act Offsets Policy (DSEWPaC 2012), including how a proposal would:

- Improve the viability of Cumberland Plain Woodland, the Swift Parrot, the Grey-headed Flying-fox or other species and communities of the Cumberland Plain;

- Be targeted towards activities in recovery plans;
- Be transparent, scientifically robust and timely;
- Be undertaken by a suitably qualified organisation; and
- Consider best-practice research approaches.

Research opportunities may include subject matter such as:

- Testing and optimising fauna reintroductions;
- Nutrient cycling;
- Revegetation and plant community restoration techniques;
- Soil rehabilitation;
- Dieback treatments; and
- Provision of supplementary habitat resources.

Any research opportunities must not prevent achievement of the quality improvement scores that are required at the Offset Area either by the potential to consume undue management effort or to cause other health impacts to the Offset Area, such as biosecurity risks.

## 4. Baseline condition, targets and validation

### 4.1 Affected threatened biota

The EPBC Act Offsets Policy requires the calculation of offsets for impacts on affected threatened biota using the 'offsets assessment guide' spreadsheet with current and future 'site quality scores' key inputs to offset calculations. The Initial Ecological Survey report outlines the baseline condition of habitat for the affected threatened biota at the Offset Area and the quantum of direct offset that would be generated through management under the Offset Plan (GHD 2019). Management actions will be implemented under this Offset Plan in order to deliver the Offset Objectives listed in section 1.4.

The Offset Objectives require increases in Offsets assessment guide quality score values for the affected threatened biota. Baseline 'Start quality' scores and 'Future quality with offset' scores are presented in the Initial Ecological Survey report along with justification for how each score was derived (GHD 2019). Site quality score values are based on:

- Three characteristics that 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 10).
- The estimated values for the Offset Area that were approved by Environment as a preliminary guide to the quantum of offset in the BODP, including the scoring relative to the quality of habitat in the impact area and relative weighting of site condition, site context and species stocking rate for each of the affected threatened biota.
- The results of the Initial Ecological Survey (GHD 2020).
- The anticipated 'Future quality with offset' scores based on the management actions outlined in the Offset Plan.

Specific Offset Objectives for each of the affected threatened biota are presented in [Table 4-1](#) to [Table 4-3](#) below along with baseline and target site quality score values and a summary of the management and monitoring approach in this Offset Plan.

Five-yearly monitoring is intended to coincide with the cycle of review and updates to the Offset Plan which will occur in August 2023, 2028, 2033 and 2038 in order to validate achievement of the Offset Objectives. The results of periodic monitoring rounds and completion surveys are to coincide with BODP Implementation periods following the 25 August 2018 approval of the BODP. Monitoring should be conducted in an ecologically appropriate season in the 12 months preceding August of each five-yearly monitoring milestone year.

Validation that the Offset Objectives are being met should be performed using the following monitoring framework:

- A plot-monitoring program comprising:
  - Longitudinal monitoring of the baseline plot/transects and photo points sampled in the Initial Ecological Survey to track ongoing performance against the Offset Objectives (vegetation sampling locations shown in [Figure 3](#); 17 plot/transects in the Northern Buffer, and 26 in the Southern Buffer);
  - Sampling of a set of duplicate plot/transects and photo points stratified between vegetation zones at the same sampling intensity as the IES at randomised locations to assist with demonstrating consistent performance against the Offset Objectives across the Offset Area;



- A landscape monitoring program including assessment and mapping of the extent of native vegetation, vegetation with mature overstorey and width of gaps between patches of habitat; and
- Monitoring of specific management objectives and condition targets integrated with an adaptive management approach.

The management of the Offset Area should aim to ensure that the specific Site Condition Score Objectives for each of the affected threatened biota presented in [Table 4-1](#) to [Table 4-3](#) are met in each plot sampled in the plot-monitoring program. Any exceptions to the achievement of these objectives within a plot should be documented and addressed as follows:

1. Visual inspection and collection of data using the same method within the patch of continuous habitat surrounding the plot to account for spatial variation in the attribute being measured;
2. Confirmation and mapping of the extent of the monitoring exception;
3. Definition of an appropriate management response;
4. Definition of targets appropriate to the management response and the approach for incorporating performance against targets in future monitoring rounds; and
5. Documentation of the evidence used to define the monitoring exception and management response, and process for monitoring success of supplementary measures to achieve the objective.

Under certain circumstances step 1 (visual inspection and collection of data within habitat surrounding the plot) may confirm that the monitoring exception reflects natural spatial variability and does not require a management response. For instance, a plot with tree species richness below target values may be associated with a large tree dominating a localised area. This would not require a management response if inspection and collection of data in the surrounding patch of habitat confirmed tree species richness that aligns with the target score. Data collected in the surrounding area must be collected using identical techniques (in this example sampling of tree species richness in a 20m by 20m plot) and must avoid sampling bias through use of randomisation and/or replication. This evidence must be documented as per step 5.

Management should aim to ensure that the specific Site Context Score Objectives for each of the affected threatened biota presented in [Table 4-1](#) to [Table 4-3](#) are met across the entire Offset Area as confirmed through the landscape monitoring program.

Table 4-1 Offset Objectives - Cumberland Plain Woodland

Offset Plan Objectives	'Start quality' score	'Future quality with offset' score (year 10)	'Future quality with offset' score (year 20)	Monitoring framework	Key management actions and focus
<b>Cumberland Plain Woodland</b>	<b>7</b>	<b>9</b>	<b>9</b>	<b>Offset calculator – Time horizon – Time until ecological benefit 10 years</b>	<b>A 'Future quality with offset' score that is two above the 'Start quality' score after 10 years</b>
<b>Site condition score (50%)</b>	<b>7</b>	<b>9</b>	<b>9</b>	<b>Plot-monitoring program</b>	
Tree species richness (number of tree growth-form species according to the BAM in a 20 m x 20 m plot)	1 to 4	2 to 5+	2 to 5+	Plot-monitoring program and performance against targets updated by August 2023, 2028, 2033 and 2038. Includes tree species present at all life-stages / in all vegetation strata. Coordinated with adaptive management monitoring of weed control and habitat enhancement activities.	Targeted over-storey and mid-storey species tree species richness planting. Supplementary planting/seeding to introduce species richness and diversity of Eucalyptus species within stands. Use of silvicultural techniques to improve stand structure and health. To be managed with consideration of native ground cover species cover and species richness, over-storey cover and structural diversity targets, as well as management of functional ecological processes such as a regular fire regime.
Shrub species richness (number of shrub growth-form species according to the BAM in a 20 m x 20 m plot)	1 to 6	2 to 8+	2 to 8+	Plot-monitoring program. Includes shrub species present at all life-stages / in all vegetation strata. Coordinated with adaptive management monitoring of weed control and habitat enhancement activities.	Targeted shrub and ground cover species richness planting. Facilitated natural regeneration combined with supplementary planting/seeding to introduce species richness and management of functional ecological processes such as a regular fire regime.
Ground cover species richness (total number of grass, grass-like, forb, fern, scrambler and climber growth-forms species according to the BAM in a 20 m x 20 m plot)	22 to 36	>30	>30	Plot-monitoring program. Coordinated with adaptive management monitoring of weed control and habitat enhancement activities.	Targeted shrub and ground cover species richness planting. Facilitated natural regeneration combined with supplementary planting/seeding to introduce species richness. Management of functional ecological processes such as a regular fire regime and exotic and over-abundant native herbivores.

Offset Plan Objectives	'Start quality' score	'Future quality with offset' score (year 10)	'Future quality with offset' score (year 20)	Monitoring framework	Key management actions and focus
Over-storey cover (over-storey cover as measured at five 5 m x 5 m quadrats along a 50 m transect according to the BBAM)	9-35%	20-35%	20-35%	Five-yearly plot-monitoring program. Coordinated with adaptive management monitoring of weed control and habitat enhancement activities.	Implementation of techniques to improve stand quality. Facilitated natural regeneration. To be managed with consideration of native ground cover species cover and species richness, over-storey cover and structural diversity targets, as well as management of functional ecological processes such as a regular fire regime. Potential for selective thinning of dense single-aged stands of over-storey species to be undertaken to assist meeting overall ecosystem compositional, structural and functional targets.
Ground cover (total cover of grass, grass-like, forb, fern, scrambler and climber growth-forms species according to the BAM in a 20 m x 20 m plot)	13-61% in PCT 849 19-54% in PCT 724	20-70% in PCT 849 20-55% in PCT 724	20-70% in PCT 849 20-55% in PCT 724	Measured via five-yearly site plot-monitoring program. Comprises an aggregate of grass, grass-like, forb, fern, scrambler and climber growth-forms. Coordinated with adaptive management monitoring of weed control and habitat enhancement activities.	Implementation of techniques to improve stand quality. Review and implement overabundant native fauna controls. Maintenance weed control.
High Threat Exotic (HTE) plant species cover (total cover of HTE species according to the BAM in a 20 m x 20 m plot)	0.1 to 5.1	<5	<5	Measured via five-yearly site plot-monitoring program. Coordinated with adaptive management monitoring of weed control and habitat enhancement activities.	Maintenance weed control.
Localised exotic plant infestations (on ground visual estimate of percentage cover and mapping of areas above certain cover classes)	Subject to weed mapping	No areas of >31% exotic plant cover in a given vegetation stratum, over a >0.2 ha patch	No areas of >20% exotic plant cover in a given vegetation stratum over a >0.05 ha patch	Annual weed class and cover monitoring coordinated with weed control activities.	Primary to maintenance weed control. Reducing weed cover to help maintain or improve native vegetation integrity.



Offset Plan Objectives	'Start quality' score	'Future quality with offset' score (year 10)	'Future quality with offset' score (year 20)	Monitoring framework	Key management actions and focus
Fallen logs (linear metres of woody debris >10 cm diameter and resting on substrate measured in 50 m x 20 m plot)	7 to 50 m	20 to >40 m	20 to >40 m	Measured via five-yearly site plot-monitoring program. Five-yearly dedicated broad scale habitat resource mapping monitoring and re-setting of targets. Coordinated with adaptive management monitoring of habitat enhancement activities. Intensive monitoring and/or research as defined on establishment of programs.	Installation of supplementary habitat resources. Installation of woody debris and other habitat resources in accordance with the ecological requirements of target ground dwelling fauna species which must include <i>Meridolum corneovirens</i> .
Hollow-bearing trees (HBTs) (number of trees with at least one hollow measured in 50 m x 20 m plot)	At least 1 hollow in 4 out of 12 plots sampled in related vegetation zones.	At least 10 HBTs, artificial hollows or nest boxes per hectare across treed areas of related vegetation zones (equivalent to at least one hollow measured in 50 m x 20 m plot).	At least 10 HBTs, artificial hollows or nest boxes per hectare across treed areas of related vegetation zones (equivalent to at least one hollow measured in 50 m x 20 m plot).	Measured via five-yearly site plot-monitoring program. Five-yearly dedicated broad scale habitat resource mapping monitoring and re-setting of targets. Coordinated with adaptive management monitoring of habitat enhancement activities. Intensive monitoring and/or research of condition, occupancy, patterns of use etc as defined on establishment of programs.	Installation of supplementary habitat resources. Installation of artificial hollows and/or nest boxes in accordance with the ecological requirements of target species which must include <i>Myotis macropus</i> and a diverse suite of microbat, bird and arboreal mammal species of the Cumberland Plain.
Tree regeneration (presence of over-storey species with dbh <5 cm in a 50 m x 20 m plot).	Over-storey species regeneration present in all baseline condition plots.	Over-storey species regeneration present in at least 80% of monitoring plots.	Over-storey species regeneration present in at least 80% of monitoring plots.	Measured via five-yearly site plot-monitoring program. Coordinated with adaptive management monitoring of weed control and habitat enhancement activities.	Implementation of techniques to improve stand quality. Facilitated natural regeneration combined with supplementary planting/seeding to introduce species richness and silvicultural techniques to improve stand health. Management of functional ecological processes such as a regular fire regime and exotic and over-abundant native herbivores.

Offset Plan Objectives	'Start quality' score	'Future quality with offset' score (year 10)	'Future quality with offset' score (year 20)	Monitoring framework	Key management actions and focus
Structural diversity (presence of stem size classes (cm): 5-10; 10-20; 20-30; 30-50; 50-80 in a 50 m x 20 m plot).	At least 80% of stem size classes present in baseline condition plots.	At least 80% of stem size classes present within all monitoring plots.	At least 80% of stem size classes present within all monitoring plots	Measured via five-yearly site plot-monitoring program. Coordinated with adaptive management monitoring of weed control and habitat enhancement activities.	Implementation of techniques to improve stand quality. Facilitated natural regeneration combined with supplementary planting/seeding to introduce species richness and silvicultural techniques to improve stand health. Management of functional ecological processes such as a regular fire regime and control of exotic and over-abundant native herbivores. Stem thinning to promote variation in age classes and stand health, coordinated with creation of habitat resources.
<b>Site context score (50%)</b>	<b>7</b>	<b>8</b>	<b>8</b>	<b>Landscape monitoring program</b>	
Total native vegetation cover within Offset Area (on ground visual inspection and mapping of vegetation zones with reference to less than 12-month-old aerial photography. 'Native vegetation' is defined as vegetation zones containing native over-storey cover >10% and >30% of ground cover native and excludes derived native grassland or scrub.)	57% (522 ha out of 919 ha)	>75% (comprising >10% sub-mature over-storey cover and >30% of ground cover native over at least 75% of suitable habitat)	100% (>10% mature over-storey cover and >30% of ground cover native over all suitable habitat).	Measured within entire Offset Area. Based on five-yearly updates to vegetation zone mapping reflecting revegetation of Poor and Low condition vegetation and cleared land. Targets to be measured in 'patches' of native vegetation which may include areas with gaps in over-storey vegetation up to 100 m wide providing for: maintenance of species rich grasslands; <i>and</i> canopy cover of >10% when measured across the entire patch.	Broad area over-storey / mid-storey planting Full structural revegetation. Facilitated natural regeneration through management of functional ecological processes such as a regular fire regime and control of exotic and over-abundant native herbivores.

Offset Plan Objectives	'Start quality' score	'Future quality with offset' score (year 10)	'Future quality with offset' score (year 20)	Monitoring framework	Key management actions and focus
Hostile gaps and hazards (on ground visual identification of hostile gaps and hazards. Mapping and measurement of distances with reference to less than 12-month-old aerial photography.)	Old fences and similar hazards as shown on Figure 8; and cleared land and exotic vegetation comprising gaps in habitat in broader Offset Area as shown on Figure 3.	Removal of all hazards; and no gaps in native vegetation >100 m wide in broader Offset Area.	No gaps in native vegetation >20 m wide; and no gaps in over-storey vegetation >100 m wide in broader Offset Area.	General broad scale adaptive management monitoring.	Removal of old fences and similar hazards. Revegetation in management unit E.
<b>Poorer quality Cumberland Plain Woodland</b>				<b>Offset calculator – Time horizon – Time until ecological benefit 20 years</b>	<b>A 'Future quality with offset' score that is two above the 'Start quality' score after 20 years</b>
<b>Site condition score (50%)</b>	<b>4</b>	<b>6</b>	<b>7</b>	<b>Plot-monitoring program</b>	
Tree species richness (number of tree growth-form species according to the BAM in a 20 m x 20 m plot)	0 to 2	2 to 5+	2 to 5+	Plot-monitoring program and performance against targets updated by August 2023, 2028, 2033 and 2038. Includes tree species present at all life-stages / in all vegetation strata. Coordinated with adaptive management monitoring of weed control and habitat enhancement activities.	Targeted over-storey and mid-storey tree species richness planting. Supplementary planting/seeding to introduce species richness and diversity of Eucalyptus species and mid-storey species within stands. To be managed with consideration of native ground cover species cover and species richness, over-storey cover and structural diversity targets, as well as management of functional ecological processes such as a regular fire regime.
Shrub species richness (number of shrub growth-form species according to the BAM in a 20 m x 20 m plot)	0 to 4	2 to 8+	2 to 8+	Five-yearly plot-monitoring program. Includes shrub species present at all life-stages / in all vegetation strata. Coordinated with adaptive management monitoring of weed control and habitat enhancement activities.	Targeted shrub and ground cover species richness planting. Facilitated natural regeneration combined with supplementary planting/seeding to introduce species richness. Management of functional ecological processes such as a regular fire regime.



Offset Plan Objectives	'Start quality' score	'Future quality with offset' score (year 10)	'Future quality with offset' score (year 20)	Monitoring framework	Key management actions and focus
Ground cover species richness (total number of grass, grass-like, forb, fern, scrambler and climber growth-forms species according to the BAM in a 20 m x 20 m plot)	15 to 34	>30	>30	Five-yearly plot-monitoring program. Coordinated with adaptive management monitoring of weed control and habitat enhancement activities.	Targeted shrub and ground cover species richness planting. Facilitated natural regeneration combined with supplementary planting/seeding to introduce species richness. Management of functional ecological processes such as a regular fire regime.
Ground cover (total cover of grass, grass-like, forb, fern, scrambler and climber growth-forms species according to the BAM in a 20 m x 20 m plot)	33-74% in PCT 849 58-89% in PCT 724	30->75% in PCT 849 50->85% in PCT 724	30->75% in PCT 849 50->85% in PCT 724	Five-yearly plot-monitoring program. Comprises an aggregate of grass, grass-like, forb, fern, scrambler and climber growth-forms. Coordinated with adaptive management monitoring of weed control and habitat enhancement activities.	Facilitated natural regeneration. Management of threats especially exotic perennial grasses and exotic and over-abundant native herbivores. To be managed with consideration of woodland regeneration / revegetation targets, as well as management of functional ecological processes such as a regular fire regime.
High Threat Exotic (HTE) plant species cover (total cover of HTE species according to the BAM in a 20 m x 20 m plot)	<1% to 10%	<5%	<5%	Five-yearly plot-monitoring program. Coordinated with adaptive management monitoring of weed control and habitat enhancement activities.	Maintenance weed control. Reducing weed cover to help maintain or improve native vegetation integrity.
Localised exotic plant infestations (on ground visual estimate of percentage cover and mapping of areas above certain cover classes)	Subject to weed mapping	No areas of >30% exotic plant cover in a given vegetation stratum, over a >0.2 ha patch	No areas of >20% exotic plant cover in a given vegetation stratum over a >0.05 ha patch	Annual weed class and cover monitoring coordinated with weed control activities.	Primary to maintenance weed control. Reducing weed cover to help maintain or improve native vegetation integrity.
Fallen logs (linear metres of woody debris >10 cm diameter and resting on substrate measured in 50 m x 20 m plot)	0 to 1 m	Management of at least 50% of associated vegetation zones to achieve 5 to >20 m	Management of 100% of associated vegetation zones to achieve 5 to >20 m	Measured via five-yearly site plot-monitoring program. Five-yearly dedicated broad scale habitat resource mapping monitoring and re-setting of targets. Coordinated with adaptive management monitoring of habitat enhancement activities. Intensive monitoring and/or research as defined on establishment of programs.	Installation of supplementary habitat resources. Installation of woody debris and other habitat resources in accordance with the ecological requirements of target ground dwelling fauna species which must include <i>Meridolum corneovirens</i> .

Offset Plan Objectives	'Start quality' score	'Future quality with offset' score (year 10)	'Future quality with offset' score (year 20)	Monitoring framework	Key management actions and focus
Tree regeneration (presence of over-storey species with dbh <5 cm in a 50 m x 20 m plot).	Over-storey species regeneration present in 50% of plots.	Over-storey species regeneration present in at least 50% of monitoring plots.	Over-storey species regeneration present in at least 80% of monitoring plots.	Measured via five-yearly site plot-monitoring program. Comprises presence of naturally regenerating over-storey species with dbh <5 cm. Coordinated with adaptive management monitoring of weed control and habitat enhancement activities.	Revegetation. Management of functional ecological processes such as a regular fire regime and exotic and over-abundant native herbivores.
<b>Site context score (50%)</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>Landscape monitoring program</b>	
Woodland regeneration / revegetation (on ground visual inspection and mapping of vegetation zones with reference to less than 12-month-old aerial photography. 'Woodland' is defined as vegetation zones containing native over-storey cover >10% and >30% of ground cover native and excludes derived native grassland or scrub.)	294.65 ha occurring as poorer quality Cumberland Plain Woodland (derived native grassland or scrub with less than 10% over storey cover).	Sufficient area occurring as sub-mature regrowth to achieve 10% over-storey cover when averaged across the area of poorer quality Cumberland Plain Woodland.	No longer comprises a gap in a functional patch of woodland vegetation. Sufficient area occurring as mature regrowth to achieve 10% over-storey cover when averaged across the area of poorer quality Cumberland Plain Woodland.	Measured within entire Offset Area. Based on five-yearly updates to vegetation zone mapping reflecting. Targets to be measured in 'patches' of native vegetation which may include areas with gaps in over-storey vegetation up to 100 m wide providing for: maintenance of species rich grasslands; <i>and</i> canopy cover of >10% when measured across the entire patch.	Broad area over-storey planting. Full structural revegetation. Facilitated natural regeneration through management of functional ecological processes such as a regular fire regime and control of exotic and over-abundant native herbivores.
Native vegetation cover, over-storey cover, gaps and hazards.	See Cumberland Plain Woodland above.				

Table 4-2 Offset Objectives - Grey-headed Flying-fox

Offset Plan Objectives	'Start quality' score	Future quality with offset' score (year 10)	Future quality with offset' score (year 20)	Monitoring framework	Management actions
<b>Grey-headed Flying-fox</b>	<b>7</b>	<b>8</b>	<b>8</b>	<b>Offset calculator – Time horizon – Time until ecological benefit 10 years</b>	<b>A 'Future quality with offset' score that is one above the 'Start quality' score after 10 years</b>
<b>Site condition score (60%)</b>	<b>7</b>	<b>8</b>	<b>8</b>		
Tree species richness (number of tree growth-form species according to the BAM in a 20 m x 20 m plot)	1 to 5	2 to 4+	2 to 4+	Plot-monitoring program and performance against targets updated by August 2023, 2028, 2033 and 2038. Includes tree species present at all life-stages / in all vegetation strata. Coordinated with adaptive management monitoring of weed control and habitat enhancement activities.	Targeted over-storey and mid-storey tree species richness planting. Supplementary planting/seeding to introduce species richness and diversity of Eucalyptus species within stands and resultant improvements in the reliability and seasonal availability of foraging resources. Use of silvicultural techniques to improve stand structure and health. To be managed with consideration of native ground cover species cover and species richness, over-storey cover and structural diversity targets, as well as management of functional ecological processes such as a regular fire regime.
Over-storey cover (over-storey cover as measured at five 5 m x 5 m quadrats along a 50 m transect according to the BBAM)	9-35%	20% +	20% +	Five-yearly plot-monitoring program. Coordinated with adaptive management monitoring of weed control and habitat enhancement activities.	Implementation of techniques to improve stand quality Facilitated natural regeneration. To be managed with consideration of native ground cover species cover and species richness, over-storey cover and structural diversity targets, as well as management of functional ecological processes such as a regular fire regime. Potential for selective thinning of dense single-aged stands of over-storey species to be undertaken to assist meeting overall ecosystem compositional, structural and functional targets.
High Threat Exotic plant species cover (total cover of HTE species according to the BAM in a 20 m x 20 m plot)	0.1 to 5.1 %	<5 %	<5 %	Measured via five-yearly site plot-monitoring program. Coordinated with adaptive management monitoring of weed control and habitat enhancement activities.	Maintenance weed control. Reducing weed cover to help maintain or improve native vegetation integrity and especially food tree cover and productivity.
Localised exotic plant infestations (on ground visual estimate of percentage cover and	Subject to updated weed class mapping	No areas of >30% exotic plant cover in a given vegetation stratum, over a	No areas of >20% exotic plant cover in a given vegetation	Annual weed class and cover monitoring coordinated with weed control activities.	Primary weed control followed by weed control rounds as required to achieve maintenance level. Reducing weed cover to help maintain or improve native vegetation integrity and especially food tree cover and productivity.



Offset Plan Objectives	'Start quality' score	Future quality with offset' score (year 10)	Future quality with offset' score (year 20)	Monitoring framework	Management actions
mapping of areas above certain cover classes)		>0.2 ha patch	stratum over a >0.05 ha patch		
Threats and restoration opportunities for the Offset Area				As indicated by monitoring of specific attributes as described above. See additional monitoring requirements below for threats and restoration opportunities for the Offset Area.	
<b>Site context score (20%)</b>	<b>7</b>	<b>8</b>	<b>8</b>		
Native vegetation cover, over-storey cover, gaps and hazards.	See Cumberland Plain Woodland above.	See Cumberland Plain Woodland above.	See Cumberland Plain Woodland above.	See Cumberland Plain Woodland above.	See Cumberland Plain Woodland above.
<b>Species stocking rate (20%)</b>	<b>7</b>	<b>7</b>	<b>7</b>	<b>Not anticipated to vary in a measurable way with management.</b>	

Table 4-3 Offset Objectives – Swift Parrot foraging habitat

Offset Plan Objectives	'Start quality' score	Future quality with offset' score (year 10)	Future quality with offset' score (year 20)	Monitoring framework	Management actions
<b>Swift Parrot foraging habitat</b>	<b>6</b>	<b>7</b>	<b>7</b>	<b>Offset calculator – Time horizon – Time until ecological benefit 10 years</b>	<b>A 'Future quality with offset' score that is one above the 'Start quality' score after 10 years</b>
<b>Site condition score (60%)</b>	<b>7</b>	<b>8</b>	<b>8</b>		
Tree species richness (number of tree growth-form species according to the BAM in a 20 m x 20 m plot)	1 to 5	2 to 4+	2 to 4+	Plot-monitoring program and performance against targets updated by August 2023, 2028, 2033 and 2038. Includes tree species present at all life-stages / in all vegetation strata. Coordinated with adaptive management monitoring of weed control and habitat enhancement activities.	Targeted over-storey and mid-storey tree species richness planting. Supplementary planting/seeding to introduce species richness and diversity of Eucalyptus species within stands and resultant improvements in the reliability and seasonal availability of foraging resources. Use of silvicultural techniques to improve stand structure and health. To be managed with consideration of native ground cover species cover and species richness, over-storey cover and structural diversity targets, as well as management of functional ecological processes such as a regular fire regime.
Over-storey cover (over-storey cover as measured at five 5 m x 5 m quadrats along a 50 m transect according to the BBAM)	9-35%	20-30%	20-30%	Five-yearly plot-monitoring program. Coordinated with adaptive management monitoring of weed control and habitat enhancement activities.	Implementation of techniques to improve stand quality Facilitated natural regeneration. To be managed with consideration of native ground cover species cover and species richness, over-storey cover and structural diversity targets, as well as management of functional ecological processes such as a regular fire regime. Potential for selective thinning of dense single-aged stands of over-storey species to be undertaken to assist meeting overall ecosystem compositional, structural and functional targets.
High Threat Exotic plant species cover (total cover of HTE species according to the BAM in a 20 m x 20 m plot)	0.1 to 5.1	<5	<5	Measured via five-yearly site plot-monitoring program. Coordinated with adaptive management monitoring of weed control and habitat enhancement activities.	Maintenance weed control. Reducing weed cover to help maintain or improve native vegetation integrity and especially food tree cover and productivity.
Localised exotic plant infestations	Subject to updated weed class mapping	No areas of >30% exotic plant cover in a	No areas of >20% exotic plant cover in	Annual weed class and cover monitoring coordinated with weed control activities.	Primary to maintenance weed control. Reducing weed cover to help maintain or improve native

Offset Plan Objectives	'Start quality' score	Future quality with offset' score (year 10)	Future quality with offset' score (year 20)	Monitoring framework	Management actions
(on ground visual estimate of percentage cover and mapping of areas above certain cover classes)		given vegetation stratum, over a >0.2 ha patch	a given vegetation stratum over a >0.05 ha patch		vegetation integrity and especially food tree cover and productivity.
Threats and restoration opportunities for the Offset Area				As indicated by monitoring of specific attributes as described above. See additional monitoring requirements below for threats and restoration opportunities for the Offset Area.	
<b>Site context score (20%)</b>	<b>7</b>	<b>8</b>	<b>8</b>		
Native vegetation cover, over-storey cover, gaps and hazards.	See Cumberland Plain Woodland above.	See Cumberland Plain Woodland above.	See Cumberland Plain Woodland above.	See Cumberland Plain Woodland above.	See Cumberland Plain Woodland above.
<b>Species stocking rate (20%)</b>	<b>4</b>	<b>4</b>	<b>4</b>	<b>Not anticipated to vary in a measurable way with management.</b>	



## 4.2 Plants, animals and their habitat

### 4.2.1 Site value

The Initial Ecological Survey confirmed the presence and distribution of five (5) PCTs which were further split according to broad condition states to yield vegetation zones. Vegetation zones are shown on [Figure 3](#) and summarised in [Table 2-1](#). The condition of these PCTs varies across the Offset Area as a result of previous land uses. Areas that have been historically cleared and/or heavily grazed now contain regrowth vegetation in poorer condition. The Offset Area has never been extensively ploughed or sown with exotic pasture and contains predominantly native vegetation. There is slight to moderate weed infestation throughout the Offset Area, with linear remnants along roads being the most severely affected. There are occasional patches of more severe weed infestation associated with areas of dumped fill or previous more intensive land uses such as firing ranges. Species richness, vegetation cover and structural complexity and the abundance of habitat resources such as woody debris and hollow-bearing trees varies across the Offset Area with disturbance history.

Site value data were collected in the Initial Ecological Survey using the BBAM plot/transect methodology and entered for each vegetation zone. One management zone was created for each vegetation zone across the site. The BBAM credit calculator was used to calculate the current site value score and future site value score with management (GHD 2020).

Change in biodiversity values through the conservation and management of the Offset Area is the basis for calculation of the change in value score as an index of the quantum of offset for plants, animals and their habitat. Conservation of vegetation within an Offset Area increases the site value by a default amount based on expected improvements in the condition of vegetation and habitat resources. There are certain circumstances where portions of an Offset Area are managed such that a different increase in site value is obtained. This may include intense, targeted management activities such as supplementary planting or revegetation.

Management zones without over-storey vegetation cover will be managed through planting of over-storey and mid-storey species. The management actions will include targeted supplementary planting of a high species richness mix of over-storey and mid-storey species combined with intensive weed control, herbivore control and soil scalping as required to achieve the Offset Objectives. The default score for over-storey and mid-storey cover has been lifted in accordance with Appendix I of the BBAM (OEH 2014b) to reflect this additional, more intensive approach to management (GHD 2020). The default increase in Offset Area value was entered for all other management zones. [Table 4-4](#) presents management zones and current and future Offset Area values based on the proposed management approach (GHD 2020).

Implementation of actions and monitoring within an adaptive management framework at the Offset Area should be tailored to the increases in site value summarised in [Table 4-4](#). Five-yearly reviews of the Offset Plan should include monitoring and assessment with reference to the BBAM as required to demonstrate that management zones are on a trajectory towards the anticipated gain in Offset Area value and/or to target adaptive management as required. The Completion Ecological Survey should include resampling of plot/transects and credit calculations with reference to the BBAM to demonstrate that the gain in Offset Area value has been achieved and/or to target supplementary management as required. In the event of any disagreement between the values in [Table 4-4](#) and the Offset Objectives set in section 4.1, the Offset Objectives for the affected threatened biota set in section 4.1 have precedence.

Table 4-4 Management zones

Veg zone ID	Management zone	Management zone	Management zone area (ha)	Management unit(s)	Summary of management approach	Current site value	Future site value	Gain in site value
1	Maintain and enhance Good condition Grey Box - Forest Red Gum grassy woodland on flats (HN528, Moderate/good -high)	MZ1	340.83	A, B	Standard default increase in all site attributes.	67.63	89.37	21.74
2	Regeneration of poor condition Grey Box - Forest Red Gum grassy woodland on flats (HN528, Moderate/good - poor)	MZ2c	123.64	C	Standard default increase in all site attributes.	35.51	66.18	30.67
2	Active restoration of poor condition Grey Box - Forest Red Gum grassy woodland on flats (HN528, Moderate/good - poor)	MZ2d	159.52	D	Inclusive of active restoration gain associated with supplementary planting of over storey and mid storey.	35.51	72.46	36.95
10	Revegetation in Grey Box - Forest Red Gum grassy woodland on flats (HN528, Low)	MZ10	60.75	D, E, F	Inclusive of active restoration gain associated with supplementary planting of over storey and mid storey.	23.91	55.07	31.16
5	Maintain and enhance Good condition Forest Red Gum - Rough-barked Apple grassy woodland (HN526, Moderate/good - high)	MZ5	118.65	A, B	Standard default increase in all site attributes.	60.07	82.29	22.22
6	Regeneration of poor condition Forest Red Gum - Rough-barked Apple grassy woodland (HN526, Moderate/good - poor)	MZ6bc	28.65	B, C	Standard default increase in all site attributes.	32.81	53.65	20.84
6	Active restoration of poor condition Forest Red Gum - Rough-barked Apple grassy woodland (HN526, Moderate/good - poor)	MZ6d	18.76	D	Inclusive of active restoration gain associated with supplementary planting of over storey and mid storey.	32.81	56.25	23.44
7	Maintain and enhance Broad-leaved Ironbark - Grey Box - <i>Melaleuca decora</i> grassy open forest on clay/gravel soils (HN512, Moderate/good – high)	MZ7	30.98	A	Standard default increase in all site attributes.	74.4	95.65	21.25
8	Regeneration of Broad-leaved Ironbark - Grey Box - <i>Melaleuca decora</i> grassy open forest on clay/gravel soils (HN512, Moderate/good – poor)	MZ8	8.03	C	Standard default increase in all site attributes.	37.68	68.6	30.92
9	Maintain and enhance <i>Phragmites australis</i> and <i>Typha orientalis</i> coastal freshwater wetlands (HN630)	MZ9	3.79	G	Standard default increase in all site attributes.	71.01	85.51	14.5
11	Maintain and enhance Broad-leaved Ironbark - <i>Melaleuca decora</i> shrubby open forest on clay soils (HN513, Moderate/good – high)	MZ11	17.67	A	Standard default increase in all site attributes.	76.09	97.83	21.74

#### 4.2.2 Threatened flora populations

Threatened flora populations at the Offset Area at the time of the Initial Ecological Survey are shown on [Figure 4](#).

A total of 1,318 *Pultenaea parviflora* were recorded, all within the Southern Buffer in Good condition Broad-leaved Ironbark - Grey Box - *Melaleuca decora* grassy open forest on clay/gravel soils and Good condition Broad-leaved Ironbark - *Melaleuca decora* grassy open forest on clay soils (GHD 2020).

A total of 72 *Dillwynia tenuifolia* were recorded, all located within Good condition Broad-leaved Ironbark - *Melaleuca decora* grassy open forest on clay soils in the eastern portion of the Southern Buffer Area. It should be noted that in 2019, *Dillwynia tenuifolia* was not recorded in the majority of areas previously occupied by this species, and that individuals observed were overgrazed, cryptic and stunted. Biodiversity monitoring indicated significant fluctuations in the abundance of these species between 2008 and 2013 (SKM 2014) and no *Dillwynia tenuifolia* were recorded during the January 2018 site inspection. This is probably because of the prolonged dry weather and intensity of grazing in preceding months. *Dillwynia tenuifolia* appears to be particularly susceptible to grazing by exotic, hooved herbivores compared to conspecific plants and may be significantly suppressed at a site under grazing pressure from cows or deer (pers. obs.). The majority of the *Dillwynia tenuifolia* detected by the Initial Ecological Survey were revealed by the July 2019 targeted threatened flora survey rounds, which followed intensive deer control in June 2019. The wild deer population at Orchard Hills was reduced from an estimated 40-46 individuals to fewer than 10 individuals in early June (AVMP 2019). The absence of wild deer may have resulted in vegetative growth and increased detectability of *Dillwynia tenuifolia*. It is likely that the population of this species in the soil seed bank and the potential population under ideal conditions is considerably greater than the 72 individuals observed in 2019 (GHD 2020).

A substantial population of around 2,528 *Marsdenia viridiflora* subsp. *viridiflora* stems was recorded at the Offset Area during the 2019 site inspections. The population recorded by this census is notably greater than the approximately 80 individuals previously recorded at the site (SKM 2014). The majority of individuals observed (around 2,500) were in the Broad-leaved Ironbark - Grey Box - *Melaleuca decora* grassy open forest on clay/gravel soils and Good condition Broad-leaved Ironbark - *Melaleuca decora* grassy open forest on clay soils in the Southern Buffer Area. A small number of stems were recorded in Grey Box – Forest Red Gum grassy woodland on flats adjoining the core population in the Southern Buffer Area and up to eight stems were recorded in this PCT in the Northern Buffer Area (GHD 2020).

The core *Marsdenia viridiflora* subsp. *viridiflora* population included mature, fruiting individuals with stems up to three metres long established through the dense mid-storey of *Bursaria spinosa* subsp. *spinosa* and *Melaleuca nodosa*. The majority of the total count of stems in 2019 was associated with tightly clustered groups of up to 100 stems less than 10 centimetres tall, presumably associated with re-sprouting lignotubers and clusters of seedlings under optimal growing conditions (GHD 2020).

A total of 88 *Grevillea juniperina* subsp. *juniperina* were recorded in Good condition Broad-leaved Ironbark - *Melaleuca decora* grassy open forest on clay soils as part of the same core area of habitat for the other threatened plants and in Grey Box – Forest Red Gum grassy woodland on flats along the south eastern boundary of the Northern Buffer. The majority of individuals of this species were recorded along fire trails and other disturbed edges of vegetated patches as is typical of this species. *Grevillea juniperina* subsp. *juniperina* is not part of the offset requirement for WSI and as such was not the subject of systematic targeted



survey. The 88 individuals recorded does not represent an accurate census of the species and is probably an underestimate (GHD 2020).

Monitoring and purposeful management to maintain or increase the extent or abundance of the populations of these species should be a particular focus of the implementation of the Offset Plan. This should include specific mitigation of threats within the area of threatened plant habitat shown on [Figure 4](#). Baseline populations and expected outcomes for threatened plant populations are summarised in [Table 4-5](#) below. Consideration should be given to collection and propagation of plant material from these threatened plant populations as source material for [Regeneration and revegetation](#) activities and as a technique for maintaining populations. However, given the inherent difficulty of obtaining an accurate population census of many threatened plants and fluctuations in populations that may occur in natural populations, no specific targets for population size increases have been set in the Offset Plan.

Table 4-5 Threatened flora population baseline and anticipated outcomes

Common name	Scientific name	Baseline number of individuals (stems) <sup>1</sup>	Baseline area of occupied habitat (ha) <sup>1</sup>	Year 10 outcome <sup>2</sup>	Year 20 outcome <sup>3</sup>	Monitoring framework	Key management actions and focus
<i>Dillwynia tenuifolia</i>	<i>Dillwynia tenuifolia</i>	72	1.26	Maintenance or increase of area of occupied habitat. Improvement of condition in line with targets for management actions.	Maintenance or increase of area of occupied habitat. Improvement of condition in line with targets for management actions.	Population estimate and mapping of area of occupied habitat and progress against anticipated management outcomes updated by August 2023, 2028, 2033 and 2038.	Weed control, ecological fire management, pest fauna control.
<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	2,528	6.99				
<i>Pultenaea parviflora</i>	<i>Pultenaea parviflora</i>	1,318	5.45				
<i>Grevillea juniperina</i>	<i>Grevillea juniperina</i> subsp. <i>juniperina</i>	188	3.91				

Notes:

1) as confirmed through Initial Ecological Survey in April-July 2019 field survey (GHD 2020).

2) as confirmed through Year 10 Offset Plan review and update by 25/8/2028.

3) as confirmed through Completion Ecological Survey by 25/8/2038.

#### 4.2.3 Terrestrial fauna and habitat

A number of threatened fauna species were recorded during the Initial Ecological Survey or other investigations as described in section 2.4.2. These fauna species have been grouped according to their ecological requirements as follows:

- Cumberland Plain Land Snail (*Meridolum corneovirens*), which is an obligate user of Cumberland Plain Woodland and related communities and is a species-credit type species according to the BBAM. This species was recorded at multiple locations in woodland and riparian forest across the Offset Area and the species' habitat would be conserved and managed through the implementation of management actions for Cumberland Plain Woodland, poorer quality Cumberland Plain Woodland, woodland and forest management and habitat enhancement;
- Southern Myotis (*Myotis macropus*) which is an obligate user of permanent waterbodies that comprise suitable foraging habitat and is a species-credit type species according to the BBAM. This species was identified based on definite call recordings at the Offset Area and would use foraging habitat as well as roosting habitat in hollow-bearing trees, bridges and culverts. This species would be conserved and managed through the implementation of management actions for Cumberland Plain Woodland, woodland and forest management, habitat enhancement, including provision of roost sites in the vicinity of waterbodies, and maintenance or improvement of waterbodies;
- Birds of woodland and forest that would be conserved and managed through the implementation of management actions for Cumberland Plain Woodland, woodland and forest management and habitat enhancement, including the following threatened species that have been recorded at the Offset Area:
  - Dusky Woodswallow (*Artamus cyanopterus*)
  - Scarlet Robin (*Petroica boodang*)
  - Varied Sitella (*Daphoenositta chrysoptera*)
  - Little Lorikeet (*Glossopsitta pusilla*)
  - Little Eagle (*Hieraaetus morphnoides*)
  - Spotted Harrier (*Circus assimilis*)
- Microbats that forage in woodland, forest or open space and that would be conserved and managed through the implementation of management actions for Cumberland Plain Woodland, woodland and forest management, habitat enhancement, including the following threatened species that have been recorded at the Offset Area:
  - Eastern Freetail Bat (*Mormopterus norfolkensis*)
  - Southern Myotis (*Myotis macropus*)
  - Little Bentwing Bat (*Miniopterus australis*)
  - Greater Broad-nosed Bat (*Scoteanax rueppellii*),
  - Eastern Bent-wing Bat (*Miniopterus schreibersii oceanensis*).

Threatened fauna observed during the Initial Ecological Survey are shown along with habitat types and resources on [Figure 5](#).

Baseline habitat areas and expected outcomes for threatened fauna habitats are summarised in [Table 4-6](#) below. No additional targets have been set for other threatened fauna species as it is assumed that targets for broad ecological restoration and threat mitigation activities will be appropriate to conserve these species and their habitats.



Periodic monitoring should aim to document the continued presence of these species within the Offset Area and the presence of any additional threatened species. Monitoring and day to day observations should note any particular habitat resources or patterns of usage that may require specific management; for example use of nests or roosts. Any such observations should be recorded and mapped and then accounted for in the adaptive management approach applied to actions that may affect the recorded feature using a risk-based approach.

These threatened species would be an appropriate target of research to demonstrate co-benefits of achieving the Offset Objectives (see sections 3.6 and 6.4).

Reintroduced fauna populations should include species that are listed as threatened under the EPBC Act and/or in NSW as identified in the fauna reintroduction strategy.

Table 4-6 Threatened fauna populations baseline and anticipated outcomes

Common name	Scientific name	Baseline area of habitat (ha) <sup>1</sup>	Year 10 outcome <sup>2</sup>	Year 20 outcome	Key management actions and focus
Cumberland Plain Land Snail	<i>Meridolum corneovirens</i>	508.14	Maintenance of baseline area of occupied habitat (508.14 ha) as confirmed by observation of individuals and shells. Improvement of condition in line with targets for management actions.	Increased area of occupied habitat comprising baseline area plus at least 50% of regeneration/revegetation area (~691 ha total) as confirmed by observation of individuals and shells. Improvement of condition in line with targets for management actions.	Woodland and forest management, regeneration and revegetation, habitat enhancement.
Southern Myotis	<i>Myotis macropus</i>	133.42	Maintenance or increase of baseline area of suitable habitat (133.42 ha) comprising woodland and forest within buffer area of 100 m surrounding suitable foraging habitat. Presence of appropriately designed and sited artificial roosts where required to supplement naturally occurring roost sites. Improvement of condition in line with targets for management actions.	Maintenance or increase of baseline area of occupied habitat (133.42 ha) comprising woodland and forest within buffer area of 100 m surrounding suitable foraging habitat. Presence of appropriately designed and sited artificial roosts where required to supplement naturally occurring roost sites. Improvement of condition in line with targets for management actions.	Woodland and forest management, regeneration and revegetation, habitat enhancement. Habitat enhancement to include installation and monitoring of appropriately designed and sited artificial roosts.
Birds of woodland and forest	Dusky Woodswallow ( <i>Artamus cyanopterus</i> ); Scarlet Robin ( <i>Petroica boodang</i> ); Varied Sitella ( <i>Daphoenositta chrysoptera</i> ); Little Lorikeet ( <i>Glossopsitta pusilla</i> ); Little Eagle ( <i>Hieraaetus morphnoides</i> ); Spotted Harrier ( <i>Circus assimilis</i> ).	508.14	Maintenance of baseline area of suitable habitat (508.14 ha). Improvement of condition in line with targets for management actions.	Increased area of suitable treed habitat comprising baseline area plus entire regeneration/revegetation area (~938.48 ha total). Improvement of condition in line with targets for management actions.	Woodland and forest management, regeneration and revegetation, habitat enhancement, control of pest fauna.
Microbats that forage in woodland, forest or open space	Eastern Freetail Bat ( <i>Mormopterus norfolkensis</i> ), Southern Myotis ( <i>Myotis</i>	978.83	Maintenance of baseline area of suitable habitat (entire Offset Area). Improvement of condition in	Maintenance of baseline area of suitable habitat (entire Offset Area). Improvement of condition in	Woodland and forest management, regeneration and revegetation,

Common name	Scientific name	Baseline area of habitat (ha) <sup>1</sup>	Year 10 outcome <sup>2</sup>	Year 20 outcome	Key management actions and focus
	<i>macropus</i> ), Little Bentwing Bat ( <i>Miniopterus australis</i> ); Greater Broad-nosed Bat ( <i>Scoteanax rueppellii</i> ), Eastern Bent-wing Bat ( <i>Miniopterus schreibersii oceanensis</i> ).		line with targets for management actions.	line with targets for management actions.	habitat enhancement, control of pest fauna.
Reintroduced fauna populations	As identified in the fauna reintroduction strategy.	Fauna reintroduction area as mapped in the fauna reintroduction strategy.	As defined in the fauna reintroduction strategy.	As defined in the fauna reintroduction strategy.	Fauna reintroductions, as supported by woodland and forest management, regeneration and revegetation, habitat enhancement, control of pest fauna.

Notes:

1) as confirmed through Initial Ecological Survey in April-July 2019 field survey (GHD 2020).

2) as confirmed through Year 10 Offset Plan review and update by 25/8/2028.

3) as confirmed through Completion Ecological Survey by 25/8/2038.



## 4.3 Threats and restoration opportunities

### 4.3.1 Summary of targets

Specific Offset Objectives for each of the affected threatened biota are presented in Table 4-1 to Table 4-3. Targets for site quality scores for plants, animals and their habitats are set in Table 4-4 with reference to the BBAM 2014. The anticipated outcomes for threatened flora populations are set in Table 4-5 and for threatened fauna populations in Table 4-6. This section outlines consideration of matters that will require management at the Offset Area in order to improve its condition and outcomes for threatened species. However, they are not specifically linked to the biodiversity targets set in these preceding sections. These actions which assist in achieving benefit for EPBC listed matters are collectively referred to as ‘threats and restoration opportunities’.

Targets related to threats to biodiversity values operating at the Offset Area and opportunities to address these threats or otherwise improve biodiversity value are summarised in Table 4-7. The targets set in Table 4-7 differ from certain targets set in preceding sections because of differences in the baseline condition of the land that will be managed and relative importance to achieving the Offset Objectives.

Targets for tree species richness and cover have been set for Cumberland Plain Woodland and for Grey-headed Flying-fox and Swift Parrot foraging habitat that encompasses all woodland and forest vegetation at the Offset Area (see section 4.1). These targets reflect the Offset Objectives for these biota. Table 4-7 sets tree species richness targets for vegetation zones 6 and 10, which are derived grassland, sedgeland or scrub communities that must be managed to improve their condition but will not directly contribute to the achievement of the Offset Objectives for Cumberland Plain Woodland, the Grey-headed Flying-fox or Swift Parrot foraging habitat. As such, lower targets have been set for these areas providing for greater flexibility in their management. For instance, areas of vegetation zone 6 could be maintained as Swamp Oak (*Casuarina glauca*) scrub with a tree species richness of one species per plot without affecting the achievement of the Offset Objectives.

Additional context for each threat or restoration opportunity and the targets set in Table 4-7 is provided in the sections below.

Table 4-7 Offset Plan Objectives – threats and restoration opportunities

Offset Plan Objectives	'Start quality' score	'Future quality with offset' score (year 10)	'Future quality with offset' score (year 20)	Monitoring framework	Key management actions and focus
Woodland and forest stand health and structural diversity	As set at the patch scale as part of the development of a management strategy by August 2022.	As per targets set at the patch scale.	As per targets set at the patch scale.	Survey and mapping of stand health and structural diversity and performance against targets updated by August 2023, 2028, 2033 and 2038.	Development and implementation of techniques to improve stand quality. Targeted tree species richness planting.
Tree species richness in vegetation zones 6 and 10 (number of tree growth-form species according to the BAM in a 20 m x 20 m plot)	0 to 3	1 to 3+	1 to 5+	Five-yearly plot-monitoring program. Includes tree species present at all life-stages / in all vegetation strata. Coordinated with adaptive management monitoring of weed control and habitat enhancement activities.	Targeted tree species richness planting of over-storey and mid-storey species. Supplementary planting/seeding to introduce species richness and diversity of Eucalyptus species within stands. Use of silvicultural techniques to improve stand structure and health. To be managed with consideration of native ground cover species cover and species richness, over-storey cover and structural diversity targets, as well as management of functional ecological processes such as a regular fire regime.
Shrub species richness in vegetation zones 6 and 10 (number of shrub growth-form species according to the BAM in a 20 m x 20 m plot)	0 to 3	2 to 8+	2 to 8+	Five-yearly plot-monitoring program. Includes shrub species present at all life-stages / in all vegetation strata. Coordinated with adaptive management monitoring of weed control and habitat enhancement activities.	Targeted shrub and ground cover species richness planting. Facilitated natural regeneration combined with supplementary planting/seeding to introduce species richness and management of functional

Offset Plan Objectives	'Start quality' score	'Future quality with offset' score (year 10)	'Future quality with offset' score (year 20)	Monitoring framework	Key management actions and focus
					ecological processes such as a regular fire regime.
Ground cover species richness in vegetation zones 6 and 10 (total number of grass, grass-like, forb, fern, scrambler and climber growth-forms species according to the BAM in a 20 m x 20 m plot)	13 to 21	>20	>20	Five-yearly plot-monitoring program. Coordinated with adaptive management monitoring of weed control and habitat enhancement activities.	Targeted shrub and ground cover species richness planting. Facilitated natural regeneration combined with supplementary planting/seeding to introduce species richness. Management of functional ecological processes such as a regular fire regime and exotic and over-abundant native herbivores.
Ground cover in vegetation zones 6 (PCT835) and 10 (PCT849) (total cover of grass, grass-like, forb, fern, scrambler and climber growth-forms species according to the BAM in a 20 m x 20 m plot)	5.3% to 32.0% in PCT 849 42.7 to 78.5% in PCT 835	20-70% in PCT 849 40-90% in PCT 835	20-70% in PCT 849 40-90% % in PCT 835	Measured via five-yearly site plot-monitoring program. Coordinated with adaptive management monitoring of weed control and habitat enhancement activities.	Review and implement overabundant native fauna controls. Maintenance weed control.
Fallen logs in vegetation zones 5, 6, 10 and 11	0 to 12 m (0 in 8 out of 9 plots)	> 10 m in 50% of plots sampled.	> 10 m in 80% of plots sampled.	Measured via five-yearly site plot-monitoring program. Five-yearly dedicated broad scale habitat resource mapping monitoring and re-setting of targets. Coordinated with adaptive management monitoring of habitat enhancement activities. Intensive monitoring and/or research as defined on	Installation of supplementary habitat resources. Installation of woody debris and other habitat resources in accordance with the ecological requirements of target ground dwelling fauna species which must include <i>Meridolum corneovirens</i> .



Offset Plan Objectives	'Start quality' score	'Future quality with offset' score (year 10)	'Future quality with offset' score (year 20)	Monitoring framework	Key management actions and focus
				establishment of programs.	
Hollow-bearing trees (HBTs) in vegetation zones 5 (PCT835) and 11 (PCT725)	At least 1 hollow in 1 out of 9 plots	At least 10 HBTs, artificial hollows or nest boxes per hectare across treed areas of related vegetation zones (equivalent to at least one hollow measured in 50 m x 20 m plot).	At least 10 HBTs, artificial hollows or nest boxes per hectare across treed areas of related vegetation zones (equivalent to at least one hollow measured in 50 m x 20 m plot).	Measured via five-yearly site plot-monitoring program. Five-yearly dedicated broad scale habitat resource mapping monitoring and re-setting of targets. Coordinated with adaptive management monitoring of habitat enhancement activities. Intensive monitoring and/or research of condition, occupancy, patterns of use etc as defined on establishment of programs.	Installation of supplementary habitat resources. Installation of artificial hollows and/or nest boxes in accordance with the ecological requirements of target species which must include <i>Myotis macropus</i> and a diverse suite of microbat, bird and arboreal mammal species of the Cumberland Plain.
Habitat enhancement	Subject to fine scale habitat resource mapping and development of strategy.	As specified in strategy.	As specified in strategy.	Survey and mapping of presence and usage of habitat resources and performance against targets updated by August 2023, 2028, 2033 and 2038.	Woodland and forest management, regeneration and revegetation, habitat enhancement including installation of resources.
High Threat Exotic cover in vegetation zones 5, 6, 10 and 11	<1% to 10%	<5%	<5%	Five-yearly plot-monitoring program. Coordinated with adaptive management monitoring of weed control and habitat enhancement activities.	Maintenance weed control Reducing weed cover to help maintain or improve native vegetation integrity.
Localised exotic plant infestations	Subject to fine scale weed mapping	No areas of >31% exotic plant cover in a given vegetation stratum, over a >0.2 ha patch	No areas of >20% exotic plant cover in a given vegetation stratum over a >0.05 ha patch	Annual weed class and cover monitoring coordinated with weed control activities.	Primary to maintenance weed control. Reducing weed cover to help maintain or improve native vegetation integrity.

Offset Plan Objectives	'Start quality' score	'Future quality with offset' score (year 10)	'Future quality with offset' score (year 20)	Monitoring framework	Key management actions and focus
Ecological fire management	Implementation of a fire management regime based on mitigating risk to human health and property, with incorporation of ecological fire regimes as practicable.	Implementation of a fire management regime based on mitigating risk to human health and property, as well as risk of native achieving biodiversity management targets through incorporation of ecological fire regimes.	Implementation of a fire management regime based on mitigating risk to human health and property, as well as risk of native achieving biodiversity management targets through incorporation of ecological fire regimes.	As prescribed in updated Bushfire Risk Management Plan.	Implementation of a more natural fire regime through coordination of ecological burns with bushfire hazard management activities.
Macropod populations and impacts of overabundant native herbivores	Populations at 'managed' levels. 2018 pre-management and 2019 post-management populations levels to be confirmed by Defence.	Populations at 'managed' levels. Targets TBC by Defence.	Populations at 'managed' levels. Targets TBC by Defence.	Prescribed Defence macropod monitoring plan monitoring and management methods.	Implementation of Animal Management program/strategy.
Pest fauna	Pest fauna individuals detected in moderate abundance through survey. Evidence of degradation of biodiversity values and habitat (e.g. overgrazed ground cover, occupied rabbit warrens).	Pest fauna suppressed. Pest fauna individuals undetectable through survey or in very low abundance No evidence of degradation of biodiversity values and habitat.	Pest fauna suppressed. Pest fauna individuals undetectable through survey or in very low abundance No evidence of degradation of biodiversity values and habitat.	Pest fauna individuals undetectable through survey or in very low abundance. Observations of evidence of degradation of biodiversity values and habitat (e.g. ground cover vegetation species richness and cover at target levels, no occupied rabbit warrens).	Implementation of fauna management program/strategy, including population monitoring through camera traps and transect observations and control measures such as shooting.
Fauna reintroductions	Target species absent. Fauna reintroduction strategy to be developed.	Populations of target fauna species introduced in accordance with plan. Fauna species richness and associated functional ecological processes introduced.	Populations of target fauna species established in accordance with plan. Fauna species richness and associated functional ecological processes established.	As prescribed in fauna reintroduction strategy.	As prescribed in fauna reintroduction strategy.
Contamination	Known and likely areas of contamination that pose a risk to human health and/or the Offset Objectives.	Contamination remediated in accordance with Remediation Action Plans (RAPs) or equivalent as specified by Defence.	Contamination remediated in accordance with RAPs or equivalent as specified by Defence.	As specified by Defence.	Facilitation of remediation actions undertaken by Defence. Notification of any ground-disturbing activities. Notification of any observations of materials of

Offset Plan Objectives	'Start quality' score	'Future quality with offset' score (year 10)	'Future quality with offset' score (year 20)	Monitoring framework	Key management actions and focus
					concern.
Non-hazardous waste	Known and likely areas of obsolete fencing and other non-hazardous waste that pose a risk to the Offset Objectives, including those shown on Figure 8.	Characterisation of all non-hazardous waste and removal of all obsolete fencing and any other material that poses a risk to the Offset Objectives.	Site maintained free of any non-hazardous waste material that poses a risk to the Offset Objectives.	Identification, characterisation and mapping of waste and setting of removal requirements using a risk-based approach. Mapping and performance against targets updated by August 2023, 2028, 2033 and 2038.	Remove non-hazardous waste and dumped materials.
Erosion and sedimentation	Known and likely areas of erosion or sedimentation that pose a risk to the Offset Objectives, including those shown on Figure 8.	Characterisation and remediation of all areas of erosion or sedimentation that pose a risk to the Offset Objectives.	Characterisation and remediation of all areas of erosion or sedimentation that pose a risk to the Offset Objectives.	Identification, characterisation and mapping of erosion and sedimentation and setting of remediation requirements using a risk-based approach. Mapping and performance against targets updated by August 2023, 2028, 2033 and 2038.	Soil and water management. Mitigation and/or remediation of erosion.



#### 4.3.2 Woodland and forest integrity

Historical impacts and residual threats have combined to reduce the integrity and resilience of woodland and forest at the Offset Area. There is low species richness and structural diversity in many patches of woodland and forest at the Offset Area. As is typical when a landscape has been extensively cleared, regeneration has occurred around a small number of isolated remnant trees. This is particularly apparent in the western portion of the Southern Buffer Area which features stands of closely spaced, uniformly aged Grey Box (*Eucalyptus moluccana*). Species richness, habitat complexity and the variety and reliability of resources is reduced in these stands. Stands of trees with these characteristics may also be particularly susceptible to *Eucalyptus* dieback.

**Woodland and forest management** actions should be implemented, including targeted tree species richness planting and use of silvicultural techniques to improve stand health and complexity (see section 5.2). These actions are to be implemented along with consideration of native ground cover species cover and species richness, landscape scale over-storey cover and structural diversity targets, as well as management of functional ecological processes such as a regular fire regime. Targets for woodland and forest integrity related to stand health and structural complexity should be set at the patch scale as part of the development of a management strategy by August 2022. Woodland and forest stand health mapping and associated targets should be refined and updated (see [Table 5-3](#)).

There are areas of overabundant Native Blackthorn (*Bursaria spinosa* subsp. *spinosa*) scrub at the Offset Area associated with previous fire and disturbance regimes, including around 300 hectares of the eastern portion of the Northern Buffer Area. Overabundant Native Blackthorn may inhibit native ground cover diversity and reduce habitat complexity and provision of resources and opportunities for fauna. High fuel loads in the mid-storey stratum may also increase the risk of damaging wildfire. Maintenance of an ecological fire regime may assist with restoring structural diversity (see section 4.3.6 and 5.6). It may also be appropriate to undertake mechanical removal of Native Blackthorn scrub to help restore a natural vegetation structure and native ground cover diversity in areas where it would not be possible to use fire to achieve this aim given the risk of damaging wildfire.

#### 4.3.3 Regeneration and revegetation

At the time of the Initial Ecological Survey there was a total of 365.80 hectares of poorer condition native vegetation comprising derived native grassland or scrub with over-storey cover substantially below benchmark values. There is a further 60.75 hectares of exotic grassland and bare earth. This total area of 426.55 hectares will be strategically regenerated or revegetated to create a landscape dominated by native woodland and forest characteristic of the natural structure of the PCTs at the Offset Area. There is a further 40.35 hectares of unmapped vegetation at the Offset Area associated with land uses that are not consistent with regeneration.

Specific targets for regeneration and revegetation have been set for poorer quality Cumberland Plain Woodland (see section 4.1) and additional areas associated with vegetation zones 6 and 10 (see [Table 4-7](#)). A strategy for achieving these targets should be developed as part of the development of a revegetation strategy specifying planting areas, techniques and finer scale time and area-bound targets. The strategy should include maintenance of areas of species rich native grasslands or scrub within a matrix of woodland and open woodland vegetation that collectively comprise continuous patches of native vegetation communities. The strategy should be supported by fine scale mapping of the extent of natural regeneration, revegetation areas and areas to be maintained as grassland. Regeneration/revegetation mapping and associated targets should be refined and updated (see [Table 5-5](#)).

#### 4.3.4 Habitat enhancement

The Offset Area contains the following broad fauna habitat types as shown on [Figure 5](#):

- Grassy woodland on gently undulating terrain on shale substrates (133.28 hectares).
- Shrubby woodland or forest, including Castlereagh Ironbark and Shale/gravel transition forest communities and shale woodlands with high cover of Native Blackthorn (256.21 hectares).
- Riparian forest on alluvial flats (118.65 hectares).
- Native grassland or scrub derived from clearing of woodland and forest (365.80 hectares).
- Wetlands (3.79 hectares).
- Exotic grassland and cleared land associated with previous, more intensive land uses and dumped fill (60.75 hectares).

Woodland and forest at the Offset Area contains relatively good quantities of pre-European occupation age trees and associated habitat resources, such as tree hollows and stags. These trees include hollows with a range of sizes, orientations and landscape positions and both living and dead trees. See descriptions of vegetation zones in field survey data in the Initial Ecological Survey report (GHD 2020) for a summary of abundance of hollow-bearing trees in plot/transects.

Additional field surveys were conducted between 4 June 2019 and 26 June 2019 throughout the Offset Area to identify and map a range of habitat resources, including hollows (Kleinfelder 2019). This survey effort resulted in the following counts of habitat resources:

- 326 small hollows (< 5 cm diameter);
- 262 medium hollows (5 – 20 cm diameter);
- 113 large hollows (> 20 cm diameter); and
- 13 hollow habitat logs.

These habitat resources were observed to be in use by a range of native and pest fauna during the survey period (Kleinfelder 2019) and are mapped on [Figure 5](#).

Woodland and forest at the Offset Area contains moderate quantities of woody debris, including averages of 21.5 linear metres to 34.5 linear metres of fallen logs in plot/transects sampled within treed vegetation zones. Recorded total lengths of fallen logs were above benchmark levels in riparian forest (PCT 835 / HN526) but averaged around half of benchmark levels in woodland PCTs. Leaf litter cover was generally at benchmark levels based on averages across plots. Overall, the Offset Area contains good quantities of shelter and foraging substrate for ground dwelling fauna that would depend on these resources, notably including the Cumberland Plain Land Snail (*Meridolum corneovirens*).

There are extensive areas of grassland at the Offset Area that would have historically supported native woodland vegetation but have been extensively modified by previous clearing and agriculture. Hollow-bearing trees, woody debris and leaf litter are generally absent from derived grassland and scrub and were all well below benchmark levels in plots sampled. Provision of these habitat resources should be a particular focus of the Offset Plan implementation, including through placement of nest boxes or artificial hollows and use of residues from stand thinning, agricultural timber such as fence posts and/or imported resources salvaged from development areas. These resources would also develop naturally in the medium to long term in regeneration and revegetation areas.

The areas of exotic grassland and cleared land contain few habitat resources of relevance to most native species and will require provision of habitat resources along with revegetation works.

Targets for habitat resources have been set for Cumberland Plain Woodland (see section 4.1). Targets for habitat resources for other areas (vegetation zones 5, 6, 10 and 11) are set in Table 4-7. Additional, specific targets should be developed as part of the development of a management strategy related to the ecological requirements of target fauna and/or the specific resource installation techniques employed. Habitat resource mapping and associated targets should be refined and updated (see Table 5-3).

#### 4.3.5 Weed control

Weed infestations revealed by the Initial Ecological Survey have been mapped according to weed classes as shown on Figure 8.

Plant species identified as Weeds of National significance (WoNs) and/or High Threat Exotic (THE) weed species and recorded at the Offset Area in the Initial Ecological survey and/or by AFL (2019b) are listed in Table 4-8.

A full list of exotic plant species recorded at the Offset Area and weed cover recorded within plots is provided in Appendix A of the Initial Ecological Survey report (GHD 2020).

Table 4-8 Listed weed species recorded at the Offset Area

Scientific Name	Common Name	WoNS (CoA 2017)	High Threat Exotic
<i>Araujia sericifera</i>	Moth Vine	Yes	Yes
<i>Asparagus asparagoides</i>	Bridal Creeper	Yes	Yes
<i>Bidens pilosa</i>	Greater Beggar's Ticks	No	Yes
<i>Bidens subalternans</i>	Purple Appleberry	No	Yes
<i>Briza subaristata</i>		No	Yes
<i>Cestrum parqui</i>	Green Cestrum	No	Yes
<i>Chloris gayana</i>	Rhodes Grass	No	Yes
<i>Cirsium vulgare</i>	Spear Thistle	Yes	Yes
<i>Ehrharta erecta</i>	Panic Veldtgrass	No	Yes
<i>Eragrostis curvula</i>	African Lovegrass	Yes	Yes
<i>Juncus acutus</i>	Sharp Rush	No	Yes
<i>Lantana camara</i>	Lantana	Yes	Yes
<i>Ligustrum lucidum</i>	Small-leaved Privet-	No	Yes
<i>Ligustrum sinense</i>	Broad-leaved Privet	No	Yes
<i>Lycium ferocissimum</i>	African Boxthorn	Yes	Yes
<i>Nassella neesiana</i>	Chilean Needle Grass	Yes	Yes
<i>Olea europaea</i> subsp. <i>cuspidata</i>	African Olive	No	Yes
<i>Opuntia stricta</i>	Common Prickly Pear	Yes	Yes
<i>Paspalum dilatatum</i>	Paspalum	No	Yes
<i>Rubus fruticosus</i> sp. agg.	Blackberry	Yes	Yes
<i>Senecio madagascariensis</i>	Fireweed	Yes	Yes

Photo monitoring locations have been established in 2019 in areas of African Olive infestation; eight in the Northern Buffer and two in the Southern Buffer (AFL 2019b). African Olive plants have evidence of grazing (likely by deer), with much higher numbers and more dense infestations in the Northern Buffer. The largest Olive infestation discovered at DEOH is less than 10m<sup>2</sup> which demonstrates high potential for these infestations to be controlled (AFL 2019b). African Olive plants are only present in woodland areas, and seeds appear to be being spread by birds and foxes. Thirteen transects of 20 metres (with 10 metres observed either side of the transect line) were surveyed for African Olive seedlings and mature trees, with one



transect in each sector of the Offset Area. Counts in the Northern Buffer ranged from 0 – 25 seedlings and 0 – 2 mature trees per transect, while counts in the Southern Buffer ranged from 0 – 8 seedlings and 0 – 2 mature trees. Only one sector transect in both the Northern and Southern Buffer had no occurrence of African Olive (AFL 2019b).

Ten (10) test plots (10 m x 10 m) have been established in the Northern and Southern Buffer areas (five (5) plots in each) to allow different methods of the treatment of African Love Grass to be trialled (AFL 2019b). The results of longer term analysis of African Love Grass control plots established by AFL (AFL 2019b) should be considered in the weed management strategy for the Offset Area. Early results indicated that spraying followed by slashing and spraying cause the African Love Grass to most rapidly and significantly turn yellow. Boom spraying trials for African Love Grass have also been performed in 2019, the results of which have not yet been verified (AFL 2019b). This method was trialled due to the presence of African Love Grass in density of up to 90 percent cover in some grassland areas.

Trial plots have also been established to compare the success of thermal weeding, hand weeding and hessian sack control methods against a control plot. Initial results indicated that thermal weeding in conjunction with hand weeding may be the most effective method to control prevent both seeding and germination from a seedbank (AFL 2019b).

Targets for weed control have been set for Cumberland Plain Woodland (see section 4.1). Targets for weed control for other vegetation zones are set in [Table 4-7](#). Additional specific time and area bound targets should be developed as part of the development of weed control planning. Weed cover class mapping and associated targets should be refined and updated (see [Table 5-3](#)). Specific targets to be developed for weed control should utilise appropriate descriptive cover classes and the need to meet targets outlined in the Offset Plan.

#### 4.3.6 Ecological fire management

The recent DEOH Property Bushfire Management Plan 2014-2019 (GHD 2014) identifies appropriate bushfire mitigation works, including scheduling a regime of low intensity burns for designated burn blocks within the Offset Area which are Strategic Fire Advantage Zones. A number of planned burns have been unable to be implemented in recent years due to weather constraints. A bushfire burned through much of the Northern Buffer and some of the Southern Buffer in the 2001-02 fire season (NPWS 2019).

The DEOH Bushfire Risk Management Plan (BRMP currently in prep) provides for a risk-based approach to fire management with the objective of protecting human safety, property, and the environment.

The ecological communities and threatened plant species at DEOH have optimum burn intervals to allow regeneration from fire with enough time in between fires for plants to reach maturity and reproduce as follows (RFS 2013a, RFS 2013c):

- *Marsdenia viridiflora* subsp. *viridiflora* – not more than once every 10 years;
- *Pultenaea parviflora*, *Dillwynia tenuifolia* and *Grevillea juniperina* subsp. *juniperina* – not more than once every 7 years;
- River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions – not more than once every 11 years;
- Cumberland Plain Woodland in the Sydney Basin Bioregion – not more than once every 7 years;
- Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion – not more than once every 7 years;

- Shale Gravel Transition Forest in the Sydney Basin Bioregion – not more than once every 7 years.

The baseline condition comprises implementation of a fire management regime based on mitigating risk to human health and property, with consideration of ecological fire regimes where practical.

The target also comprises implementation of a fire management regime that includes consideration of the risk of not achieving biodiversity management targets. This should be achieved through the purposeful implementation of ecological burns while ensuring the minimum fire intervals for threatened biota listed above are not exceeded. Specific time and area bound targets related to burn cells should be coordinated with the implementation of the BRMP.

#### 4.3.7 Pest fauna and overabundant native fauna

Pest fauna are present at DEOH and within the Offset Area, posing a direct threat to native fauna in some cases and increasing competition for resources. At the time of the Initial Ecological Survey and 2019 pest fauna control round, there were populations of foxes, hares, wild (Fallow) deer, rabbits and feral cats, exotic birds and European honey bees at the Offset Area (GHD 2020; AFL 2019a). Wild dogs and feral pigs are not known to occur at DEOH.

Fencing at DEOH currently allows feral animal species to enter the Offset Area and move between zones. To mitigate biodiversity threats, implementation of pest fauna exclusion and control would need to be managed. This would include control of predator pest species such as feral cats and foxes and exclusion of feral herbivores such as rabbits, hares and deer, coordinated with existing control programs in the locality.

Linear thermal transect count monitoring was performed over eight nights in 2019 to establish feral pest population numbers (AVPM 2019). During this survey effort there were 94 sightings of wild deer (Fallow deer), 167 rabbits, 32 hares, 11 foxes and 1 feral cat across the DEOH site including the Offset Area (AVPM 2019). These numbers indicated a high level of wild deer activity, suggesting a deer population of around 40-46 wild deer. Hare and fox activity was also deemed high, while rabbit activity was low.

A ground shooting program of 14 days in 2019 resulted in a 78-90 percent reduction in the wild deer population. An 82 percent reduction in numbers of rabbits detected on transects and a 45 percent reduction in fox activity were also achieved (AVPM 2019). Hares are well established throughout the central zones of DEOH which makes this species likely to be more difficult to control. Hare activity increased in monitoring results following pest control which is likely due to the suppression of foxes (AVPM 2019). These results demonstrate that rapid improvements in pest fauna levels are achievable in the Offset Area, particularly if combined with fencing improvements. Pest fauna management should be undertaken so that there is little to no evidence of ground dwelling pest fauna or their impact to biodiversity values and habitat.

Flying pest fauna including the Common Myna (*Sturnus tristis*), Common Starling (*Sturnus vulgaris*) and European Honey Bees (*Apis mellifera*) would also compete with native fauna for habitat resources. Competition for tree hollows is a potentially serious negative impact of their presence. It is unlikely to be possible to exclude these flying species from the Offset Area, however monitoring of any artificial hollows or nest boxes should include attention to pest fauna and local control to remove resident pest fauna as required.

DEOH is entirely and securely fenced and contains several large, discrete regions each with their own enclosed macropod populations, including Eastern Grey Kangaroos (*Macropus giganteus*), Swamp Wallabies (*Wallabia bicolor*) and Common Wallaroos (*Macropus robustus*).

Any enclosed area with a resident macropod population poses a long-term management challenge, as macropods are fast breeders in suitable conditions and can exert significant grazing pressure. DEOH contains an abundant enclosed macropod population that is having a significant effect on the ecology of the Offset Area and has been the subject of monitoring and management since 2005 (Cumberland Ecology 2014; GHD 2020).

The effect of pests and overabundant native herbivores on vegetation at the Offset Area has been monitored through sampling of open and herbivore exclosure plots according to a methodology established by Biosis in 2008 with the most recent survey conducted in mid-2019 (AFL 2019a). All exclosure plots featured high native grass cover, high exotic grass cover, low native herb cover and low native plant species richness. Herbivore grazing was associated with lower native grass cover and lower native plant cover overall but higher native herb cover and higher native plant species richness. There is no evidence to support that complete exclusion of herbivore grazing from the Offset Area would result in improved plant community health or species richness (AFL 2019a).

Macropod populations have steadily grown over recent decades, from an estimated population of 266 in 2005, to 800 in 2008, to more than 1,500 in 2010 (Defence 2014). Target kangaroo densities for the Offset Area are 1.5 kangaroos per grazing hectare (Defence 2014). Control rounds were undertaken in early 2019 which culled approximately 2800 Eastern Grey Kangaroos at DEOH (AFL 2019a) as part of ongoing environmental management processes. Given the potential for kangaroo populations to grow very rapidly, an adaptive approach to management is essential, with the potential for changes in population dynamics due to additional fencing for the Offset Area.

Targets (e.g., carrying capacity, trigger levels, thresholds) should be set on the basis of best current information, and then progressively refined as information becomes available through ongoing monitoring. Monitoring and setting of trigger levels for overabundant macropod management must consider current environmental conditions, current carrying capacity and level of environmental impact.

#### 4.3.8 Fauna reintroductions

Reintroduction of locally extinct native fauna, particularly threatened species and those that performed important ecosystem roles in natural communities of the Cumberland Plain should be considered. Fauna reintroductions would, in general, increase species richness of the receiver site. Appropriately targeted introductions would deliver associated benefits for vegetation condition and ecosystem function through services such as inoculation with fungi spores, pollination and transmission of propagules.

A fauna reintroduction strategy is to be developed based on the considerations outlined in section 5.8. The baseline condition is that the subject fauna species are absent from the Offset Area. Targets will be as set in the fauna reintroduction strategy. The intention would be that the benefits of fauna reintroductions should ideally be manifest in other monitoring outcomes with respect to ecosystem health and improvement, as well as the direct benefit of increased species richness and a community more representative of a natural Cumberland Plain species assemblage being present on site.

#### 4.3.9 Contamination and human activities

A preliminary site investigation was undertaken by AECOM in 2019. This investigation identified ten (10) potential contaminated site records, in addition to ten contaminated site records already known by Defence (AECOM 2019). More recent investigations have suggested that there are additional contamination concerns at DEOH, including unexploded ordnance (UXO) and other hazardous materials which may extend into the Offset Area. The risk of



contamination is highest in the Southern Buffer Area which has had higher military use and storage of materials during World War II. Any contaminated sites requiring remediation occurring in the Offset Area will be remediated by Defence. Ground-disturbing activities must not be undertaken without appropriate safeguarding and remediation as required. In some cases it may be a legitimate action to retain contaminated sites *in situ*, as the future purpose of the site as an environmental offset does not require ground-disturbing activities. Retention of contamination must take into account issues such as the potential mobilisation of any contaminants of the site, and this decision-making must be undertaken as early as possible within the improvement period to avoid the requirement for future vegetation clearance and rehabilitation associated with contamination remediation.

There is non-hazardous waste associated with previous human activity at the Offset Area which will need to be removed and disposed of where it comprises a risk to the delivery of the Offset Objectives. This should include removal of any damaged or obsolete fencing, with a particular focus on barbed wire fence strand removal to help reduce the risk and energy costs of fauna movement between patches of habitat. Management actions should include identification, mapping and characterisation of non-hazardous waste and determine whether it comprises a risk to the delivery of the Offset Objectives and requires removal. Certain material such as waste rock, concrete or wooden fence posts may have habitat value and be appropriate to leave in place. Areas that require fence removal and characterisation and potential removal of non-hazardous waste that were revealed by the Initial Ecological Survey are shown on [Figure 8](#).

No activities that prevent achievement of the Offset Objectives are currently occurring or should be performed at the Offset Area. A risk-based approach should be applied to assess proposed activities for consistency with the Offset Objectives. An adaptive management approach should be applied to modify or intensify actions such as revegetation as required to compensate for any necessary harmful activities (for example revegetation following contamination remediation or installation of security fencing).

#### 4.3.10 Water quality, erosion and sedimentation

Drainage lines and waterbodies occur across the Offset Area, containing exotic and native aquatic vegetation and providing habitat for native fauna. There was no evidence that water quality at DEOH was impacting the biodiversity values observed during the Initial Ecological Survey (GHD 2020) or through desktop assessment. The majority of the catchments of the waterbodies at the Offset Area are located entirely within DEOH and separated from more intensive Defence land uses by several hundred metres of open space or natural vegetation. Baseline values for water quality parameters have not been set in the Offset Plan and are not a particular focus of monitoring or management. Threats to water quality should, in general, be mitigated at all times during the implementation of the Offset Plan including use of appropriate management plans and safe work method statements to prevent pollution of waterways during the use of chemicals for weed control. If any particular water quality issues or threats are detected during the implementation of the Offset Plan, then water quality testing or other monitoring should be undertaken as part of an adaptive management framework.

Localised areas of sheet and gully erosion were observed through 2019 and are mapped on [Figure 8](#). The shale-derived and alluvial soil landscapes at the Offset Area feature generally high erosion hazard given their physical and chemical properties (Bannerman and Hazelton 1990) and would be particularly susceptible when cleared of woody vegetation.

Tracks and fire trails present at the Offset Area at the time of the Initial Ecological Survey are shown on [Figure 8](#) and will require monitoring of condition and associated risk of erosion. Targets for mitigation of impacts of erosion and sedimentation are set in [Table 4-7](#).

## 5. Management actions

### 5.1 Management units

Management actions will be performed across the Offset Area to achieve the Offset Plan objectives (Offset Objectives) with a particular focus on the required increase in the site quality score of habitat for the affected threatened biota. Management actions include those that are specific to certain habitat types (e.g. installation of habitat resources in woodland; revegetation of derived grasslands) and those that will be applied to alleviate threats or achieve restoration opportunities across the Offset Area (e.g. management of fire for conservation, control of pest fauna).

‘Management units’ have been defined and mapped across the Offset Area based on:

- Baseline habitat type and quality;
- Resilience, and capacity for regeneration of vegetation and development of habitat resources;
- The type, extent and intensity of threats to biodiversity values; and
- The type and intensity of management that is proposed based on the above considerations.

These management units have been named according to the main, overarching focus of ecological restoration that will be implemented in each unit and will include a suite of appropriate management actions to increase site quality or mitigate threats.

A management unit may include multiple ‘management zones’ as presented in the Initial Ecological Survey report (GHD 2020) noting that management zones must be split according to plant community types (PCTs) according to the BAM and BBAM as a necessary part of credit calculations (OEH 2014; OEH 2017). The on-ground management of the Offset Area may cross PCT boundaries and so management units have been defined across these divisions.

Biodiversity values would be mapped, sampled and assessed as required at the management zone scale at the time of five-yearly updates to the Offset Plan and the Completion Ecological Survey (see Chapter 6).

Management units are shown on [Figure 7](#) and summarised in [Table 5-1](#). A matrix illustrating the management actions that will be performed within each management unit is included as [Table 5-2](#). Management actions are described in detail in sections 5.2 to 5.10.

The management actions summary tables presented in these sections would form the basis of audits of the delivery of the Offset Plan and include high level completion criteria to demonstrate compliance.



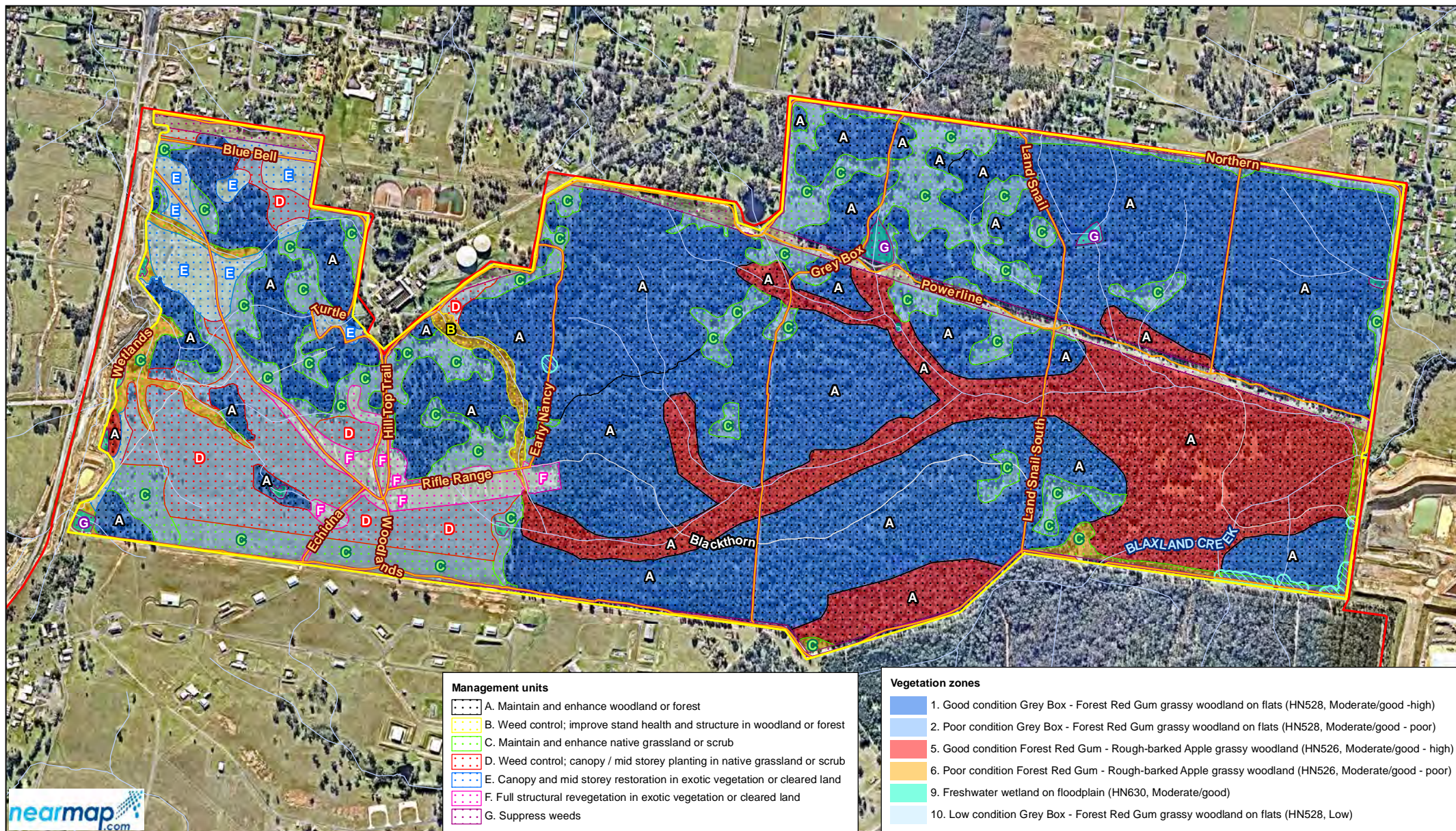
Table 5-1 Management units

ID	Management unit	Management unit description	Affected threatened biota	Applicable vegetation zones
A	A - Maintain and enhance woodland or forest	Mature woodland or forest in good condition with high resilience, low weed cover, moderate to high quantities of habitat resources and natural regeneration. Management would focus on: maintaining integrity; enhancing condition through targeted species richness planting or installing habitat resources; and addressing localised threats such as weed infestations.	Cumberland Plain Woodland (part) Grey-headed Flying-fox (part) Swift Parrot foraging habitat (part)	1 Good condition Grey Box - Forest Red Gum grassy woodland on flats (part) 5 Good condition Forest Red Gum - Rough-barked Apple grassy woodland (part) 7 Good condition Broad-leaved Ironbark - Grey Box - <i>Melaleuca decora</i> grassy open forest on clay/gravel soils 11 Good condition Broad-leaved Ironbark - <i>Melaleuca decora</i> grassy open forest on clay soils
B	B - Weed control; improve stand health and structure in woodland or forest	Mature woodland or forest in moderate condition with moderate resilience, high weed cover, moderate to high quantities of habitat resources and natural regeneration. Management would focus on: improving integrity through intensive weed control; promoting stand health and structure by treating dieback or targeted thinning; and then enhancing condition through targeted species richness planting or installing habitat resources.	Cumberland Plain Woodland (part) Grey-headed Flying-fox (part) Swift Parrot foraging habitat (part)	1 Good condition Grey Box - Forest Red Gum grassy woodland on flats (part) 5 Good condition Forest Red Gum - Rough-barked Apple grassy woodland (part)
C	C - Maintain and enhance native grassland or scrub	Derived native grassland or scrub in good condition with high resilience, low weed cover, limited habitat resources and natural regeneration. Management would focus on: maintaining integrity and facilitating natural regeneration of areas towards woodland or forest structure while maintaining areas of species rich grasslands; enhancing condition through targeted species richness planting and installing habitat	Poorer quality Cumberland Plain Woodland (part)	2 Poor condition Grey Box - Forest Red Gum grassy woodland on flats (part) 6 Poor condition Forest Red Gum - Rough-barked Apple grassy woodland (part) 8 Poor condition Broad-leaved Ironbark - Grey Box - <i>Melaleuca decora</i> grassy open forest on clay/gravel soils (part)

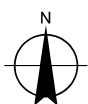
ID	Management unit	Management unit description	Affected threatened biota	Applicable vegetation zones
		resources; and addressing localised issues such as weed infestations.		
D	D - Weed control; over-storey / mid-storey planting in native grassland or scrub	Derived native grassland or scrub in moderate condition with moderate resilience, moderate weed cover, limited habitat resources and limited natural regeneration. Management would focus on: intensive weed control where required combined with broad area over-storey / mid-storey planting to achieve a woodland structure while maintaining areas of species rich grasslands; and enhancing condition through targeted species richness planting and installing habitat resources.	Poorer quality Cumberland Plain Woodland (part)	2 Poor condition Grey Box - Forest Red Gum grassy woodland on flats (part) 6 Poor condition Forest Red Gum - Rough-barked Apple grassy woodland (part) 8 Poor condition Broad-leaved Ironbark - Grey Box - <i>Melaleuca decora</i> grassy open forest on clay/gravel soils (part)
E	E - Over-storey and mid-storey restoration in exotic vegetation or cleared land	Exotic grassland or cleared land in poor condition with low resilience, high weed cover, very few habitat resources and very limited natural regeneration. Management would focus on suppressing weeds to help mitigate threats to better condition areas combined with over-storey / mid-storey planting to improve habitat connectivity.	Averted risk and site context score improvements only	10 Low condition Grey Box - Forest Red Gum grassy woodland on flats (part)
F	F - Full structural revegetation in exotic vegetation or cleared land	Exotic grassland or cleared land in poor condition with low resilience, high weed cover, very few habitat resources and very limited natural regeneration. Management would focus on: removing weeds followed by broad area over-storey / mid-storey planting and high species richness ground cover planting to restore a functioning woodland or forest community; and installing habitat resources.	Averted risk and site context score improvements only	10 Low condition Grey Box - Forest Red Gum grassy woodland on flats (part)

ID	Management unit	Management unit description	Affected threatened biota	Applicable vegetation zones
G	G - Suppress weeds	<p>Exotic grassland or cleared land with high weed cover, low resilience and very limited potential for restoration; better condition vegetation in electricity easements and similar areas where the potential for ecological restoration is limited by other land uses; and artificial wetlands with high native vegetation cover and integrity but little potential for enhancement.</p> <p>Management would focus on suppressing weeds and preventing their spread to help mitigate threats to better condition areas.</p>	Averted risk and site context score improvements only	<p>10 Low condition Grey Box - Forest Red Gum grassy woodland on flats (part)</p> <p>9 Freshwater wetland on floodplain</p> <p>Unclassified native vegetation in electricity easements.</p>





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Grid: GDA 1994 MGA Zone 56



#### LEGEND

- Defence Establishment Orchard Hills
- Offset Area
- Threatened flora habitat
- Waterways
- Fire trail
- Unsealed road / track



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Orchard Hills Offset Area Environmental Program  
Offset Plan

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Date 26 Jul 2021

Management units  
Northern buffer area

Figure 7a

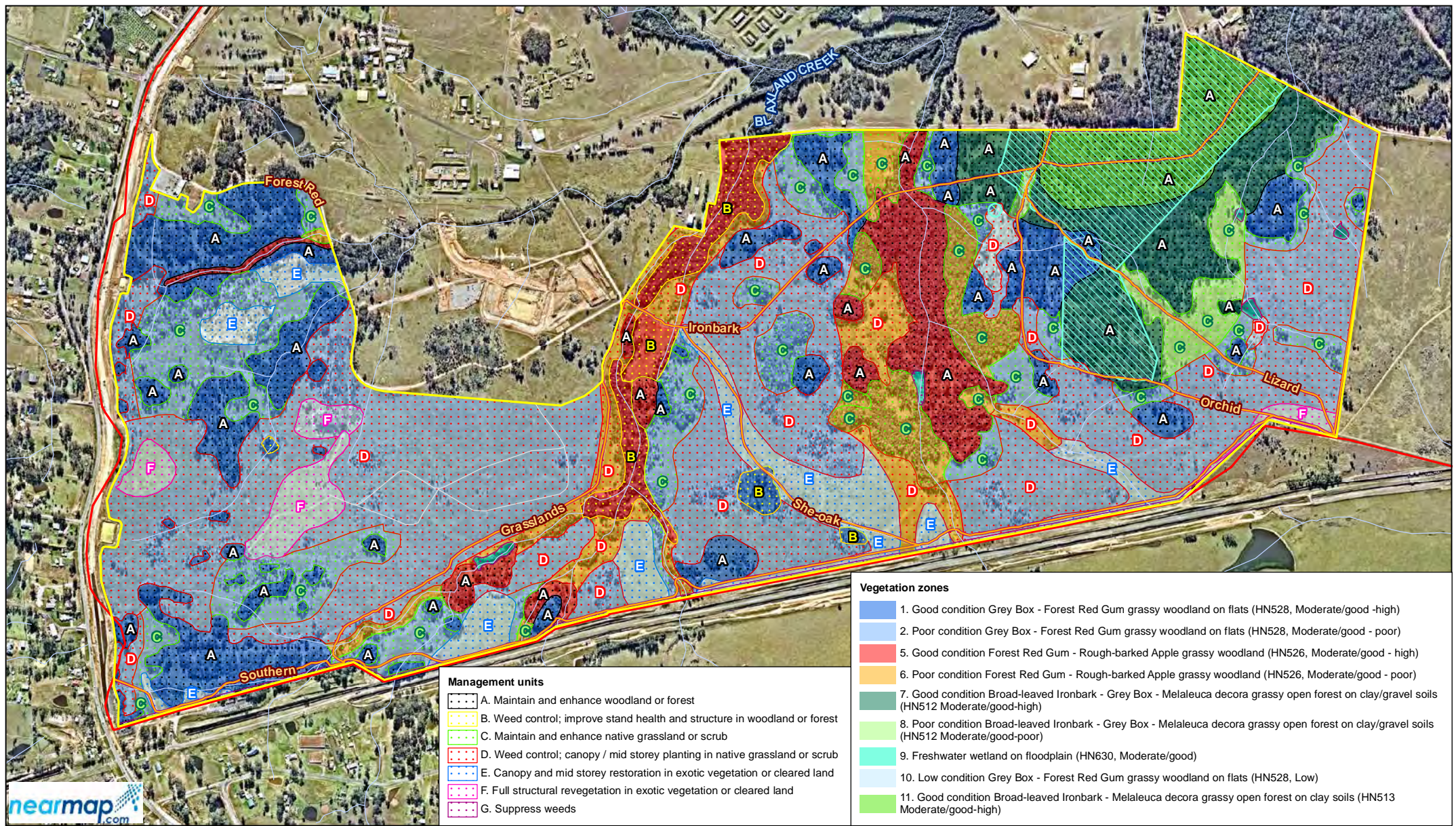
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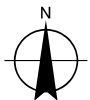
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#### LEGEND

- Defence Establishment Orchard Hills
- Offset Area
- Threatened flora habitat
- Waterways
- Fire trail
- Unsealed road / track



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Offset Plan

Job Number 23-16681  
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Management units  
Southern buffer area

Figure 7b

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Table 5-2 Management units and actions

ID	Management Action	Offset Objective	Management units						
			A - Maintain and enhance woodland or forest	B - Weed control; improve stand health and structure in woodland or forest	C - Maintain and enhance native grassland or scrub	D - Weed control; over-storey / mid-storey planting in native grassland or scrub	E - Over-storey and mid-storey restoration in exotic vegetation or cleared land	F - Full structural revegetation in exotic vegetation or cleared land	G - Suppress weeds
	Area		494 hectares	17 hectares	158 hectares	209 hectares	37 hectares	20 hectares	44 hectares
<b>1</b>	<b>Woodland and forest management</b>								
1.1	Develop woodland and forest management strategy	a, b, d	X	X	X	X	X	X	X
1.2	Woodland and forest stand health mapping	a, b, d	X	X					
1.3	Develop and implement techniques to improve stand quality	a, b, d	X	X					
1.4	Targeted tree species richness planting	a, b, d	X	X					
1.5	Management of overabundant Native Blackthorn scrub	a, b, d	X	X					
<b>2</b>	<b>Regeneration and revegetation</b>								
2.1	Develop regeneration and revegetation strategy	a, c, d			X	X	X	X	
2.2	Targeted shrub and ground cover species richness planting	a, c, d			X	X			
2.3	Broad area over-storey / mid-storey planting	a, c, d				X	X		
2.4	Full structural revegetation	a, c, d						X	
<b>3</b>	<b>Habitat enhancement</b>								
3.1	Develop habitat enhancement strategy	a, c, d	X	X	X	X		X	
3.2	Installation of supplementary habitat resources	a, c, d	X	X	X	X		X	
3.3	Aquatic habitat mapping and planning	d	X	X	X	X		X	
3.4	Implement measures to improve aquatic habitat	d	X	X	X	X		X	
3.5	Identify significant sources of light pollution and management actions to minimise their impact	a, b, c, d	X	X	X	X	X	X	
<b>4</b>	<b>Weed control</b>								
4.1	Develop weed control strategy	a, b, c, d	X	X	X	X	X	X	X
4.2	Primary weed control followed by weed control rounds as required to achieve maintenance level	a, b, c, d		X		X		X	
4.3	Maintenance weed control	a, b, c, d	X		X				
4.4	Suppress weeds	e					X		X
<b>5</b>	<b>Ecological fire management</b>								
5.1	Review DEOH Bushfire Risk Management Plan and develop supplementary ecological fire management strategy	a, b, c, d	X	X	X	X	X	X	
5.2	Support the implementation of the DEOH Bushfire Risk Management Plan	a, b, c, d	X	X	X	X	X	X	
5.3	Implement the ecological fire management actions	a, b, c, d	X	X	X	X	X	X	
<b>6</b>	<b>Pest fauna and overabundant native fauna control</b>								
6.1	Develop fauna management strategy	a, b, c, d	X	X	X	X	X	X	X
6.2	Maintain exclusion fencing around Offset Area	a, b, c, d	X	X	X	X	X	X	X

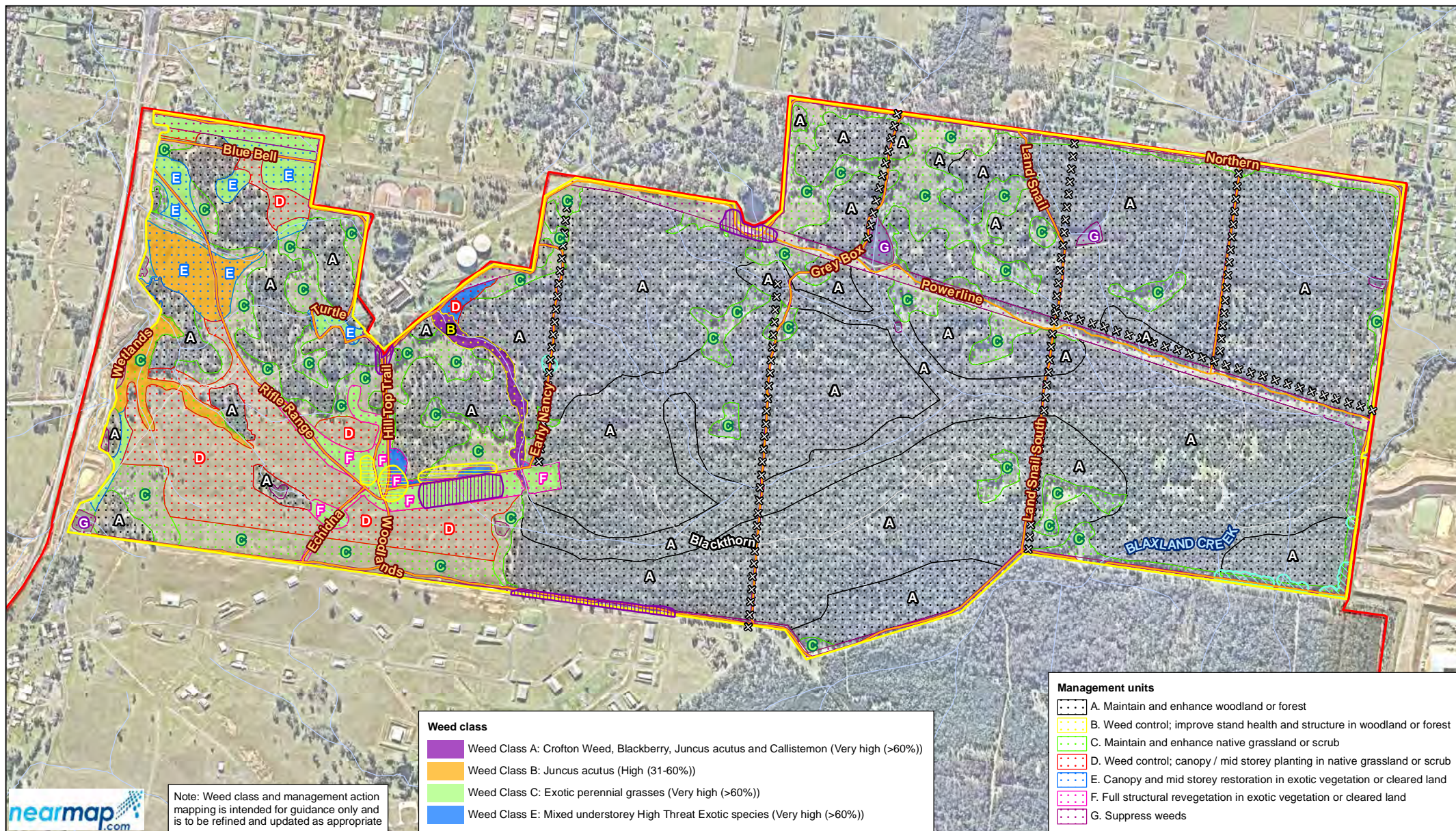
			Management units						
ID	Management Action	Offset Objective	A - Maintain and enhance woodland or forest	B - Weed control; improve stand health and structure in woodland or forest	C - Maintain and enhance native grassland or scrub	D - Weed control; over-storey / mid-storey planting in native grassland or scrub	E - Over-storey and mid-storey restoration in exotic vegetation or cleared land	F - Full structural revegetation in exotic vegetation or cleared land	G - Suppress weeds
	Area		494 hectares	17 hectares	158 hectares	209 hectares	37 hectares	20 hectares	44 hectares
6.3	Implement pest fauna controls	a, b, c, d	X	X	X	X	X	X	X
6.4	Review and implement overabundant macropod controls	a, c, d	X	X	X	X	X	X	X
<b>7</b>	<b>Fauna reintroduction</b>								
7.1	Develop fauna reintroduction strategy	a, c, d	X	X	X	X	X		
7.2	Maintain pest-proof fencing around fauna reintroduction area	a, b, c, d	X	X	X	X	X		
7.3	Exclude pest fauna from fauna reintroduction area	a, b, c, d	X	X	X	X	X		
7.4	Introduce fauna in line with the strategy developed including monitoring and adaptive management	a, c, d	X	X	X	X	X		
<b>8</b>	<b>Contamination and human activities</b>								
8.1	Identify and report significant sources of contamination	e	X	X	X	X	X	X	X
8.2	Facilitate contamination remediation by Defence in Offset Area and adjoining areas	e	X	X	X	X	X	X	X
8.3	Ensure appropriate quality of revegetation in remediation areas	e	X	X	X	X	X	X	X
8.4	Remove non-hazardous waste and dumped materials	e	X	X	X	X	X	X	X
<b>9</b>	<b>Soil and water management</b>								
9.1	Develop soil and water quality management strategy	a, c, d, e	X	X	X	X	X	X	X
9.2	Fine scale erosion mapping	a, c, d, e	X	X	X	X	X	X	X
9.3	Implement soil and water quality management system	a, c, d, e	X	X	X	X	X	X	X
9.4	Mitigate and/or remediate erosion	e	X	X	X	X	X	X	X

Offset Objectives:

- a. 'Future quality with offset' score that is two greater than the 'Start quality' score that is defined in the Initial Ecological Survey for the area of Cumberland Plain Woodland;
- b. 'Future quality with offset' score that is one greater than the 'Start quality' score that is defined in the Initial Ecological Survey for the area of habitat for the Swift Parrot and Grey-headed Flying-fox in the Offset Area;
- c. 'Future quality with offset' score for the area of poorer quality Cumberland Plain Woodland in the Offset Area that is at least:
  - i) as high as the quality score for the Cumberland Plain Woodland in the Stage 1 Construction Impact Zone (6 out of 10), and
  - ii) two greater than the 'Start quality' score that is defined in the Initial Ecological Survey for the area of poorer quality Cumberland Plain Woodland in the Offset Area.
- d. Site value scores with active restoration and management at least equal to the scores defined in the Initial Ecological Survey to confirm the quantum of offset for plants, animals and their habitat as calculated with the BBAM.
- e. Averted risk, management of threats and site context score improvements in areas that do not comprise habitat but that would contribute to achieving the core Offset Objectives a-d listed above.

Fauna reintroduction management actions would only be applied to the area of management units within the fauna reintroduction area, which will be defined based on based on consideration of ecological and practical constraints as described in section 5.8.



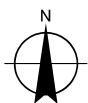


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#### LEGEND

- Defence Establishment Orchard Hills
- Offset Area
- Threatened flora habitat
- Waterways
- Remove fence
- Maintain fire trail
- Maintain unsealed road / track
- Mitigate / remediate erosion
- Manage waste



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Management actions  
Northern buffer area

Figure 8a

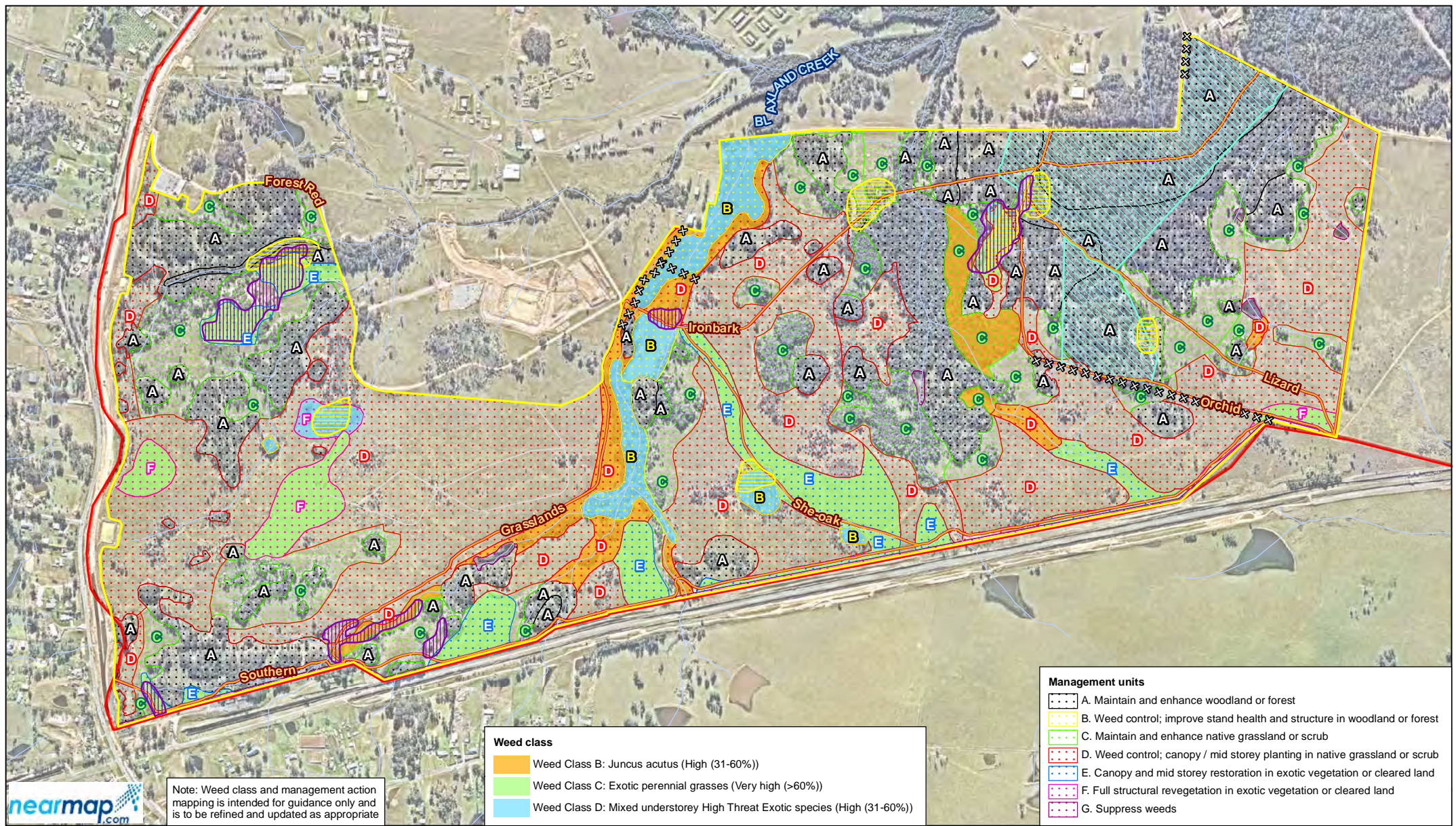
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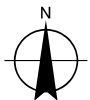
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#### LEGEND

Defence Establishment Orchard Hills  
Offset Area  
Threatened flora habitat  
Waterways

Remove fence  
Maintain fire trail  
Maintain unsealed road / track  
Mitigate / remediate erosion

Manage waste



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Management actions  
Southern buffer area

Figure 8b

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## 5.2 Woodland and forest management

‘Woodland and forest management’ comprises a range of techniques to preserve and promote the diversity (species and age) and health of stands of trees within areas of woodland and forest. In this context ‘stand health’ refers to tree species richness, diversity of stem size classes, presence/absence of dieback and presence/absence of natural senescence. Stand health should be assessed and defined based on observed variability in these factors and management responses planned accordingly. Management actions are likely to include silvicultural techniques such as stand thinning, supplementary planting for species richness and mechanical removal of Native Blackthorn scrub to help restore a natural vegetation structure and native ground cover diversity in areas where it would not be possible to use fire to achieve this aim given the risk of damaging wildfire. These techniques should be developed, implemented and reviewed.

For the purposes of this Offset Plan a number of other techniques have been described in the following sections (such as habitat enhancement, weed control and ecological fire management) which would also improve woodland and forest condition but have been separated into like activities for ease of management. Woodland and forest management actions should be coordinated with these other actions where appropriate, for instance purposeful use of residues from stand thinning for habitat enhancement activities.

The implementation of woodland and forest management actions must incorporate the following approaches, standards and guidelines (or current equivalents that apply):

- Development of a woodland and forest management strategy prepared in accordance with the management framework outlined in chapter 3 and including specific measures to help meet the targets presented in chapter 4 and including verification of the baseline biodiversity values and approaches presented in this Offset Plan.
- Consideration of the key diagnostic characteristics and condition thresholds specified in the *Commonwealth Listing Advice on Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest* (TSSC 2008) with a particular focus on:
  - The distinction between ‘Cumberland Plain Woodland’ (over-storey cover >10%, baseline site quality score of 7/10) and ‘Poorer quality Cumberland Plain Woodland’ (over-storey cover <10%, baseline site quality score of 4/10) as defined in section 4.1;
  - Maintaining or restoring at least 10% total foliage projective cover of mature (>10m tall) over-storey species *Eucalyptus moluccana*, *E. tereticornis*, *E. fibrosa*, *E. crebra* and *E. eugenioides* averaged across continuous patches of the community.
- Management units shown on [Figure 7](#) supported by fine scale, supplementary mapping of better quality stands (species richness, structurally diverse, free of die back, low weed cover) and poorer quality stands (species poor, structurally uniform, affected by dieback and/or high weed cover) to support the distinction between management units A and B.
- Investigation of the causes and treatment of *Eucalyptus* dieback and of the utility of stand thinning, other silvicultural techniques or other ecological restoration techniques to help meet performance targets, supported by monitoring and research as appropriate.
- Targeted tree species richness planting should aim to increase overall tree species richness with a particular focus on improving habitat complexity and food resources for native fauna. Planting of Forest Red Gum (*E. tereticornis*) should be a particular focus noting that this species has high productivity and reliability of flowering, flowers in late winter and spring during the food bottleneck for the Grey-headed Flying-fox (Eby and Law 2008) and is a key food tree within the non-breeding range of the Swift Parrot (Saunders and Tzaros 2011).
- Management of overabundant Native Blackthorn scrub should:



- aim to set Offset Objectives using the same approach and format as set in Table 4-1 of this plan including 10 and 20 year site quality score targets and monitoring framework. Nominal Offset Objectives for management of overabundant Native Blackthorn scrub set in Table 5-4 as a guide.
  - be informed by baseline sampling and definition of ‘overabundant Native Blackthorn’ based on demonstrable reduction in cover or species richness of groundcover vegetation or unacceptable risk of damaging wildfire. Note the nominal definition of greater than 50% cover as set in Table 5-4.
  - be informed by a research-based trial of the potential of this action to help realise Offset Objectives and avoid detrimental impact on understorey species richness and cover; Cumberland Plain Land Snail abundance; and bird species richness and abundance. Research should consider hypotheses related to effects on vegetation structural complexity, flora and fauna species richness and effects on weed and pest species.
  - Native Blackthorn cover reduction targets and target areas should be set based on the research-based trial. Nominal targets set in Table 5-4 should be revised as appropriate to the outcomes of trials.
  - Management of Native Blackthorn scrub should consider a variety of techniques including ecological burns commencing in existing clearings and mechanical removal of Native Blackthorn.
- The presence of the threatened flora species shown on Figure 4 and any other threatened plants detected in the Offset Area, and the modification of silvicultural techniques and other actions as necessary to avoid impacts to threatened plants.
  - Definition of specific, measurable, time and area bound targets and performance indicators to demonstrate how the woodland and forest management actions will help achieve site quality score targets.

Table 5-3 Woodland and forest management actions, outcomes and performance criteria

ID	Management action	Outcomes	Timing	Completion criteria
1.1	Develop woodland and forest management strategy	Woodland and forest management strategy which includes verification of the baseline biodiversity values, vegetation zone mapping and approaches presented in this Offset Plan, and provides for definition and implementation of management techniques and performance targets. Refine targets in line with Offset Plan updates at year 5, 10	Strategy developed by December 2022. Targets refined August 2023, 2028 and 2033.	Strategy developed. Compliance documented in annual report. Components of strategy documented in works implementation plans.

ID	Management action	Outcomes	Timing	Completion criteria
		and 15 of Offset Improvement Period.		
1.2	Woodland and forest stand health mapping	<p>Fine scale mapping of stand health, including tree species richness, dieback and diversity of stem size classes and definition of specific targets and management actions appropriate to each stand.</p> <p>Include baseline maps in Offset Plan update at year 5 and then update maps in line with Offset Plan updates in year 10 and 15 of Offset Improvement Period.</p>	Baseline mapping and targets by December 2022. Mapping and performance against targets updated August 2023, 2028, 2033 and at completion.	<p>Baseline stand health map and targets developed.</p> <p>Stand maps updated showing compliance with targets.</p>
1.3	Develop and implement techniques to improve stand quality	<p>Identification and implementation of dieback treatments, stand thinning, other silvicultural techniques or other ecological restoration techniques to help meet performance targets.</p> <p>Facilitate opportunities to undertake research program.</p> <p>Provide inputs to Offset Plan updates at year 5, 10 and 15 of Offset Improvement Period.</p>	<p>Implementation of research program and development of techniques in accordance with the strategy.</p> <p>Input to Offset Plan updates by August 2023, 2028 and 2033.</p> <p>According to specific time and area bound targets.</p>	<p>Confirmed techniques and associated targets.</p> <p>Updated/reconfirmed techniques documented.</p> <p>Compliance with specific time and area bound targets (and subsequent updates) documented.</p>
1.4	Targeted tree species richness planting	Implementation of targeted supplementary planting of over-storey and mid-storey tree species to increase tree species richness and provision of foraging resources.	Commenced by August 2023. According to specific, time and area bound targets thereafter.	Compliance with specific, time and area bound targets (and subsequent updates) documented.
1.5	Management of overabundant	Definition of management areas and Native Blackthorn	Initial trial stages completed, research outcomes	Compliance with specific, time and area bound targets

ID	Management action	Outcomes	Timing	Completion criteria
	Native Blackthorn scrub	cover targets as informed by a research-based trial. Nominal targets set in Table 5-4 should be revised as appropriate to the outcomes of trials. Reduction in extent of overabundant Native Blackthorn scrub.	confirmed, target areas mapped and management commenced by August 2023. According to specific, time and area bound targets thereafter.	(and subsequent updates) documented.

Note: the strategy referenced in the above table is to be developed in accordance with the approaches, standards and guidelines specified above and consideration of complementary strategies and management actions detailed in the following sections.



Table 5-4 Nominal Offset Objectives - Overabundant Native Blackthorn cover

Offset Plan Objectives	'Start quality' score	'Future quality with offset' score (year 10)	'Future quality with offset' score (year 20)	Monitoring framework	Key management actions and focus
Overabundant Native Blackthorn cover (on ground visual estimate of percentage cover and mapping of areas above certain cover classes)	>50% Native Blackthorn cover over an area of ~400 ha.	Definition of Native Blackthorn cover reduction targets and target areas as informed by a research-based trial. Nominal target set as Native Blackthorn cover reduced to <25% across target area of at least 100 ha.	Achievement of Native Blackthorn cover reduction targets and target areas as set by a research-based trial. Nominal target set as Native Blackthorn cover reduced to <25% across target area of at least 200 ha.	Baseline monitoring of trial treatment areas against local reference areas. Testing of hypotheses related to effects on structural complexity, flora and fauna species richness and weed and pest species. Targeted monitoring in conjunction with five-yearly plot-monitoring program. Coordinated with adaptive management monitoring of weed control and habitat enhancement activities.	Research based trial of potential for management of Native Blackthorn cover to help realise Offset Objectives and avoid detrimental effects. Management of Native Blackthorn scrub Ecological burns, commencing in existing clearings. Mechanical removal of Native Blackthorn.

### 5.3 Regeneration and revegetation

'Regeneration and revegetation' comprises facilitated natural regeneration and supplementary planting or revegetation where natural regeneration will not be sufficient to achieve management outcomes. Natural regeneration will be enhanced in areas of higher resilience, such as derived native grassland. More intensive revegetation actions will be applied in areas of lower resilience where natural regeneration is not occurring, such as areas of exotic grassland, bare earth or imported fill. Some areas would be maintained as native grassland to maintain the diversity of habitat types and to help maximise native plant species richness.

The implementation of regeneration and revegetation must incorporate the following approaches, standards and guidelines (or current equivalents that apply):

- Development of a regeneration and revegetation management strategy prepared in accordance with the management framework outlined in chapter 3 and including specific measures to help meet the targets presented in chapter 4 and including verification of the baseline biodiversity values and approaches presented in this Offset Plan.
- Consideration of the key diagnostic characteristics and condition thresholds specified in the *Commonwealth Listing Advice on Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest* (TSSC 2008) with a particular focus on:
  - The distinction between 'Cumberland Plain Woodland' (over-storey cover >10%, baseline site quality score of 7/10) and 'Poorer quality Cumberland Plain Woodland' (over-storey cover <10%, baseline site quality score of 4/10) as defined in section 4.1;
  - Maintaining or restoring at least 10% total foliage projective cover of mature (>10 m tall) over-storey species (*Eucalyptus moluccana*, *E. tereticornis*, *E. fibrosa*, *E. crebra* and *E. eugenioides*) averaged across continuous patches of the community;
  - Maintaining areas of species rich native grasslands or scrub within a matrix of woodland and open woodland vegetation that collectively comprise continuous patches of native vegetation communities. For the purposes of quantifying site quality score targets for 'Total native vegetation cover within Offset Area', 'continuous patches' may include areas with gaps in over-storey vegetation up to 100 m wide providing for maintenance of species rich grasslands as long as canopy cover of >10% is achieved when measured across the entire patch.
- Management units shown on [Figure 7](#) supported by fine scale, supplementary mapping of natural regeneration areas, revegetation areas and grassland maintenance areas to support the distinction between management units C, D, E and F;
- Provision of local provenance seed and plant material for revegetation, including on-site collection;
- The potential presence of contaminated material and the need to notify Defence prior to any intrusive activities and to coordinate with any remediation actions in accordance with the Contamination and human activities management requirements set out in section 4.3.9;
- The presence of the threatened flora species shown on [Figure 4](#) and any other threatened plants detected in the Offset Area, and the modification of revegetation techniques and other actions as necessary to avoid impacts to threatened plants;
- Definition of specific, measurable, time and area bound targets and performance indicators to demonstrate how the woodland and forest management actions will contribute to site quality score targets; and
- Definition of a maintenance and monitoring regime along with corrective actions.

Table 5-5 Regeneration and revegetation actions, outcomes and performance criteria

ID	Management action	Outcomes	Timing	Completion criteria
2.1	Develop regeneration and revegetation strategy	Regeneration and revegetation strategy which includes verification of the baseline biodiversity values and approaches presented in this Offset Plan, and provides for definition and implementation of management techniques and performance targets. Supported by fine scale mapping of extent of natural regeneration, revegetation areas and areas to be maintained as grassland noting overall objective of canopy cover of >10% when measured across continuous patches.	Baseline mapping, strategy and targets by December 2022. Mapping and performance against targets updated at August 2023, 2028, 2033 and at completion.	Baseline regeneration / revegetation map and targets developed. Maps updated demonstrating achievement of targets.
2.2	Targeted shrub and ground cover species richness planting	Definition of areas, appropriate species and cover targets to increase shrub and ground cover species richness. Site preparation, planting and maintenance to ensure establishment and achieve target species richness.	Target areas mapped and management commenced by December 2022. Ongoing as planned. Inputs to Offset Plan updates as required.	Planting success recorded and mapped.
2.3	Broad area over-storey / mid-storey planting	Definition of areas, appropriate species and cover targets to increase over-storey and mid-storey cover. Site preparation, planting and maintenance to ensure establishment and achieve cover and species richness targets. Monitoring and inputs to vegetation strategy and Offset Plan updates at year 5, 10 and 15 of the Offset Improvement Period.	Target areas mapped and management commenced by December 2022. Ongoing as planned. Inputs to Offset Plan updates as required.	Planting success recorded and mapped. Monitoring results reported.



ID	Management action	Outcomes	Timing	Completion criteria
2.4	Full structural revegetation	<p>Definition of areas, appropriate species and cover targets to achieve full structural revegetation resembling ecological communities in Offset Area.</p> <p>Site preparation, planting and maintenance to achieve cover and species richness targets.</p> <p>Monitoring and inputs to vegetation strategy and Offset Plan updates at year 5, 10 and 15 of the Offset Improvement Period.</p>	<p>Target areas mapped and management commenced by December 2022.</p> <p>Ongoing as planned.</p> <p>Inputs to Offset Plan updates as required.</p>	<p>Planting success recorded and mapped.</p> <p>Monitoring results reported.</p>

Note: the strategy referenced in the above table is to be developed in accordance with the approaches, standards and guidelines specified above and consideration of complementary strategies and management actions presented in Chapter 5 of this plan.

## 5.4 Habitat enhancement

Habitat enhancement includes the supply and installation of supplementary habitat resources including, but not limited to, salvaged timber, nest boxes, artificial tree hollows, and any other habitat features that will not naturally regenerate for long time periods or in the absence of mature over-storey vegetation.

Aquatic habitat across the Offset Area includes drainage lines and constructed waterbodies, containing exotic and native aquatic vegetation and providing habitat for native fish, aquatic invertebrates and wetland fauna. Consideration should be given to removal of barriers and restoration of natural flows in drainage lines where consistent with track maintenance and other Defence activities.

The approach to habitat enhancement must incorporate the following approaches, standards and guidelines (or current equivalents that apply):

- Development of a habitat enhancement strategy prepared in accordance with the management framework outlined in chapter 3 and including specific measures to help meet the targets presented in chapter 4 and including verification of the baseline biodiversity values and approaches presented in this Offset Plan.
- Installation of a range of supplementary hollow/roost sizes and consideration of other ecological requirements of target species which must include *Myotis macropus* and a diverse suite of microbat, bird and arboreal mammal species of the Cumberland Plain.
- The need to monitor and maintain artificial hollows or nest boxes to ensure their functionality and to control feral bees or pest fauna such as the Common Myna (*Sturnus tristis*) as required.
- Consideration of guidelines for the appropriate height, placement, orientation, aspect and fixing techniques for nest boxes presented in *Nest Boxes for Wildlife, a practical guide* (Franks and Franks 2011) and other publications for alternative hollow/roost designs.

- Consideration of the ecological requirements of target ground dwelling fauna species which must include *Meridolum corneovirens* and guidelines for the installation of supplementary woody debris or alternative shelter resources.
- Sustainable salvage and reuse of habitat resources such as fence posts, stock yards or 'stacked' timber from previous agricultural land uses and/or resources generated from stand thinning (see section 5.2), woody weed control (see section 5.5), remediation (see section 5.9), Defence activities or other development activities in the local area.
- Integration with the restoration and revegetation strategy for the Offset Area (see section 5.3), including assessment of the potential for installation of roosts / hollows in revegetation areas in years 15-20 of the Offset Improvement Period based on consideration of the maturity and suitability of host trees.
- Consideration of the extent and quality of aquatic habitat and the potential for improvement or removal of threats.
- Department of Land and Water Conservation (DLWC), 1998. *Constructed Wetlands Manual*.
- Consideration of light pollution sources and their impact on habitat quality for nocturnal fauna and opportunities to mitigate these impacts with reference to the *National Light Pollution Guidelines for Wildlife Including Marine Turtles, Seabirds and Migratory Shorebirds* (CoA 2020), including consideration of biological parameters as well as light level auditing.
- Definition of specific, measurable, time and area bound targets and performance indicators to demonstrate how the habitat resource management actions will contribute to site quality score targets.
- Definition of a maintenance and monitoring regime along with corrective actions.

**Table 5-6 Habitat enhancement actions, outcomes and performance criteria**

ID	Management action	Outcomes	Timing	Completion criteria
3.1	Develop habitat enhancement strategy	Habitat resource enhancement strategy which includes verification of the baseline biodiversity values and approaches presented in this Offset Plan and provides for definition and implementation of management techniques and performance targets. Supported by fine scale hollow / roost and woody debris mapping. Definition of hollow / roost and woody debris density classes relative to baseline and targets. Definition of time and area bound delivery	Baseline mapping, strategy and targets by December 2022. Mapping and performance against targets updated by August 2023, 2028, 2033 and 2038.	Baseline habitat resources maps and targets developed and updated. Time and area bound strategy for habitat enhancement actions.

ID	Management action	Outcomes	Timing	Completion criteria
		targets appropriate to each class. Definition of maintenance and monitoring regime. Refined mapping and targets at year 5, 10, 15 and completion of the Offset Improvement Period.		
3.2	Installation of supplementary habitat resources	Confirmation of effective and ecologically appropriate habitat resource delivery actions for target species within specific work areas. Installation of supplementary habitat resources, including hollows, nest boxes, woody debris and other resources as planned to meet defined targets.	Definition and implementation of actions in accordance with planned approach and specific time and area bound targets. Inputs to Offset Plan updates as required.	Demonstrated installation and maintenance of habitat resources according to targets.
3.3	Aquatic habitat mapping and planning	Fine scale waterways, aquatic habitat features and threats mapping. Identification of effective and ecologically appropriate actions to maximise aquatic habitat value within operational constraints. Definition of time and area bound plan for implementation of actions.	Baseline mapping, planned strategy and targets by December 2022. Mapping and performance against targets updated August 2023, 2028, 2033 and 2038.	Baseline aquatic habitat map, strategy and targets developed and updated as planned. Confirmation of completion targets.
3.4	Implement measures to improve aquatic habitat	Planned measures implemented, mapped and maintained to ensure establishment/ effectiveness to maintain aquatic habitat and enhance where possible and beneficial to Offset Objectives.	Implementation of actions in accordance with planned approach and specific time and area bound targets. Inputs to Offset Plan updates as required.	Confirmation of completion targets as planned.
3.5	Identify significant sources of light pollution	Undertake night-time inspections to determine significant sources of light pollution and their	Surveys and approach confirmed in time to inform	Follow-up surveys confirm light pollution reduced.



ID	Management action	Outcomes	Timing	Completion criteria
	and management actions to minimise their impact	<p>impact on habitat quality for nocturnal fauna that should be mitigated.</p> <p>Consult with Defence and adjoining land users as appropriate to identify engineered mitigation measures.</p> <p>Integrate mitigation measures with other programs such as modifying revegetation program to provide screening.</p>	<p>vegetation management strategy.</p> <p>Implementation of actions in accordance with planned approach and specific time and area bound targets.</p> <p>Inputs to Offset Plan updates as required.</p>	Confirmation of completion targets as planned.

Note: the strategy referenced in the above table is to be developed in accordance with the approaches, standards and guidelines specified above and consideration of complementary strategies and management actions presented in Chapter 5 of this plan.

## 5.5 Weed control

Weed control should be undertaken across the Offset Area, in line with the intensity prescribed by the management unit definition (maintenance, primary to maintenance or suppressing weeds/mitigating threats only). Management targets and effort should be guided by the need to reduce High Threat Exotic and exotic species cover as inputs to site quality and to help meet Offset Objectives (see Chapter 4). By the end of the Offset Improvement Period, the following targets must be achieved:

- High Threat Exotic plant species cover must be maintained at less than five percent cover within all mapped native vegetation in the Offset Area, and;
- Exotic plant infestations (defined as areas with greater than 31 percent exotic plant cover in a given vegetation stratum as part of a patch greater than 0.05 hectares) must be excluded from the entire Offset Area.

The approach to weed control must incorporate the following approaches, standards and guidelines (or current equivalents that apply):

- Development of a weed control strategy prepared in accordance with the management framework outlined in chapter 3 and including specific measures to help meet the targets presented in chapter 4 and including verification of the baseline biodiversity values and approaches presented in this Offset Plan.
- Preparation of works plans at appropriate intervals to facilitate adaptive management, planning and reporting.
- The *Australian Weeds Strategy 2017 to 2027* and list of 'weeds of national significance' (WoNS) in Appendix B (CoA 2017a).
- The High Threat Exotic (HTE) list of plant species that pose a particular risk to biodiversity values administered by the NSW BCD.
- Defence Environment and Heritage Manual Chapter 4 – Domestic Biosecurity.
- Trial plots and monitoring plots established in 2019 (AFL 2019b) to determine the most appropriate treatment methods for African Lovegrass and African Olive. The results of longer

term analysis of these plots established by AFL should be considered in the weed management strategy for the Offset Area.

- Management units shown on [Figure 7](#).
- The broad scale, baseline 'weed class' mapping shown on [Figure 8](#)
- Fine scale, supplementary mapping of 'weed classes' comprising polygons encompassing infestations of weed species that can be usefully grouped based on common control techniques combined with the following vegetation cover ranges:
  - Very high (>60%)
  - High (31-60%)
  - Moderate (5-30%)
  - Low (<5%).
- The presence of the threatened flora species shown on [Figure 4](#) and any other threatened plants detected in the Offset Area, and the modification of herbicide use and other weed control techniques as necessary to avoid impacts to threatened plants
- Implementation of broad weed control approaches appropriate to the degree of weed infestation and integrity of native vegetation as follows:
  - 'Maintenance weed control', comprising ongoing treatment of minor or localised weed infestations in areas of higher quality native vegetation as required
  - 'Primary to maintenance weed control', comprising primary treatment of severe weed infestations and follow-up treatment round(s) as required to reach maintenance level
  - 'Suppress weeds', comprising treatment of weed infestations to the level required to ensure that they do not spread including, as a minimum, removal of flowering or fruiting material.
- The effective treatment, storage and/or off-site disposal of green waste material so as to ensure weed material could not propagate off site or in any areas of native vegetation.
- The frequency and intensity of weed control activities, taking into account circumstances where weeds are providing habitat for native species or stabilising soil. If necessary, primary weed removal should be staged in order to avoid over-clearing of habitat and potential soil destabilisation.
- Integration with the restoration and revegetation strategy for the Offset Area (see section 5.3), including preparation for planting activities and consideration of the timing of planting to provide alternative habitat for native species affected by weed control activities.
- Definition of specific, measurable, time and area bound targets and performance indicators to demonstrate how the weed management actions will contribute to site quality score targets.
- The use and storage of HAZCHEM on base requires approval by the Sponsor/Defence representative and Base Support Manager, respectively. Safety Data Sheets (SDS) are to be provided for approval upon request.

Table 5-7 Weed control actions, outcomes and performance criteria

ID	Management action	Outcomes	Timing	Completion criteria
4.1	Develop weed control strategy	Weed control strategy which includes verification of the baseline biodiversity values and approaches presented in this Offset Plan and provides for definition and implementation of management techniques and performance targets. Supported by weed class and cover mapping, including species, extent and intensity of infestations and definition of targets appropriate to each weed class. Input to Offset Plan updates at year 5, 10 and 15 of the Offset Improvement Period.	Baseline mapping, strategy and targets by December 2022. Ongoing annual and ad hoc updates in line with completion of work plans. Input to Offset Plan updates as required.	Weed infestations mapped by cover and class presented in annual reports and input to Offset Plan updates as required.
4.2	Primary weed control followed by weed control rounds as required to achieve maintenance level	Development and implementation of techniques for different weed classes. Primary weed control of mapped weed infestations followed by control rounds as required to achieve <5% weed cover. Detailed works plan developed to stage intensive weed management and coordinate with revegetation efforts.	Ongoing, as planned.	Reduction in weed cover demonstrated by annual mapping.
4.3	Maintenance weed control	Development and implementation of techniques for different weed classes. Development of works plan to maintain low (<5%) weed cover and monitoring regime and adaptive works plan to mitigate against new incursions.	Ongoing, as planned.	Maintained low weed cover demonstrated by annual mapping.
4.4	Suppress weeds	Development and implementation of techniques for different weed classes. Reduced cover and extent of infestations. Risk of spread suppressed through removal of fertile material.	Ongoing, as planned.	Weed cover maintained or reduced. No additional weed cover in adjoining areas.



Note: the strategy referenced in the above table is to be developed in accordance with the approaches, standards and guidelines specified above and consideration of complementary strategies and management actions presented in Chapter 5 of this plan.

## 5.6 Ecological fire management

The fire regime must meet Defence operational and safety requirements, with consideration of existing fire management plans, risks, requirements of the target ecological communities and constituent species, and maintenance of a diversity of habitat types.

The DEOH Bushfire Risk Management Plan (BRMP) provides for a risk-based approach to fire management including environmental risks. An ecological fire management strategy should be developed to supplement the BRMP to provide for ecological fire management within the Offset Area with the objective of improving biodiversity values.

The approach to ecological fire management must incorporate the following approaches, standards and guidelines (or current equivalents that apply):

- Defence Manual of Fire Protection Engineering (MFPE) – Chapter 6, Bushfire Management on the Defence Estate.
- Defence Environment and Heritage Manual Chapter 7 – Bushfire Management.
- Defence National Guidelines for Bushfire Management and Mitigation (under review).
- eDEOP 101 – Department of Defence Explosives Regulations, Regulation 4.5 'Procedure 1 – Control of Vegetation, Livestock and Indigenous Fauna and Vermin'.
- Defence Environmental Legal Obligations and Compliance Registers.
- Development of an ecological fire management strategy prepared in accordance with the management framework outlined in chapter 3, including specific measures to help meet the targets presented in chapter 4.
- Coordination with the BRMP as described above and support for activities such as maintenance of fire trails, fire breaks and signage maintained for site personnel safety and firefighting access requirements.
- Recognition that failure to implement an ecological fire regime contributes to a risk that the Offset Objectives could not be achieved in the context of the development and implementation of the BRMP.
- Definition of appropriate ecological fire regimes for the native species and communities at the Offset Area with reference to NSW Rural Fire Service publications, including the Bush Fire Environmental Assessment Code for New South Wales (RFS 2006) and associated guidance and threatened species hazard reduction lists administered by RFS, including:
  - *Rules and Notes for implementation of the Threatened Species Hazard Reduction List for the Bush Fire Environmental Assessment Code* (RFS undated);
  - *Threatened Species Hazard Reduction List – Part 1 – Plants* (RFS 2013a);
  - *Threatened Species Hazard Reduction List – Part 2 – Animals* (RFS 2013b);
  - *Threatened Species Hazard Reduction List – Part 3 – Threatened Ecological Communities* (RFS 2013c).
- The presence of the threatened flora species shown on [Figure 4](#) and any other threatened plants detected in the Offset Area, and the need to avoid direct impacts to threatened plants and animals through actions such as establishing fire containment lines.

- Integration with the restoration and revegetation strategy for the Offset Area (see section 5.3) including preparation for planting activities and avoiding premature burning of revegetation areas.
- Definition and mapping of fire cells encompassing areas with similar ecological fire requirements and based on consideration of practical boundaries such as fire trails and drainage lines.
- The need to establish a mosaic-pattern of different burn ages (i.e. time since fire) between fire cells to help increase plant species richness and structural diversity and to ensure that the site retains refuge areas for native fauna at all times.
- Mapping and description of any planned burns that are implemented must be documented including relevant details such as fire cell, timing, extent, intensity, vegetation and habitat types burnt, performance against objectives, any adverse outcomes and corrective actions / management responses.

**Table 5-8 Ecological fire management, outcomes and performance criteria**

ID	Management action	Outcomes	Timing	Completion criteria
5.1	Review DEOH Bushfire Risk Management Plan (BRMP) and develop supplementary ecological fire management strategy	Development of clear roles and responsibilities relating to fire management. Fire management cells and appropriate fire regimes identified. Contribution to risk assessment processes and development and implementation of the BRMP as required.	By December 2022	BRMP identifies ecological risks. Target schedule for planned ecological burns documented.
5.2	Support the implementation of the DEOH Bushfire Risk Management Plan	Facilitate the objectives of the DEOH BRMP including maintenance of access, fire breaks and signage.	Ongoing, as planned	Management activities documented in BRMP facilitated.
5.3	Implement the ecological fire management actions	Maintenance of ecologically appropriate fire regimes in accordance with the BRMP and strategy developed. Implementation of prescribed burns and other actions as required to achieve objectives.	Ongoing, as planned	Planned burns conducted at ecologically appropriate intervals. Mapping and description of any planned burns documented.

Note: the strategy referenced in the above table is to be developed in accordance with the approaches, standards and guidelines specified above and consideration of complementary strategies and management actions presented in Chapter 5 of this plan.

## 5.7 Pest fauna and overabundant native fauna management

Pest fauna exclusion and control should be undertaken to mitigate threats to biodiversity values. This would include control of predator pest species such as feral cats and foxes and exclusion of feral herbivores such as rabbits, hares and deer, coordinated with existing control programs in the locality.

This Offset Plan provides for native fauna reintroductions to a 'fauna reintroduction area' defined within a portion of the Offset Area based on consideration of ecological and practical constraints. The pest control and monitoring program would need to be reviewed and increased in intensity as required to ensure that reintroduced fauna populations are not threatened. This would include targeting complete eradication of foxes, feral cats and wild dogs in the fauna reintroduction area to prevent predation.

DEOH is entirely and securely fenced and contains enclosed macropod populations that are having a significant effect on the ecology of the site and have been the subject of monitoring and management since 2005 (Cumberland Ecology 2014; GHD 2020). Management of overabundant native herbivores with consideration of existing monitoring and control programs would need to be required. There is not any evidence to support that complete exclusion of herbivore grazing from the Offset Area would result in improved plant community health or species richness (AFL 2019a).

The approach to pest fauna and overabundant fauna management must incorporate the following approaches, standards and guidelines (or current equivalents that apply):

- Consideration of the pest fauna management and monitoring approaches presented in the *DEOH Feral Animal Management Program* (AVPM 2019).
- *Defence Establishment Orchard Hills Kangaroo Management Plan* (Defence 2014).
- *Defence Support NSW, Kangaroo Management – Background, Management Protocols, Monitoring Methodology, Communications* (Defence 2012).
- *National Guidelines for the Management of Biosecurity and Overabundant Native Species Risks on the Defence Estate* (Defence 2009).
- Development of a fauna management strategy by the end of year one in accordance with the management framework outlined in chapter 3 and including specific measures to help meet the targets presented in chapter 4. The fauna management strategy should include:
  - pest fauna controls, approach and targets;
  - overabundant macropod controls, strategy and targets; and
  - be updated to align with the fauna reintroductions strategy delivered in accordance with section 5.8.
- *National Code of Practice for the Humane Shooting of Kangaroos and Wallabies for Non-Commercial Purposes* (CoA 2008).
- An adaptive approach to overabundant macropod management with carrying capacity, trigger levels and thresholds for management interventions set on the basis of best current information, and then progressively refined as informed by ongoing monitoring.
- Monitoring and setting of trigger levels for overabundant macropod management must consider current environmental conditions, current carrying capacity and level of environmental impact.
- Defence Environment and Heritage Manual Chapter 5 – Native Species and Communities.



Table 5-9 Pest fauna and overabundant native fauna control actions, outcomes and performance criteria

ID	Management action	Outcomes	Timing	Completion criteria
6.1	Develop fauna management strategy	Pest fauna and overabundant native fauna management strategy, integrated with existing programs and plans.	Strategy and targets by December 2022.	Strategy developed.
6.2	Maintain exclusion fencing around Offset Area	Appropriate monitoring and maintenance regime developed and implemented for fencing around the Offset Area.	In line with monitoring and maintenance program.	No observable damage to fencing.
6.3	Implement pest fauna controls	Implementation to achieve planned targets with the overarching aim to eradicate pest fauna within the Offset Area in the first 10 years of the Offset Improvement Period.	Implementation as planned. Pest fauna eradicated by end 2028.	Demonstrated implementation of actions as planned. No pest fauna revealed by periodic or post control round monitoring.
6.4	Review and implement overabundant macropod controls	Review existing kangaroo management plan and implement supplementary strategies and works plans as required to manage macropod populations such that Offset Objectives are not threatened.	Macropod management strategies developed by August 2025 (assuming ongoing macropod management under existing management plans until new requirements emerge to manage threats to habitat improvements that require offset-area specific management). Ongoing management.	Macropod populations are not adversely affecting delivery of Offset Objectives.

Note: the strategy referenced in the above table is to be developed in accordance with the approaches, standards and guidelines specified above and consideration of complementary strategies and management actions presented in Chapter 5 of this plan.

## 5.8 Fauna reintroductions

The Offset Area at DEOH provides a well-fenced and maintained area of Cumberland Plain Woodland which presents the opportunity to reintroduce native fauna with modification of the current security fencing to make it fauna-proof. Fauna reintroductions should focus on animals that are locally extinct native fauna that performed important ecosystem roles in natural communities of the Cumberland Plain, such as bettongs and bandicoots, or locally extinct threatened species that naturally form part of Cumberland Plain communities such as the Bush Stone Curlew (*Burhinus grallarius*). The reintroduction of fauna places considerable ethical and management obligations to ensure that competitive and predator pests, fire and disease are all able to be managed such that the introduced population is not threatened. Similarly, the species introduced and population levels to be maintained must avoid negative impacts on the ecological communities at the Offset Area or interfering with the delivery of the Offset Objectives. As such, a significant amount of planning and coordination must be performed before the reintroduction, and a monitoring and management framework implemented. Once introduced, adaptive management and monitoring should be ongoing.

The approach to potential fauna reintroduction must incorporate the following approaches, standards and guidelines (or current equivalents that apply):

- Office of Environment and Heritage (2019) *Translocation operational policy*;
- NPWS (2001) *Policy for the Translocation of Threatened Fauna in NSW: Policy and Procedure Statement No. 9*;
- IUCN/SSC (2013) *Guidelines for reintroductions and other conservation translocations, version 1.0* (Gland, Switzerland);
- Jakob-Hoff et al. (2014) *Manual of Procedures for Wildlife Disease Risk Analysis*;
- OIE/IUCN (2014) *Guidelines for Wildlife Disease Risk Analysis*;
- Inputs and updates to broader native and pest fauna management at DEOH;
- Development of a fauna reintroduction strategy with clear objectives, short and long-term targets, in accordance with the management framework outlined in chapter 3, including specific measures to help meet the targets presented in chapter 4 and run as scientific trials, with research findings an intended outcome of the reintroduction in accordance with section 6.4;
- Definition of a 'fauna reintroduction area' based on consideration of ecological and practical constraints including habitat types, fencing requirements, access requirements and consistency with other management actions such as with regeneration and revegetation;
- Identification of 'pest fauna' comprising predator or competitor species that pose a tangible threat to the achievement of the objectives of the fauna reintroduction strategy or other Offset Objectives;
- Definition of a fencing strategy integrated with other pest fauna control measures as required to exclude pest fauna from the fauna reintroduction area;
- A risk-based approach to the development of the strategy, including specific consideration of the consistency of fauna reintroduction with other Offset Plan objectives;
- The reintroduction benefits must outweigh the risks to both the species to be reintroduced and to the communities and species of the reintroduction site;
- Reintroduction must be rigorously planned, appropriately resourced, and managed and monitored over appropriate timescales (OEH 2019);

- Monitoring frameworks must be robust, based on scientific data and include triggers and mitigation actions for identified risks (OEH 2019);
- There must be no significant adverse impacts to the source population of the reintroduced species. Identification of a source population should include consideration of population sizes, estimates of genetic diversity, and the resilience of the species to translocation (OEH 2019);
- The suitability of the Offset Site designated for fauna reintroduction must meet the habitat requirements for the species being reintroduced and have sufficient resources to meet the size of the population and its potential growth;
- Animal ethics considerations, including the risk of disease and obligations to report on animal welfare; and
- Consideration must be given to the cause of the local extinction of the target species and whether this cause has been adequately mitigated to allow natural establishment of a new population.

**Table 5-10 Fauna reintroduction actions, outcomes and performance criteria**

ID	Management action	Outcomes	Timing	Completion criteria
7.1	Develop fauna reintroduction strategy	Fauna reintroduction strategy, including definition of fauna reintroduction area, approach and targets. Completion of a risk assessment. Identification and assessment of source population. Update of other management plans as required.	Inputs to strategy by August 2025. Monitoring and performance against targets updated by end 2028, end 2033, and at completion (2038).	Strategy developed and documented. Updated strategy and targets at 2028 and 2033 Confirmation of completion targets.
7.2	Maintain pest-proof fencing around fauna reintroduction area	Integrate with DEOH boundary fencing and upgrade where required to achieve pest exclusion standard. Develop appropriate monitoring and maintenance regime to safeguard introduced animals.	Fence installed prior to fauna reintroductions. In line with monitoring and maintenance program prescribed in the strategy thereafter.	In line with planned monitoring and maintenance program to be developed.
7.3	Exclude key vertebrate pests from fauna reintroduction area	Integrate with pest fauna management actions across Offset Area. Increase intensity of management actions as required to achieve complete	Prior to fauna reintroductions. In line with monitoring and implementation program prescribed in the	No deer (or other exotic grazers or browsers), rabbits, hares, cats or foxes revealed by periodic or post control round monitoring.



ID	Management action	Outcomes	Timing	Completion criteria
		pest fauna exclusion from fauna reintroduction area.	strategy thereafter.	
7.4	Introduce fauna in line with the strategy developed, including monitoring and adaptive management	Introduce fauna populations in accordance with the strategy, monitoring framework and triggers for mitigation actions.	As planned.	As developed in the strategy.

Note: the strategy referenced in the above table is to be developed in accordance with the approaches, standards and guidelines specified above and consideration of complementary strategies and management actions presented in Chapter 5 of this plan.

## 5.9 Contamination and human activity management

There is a known risk of contamination sources both in the Offset Area and adjoining areas, including unexploded ordnance (UXO) and other materials of concern. Any contaminated sites occurring in the Offset Area should be remediated to the standard required by Defence based on consideration of future activities and risks.

Human activities and land uses that are inconsistent with the biodiversity requirements described in this Offset Plan should be minimised and completely prevented where possible.

The implementation of management against contamination and human activities that threaten Offset Objectives must incorporate the following approaches, standards and guidelines (or current equivalents that apply):

- Preliminary site investigations undertaken by Defence (AECOM 2019);
- Potential for sources of contamination to impact waterways, aquatic habitat or move off-site;
- DEOH is an operational base and as such Defence has discretion to allow activities and has a responsibility to restrict and control access (in particular excluding public access) as described in section 3.4;
- Existing Defence programs for contamination remediation should be facilitated and promoted where they do not threaten the Offset Objectives – early intervention should be promoted to provide maximum time to recover during the Offset Improvement Period;
- Ground-disturbing activities such as fencing and planting must not occur without appropriate safeguarding and remediation as required;
- Programming of revegetation should consider contamination remediation efforts, to ensure that recovery of sites where contamination remediation has occurred is at the same standard of other revegetation efforts;
- Future Remediation Action Plans (or equivalent, if required) must be considered and complied with. Areas that are excavated or otherwise disturbed must be rehabilitated and revegetated to the standard of a functioning ecological community through the implementation of the management actions in this Offset Plan. All remediation areas must be treated as management unit E – full structural revegetation;
- Any programming of activities must consider the potential for wasted effort if significant remediation (and associated disturbance) may be required in the future.

- Removal of any damaged or obsolete fencing, with a particular focus on barbed wire fence strand removal to help reduce the risk and energy costs of fauna movement between patches of habitat;
- Sustainable salvage and reuse of habitat resources such as fence posts, stock yards or 'stacked' timber from previous agricultural land uses and in habitat enhancement activities (see section 5.4), and
- Defence Environment and Heritage Manual Chapter 9 – Site Contamination Management.

**Table 5-11 Contamination and human activity control actions, outcomes and performance criteria**

ID	Management action	Outcomes	Timing	Completion criteria
8.1	Identify and report significant sources of contamination	Report evidence of contamination to Defence with GPS coordinates.	Ad hoc	Records of any contamination sources reported to Defence
8.2	Facilitate contamination remediation by Defence in Offset Area and adjoining areas	All proposed ground-disturbing activities to be reported to Defence to allow appropriate clearance and remediation (if required) prior to the activity commencing. Revegetation or activities to be conducted in areas planned to be remediated by Defence with significant disturbance.	Ongoing	Timeline of significant remediation activities required to be agreed with Defence.
8.3	Ensure appropriate quality of revegetation in remediation areas	All remediation areas must be treated as management unit E – full structural revegetation	As required. Implementation as specified in revegetation works implementation plan(s).	Delivery of revegetation works implementation plan(s).
8.4	Remove non-hazardous waste and dumped materials	Remove obsolete fences, sources of asbestos, rubbish or other dumped materials from the Offset Area.	Initial effort by December 2022. Ongoing as required.	No fence materials beyond those maintained fences required to achieve management objectives. No observable rubbish or waste

ID	Management action	Outcomes	Timing	Completion criteria
				sources in the Offset Area

Note: contamination remediation activities should be developed in accordance with the approaches, standards and guidelines specified above and consideration of complementary strategies and management actions presented in Chapter 5 of this plan.

## 5.10 Soil and water management

Drainage lines and waterbodies across the Offset Area have evidence of weed infestation and soil erosion and should be managed to maintain their integrity and habitat quality. In addition, erosion in the Offset Area must be remediated and controlled where it poses a risk to the Offset Objectives and where management will contribute to the health or quality of the site.

The approach to soil and water management must incorporate the following approaches, standards and guidelines (or current equivalents that apply):

- The overall objective of maintaining or improving the quality of existing habitat conferred by built waterbodies, including physical and chemical properties by developing and implementing a soil and water management strategy;
- Development of the strategy in accordance with the management framework outlined in chapter 3 and including specific measures to help meet the targets presented in chapter 4 including verification of the baseline biodiversity values and approaches presented in this Offset Plan;
- *Erosion and sediment control on unsealed roads, A field guide for erosion and sediment control maintenance practices* (State of NSW, 2012);
- *Department of Defence DEOH soil conservation manual* (GHD 2011);
- *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (2018);
- *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC 2000 Guidelines);
- The frequency and intensity of weed control activities, taking into account circumstances where weeds are stabilising soil and waterways. If necessary, primary weed removal should be staged in order to avoid potential soil destabilisation;
- Implementation of appropriate management plans and safe work method statements to prevent pollution of waterways including during the use of chemicals for weed management;
- Definition of specific, measurable, time and area bound targets and performance indicators to demonstrate how the soil erosion and water management actions will contribute to site quality score targets;
- Unsealed roads through the Offset Area will be maintained by Defence. Coordinate with Defence road maintenance activities including ongoing monitoring and reporting of erosion and sedimentation problems, investigation of options to improve road design and implementation of mitigation and/or remediation measures to address erosion adjacent to unsealed roads;
- Fine scale mapping of soil erosion areas and associated management measures (such as sediment traps);
- Defence Environment and Heritage Manual Chapter 6 – Soil Management; and



- Defence Pollution Prevention Management Manual, Annex 1A – Acid Sulfate Soil Management.

Table 5-12 Soil and water management actions, outcomes and performance criteria

ID	Management action	Outcomes	Timing	Completion criteria
9.1	Develop soil and water quality management strategy	A soil and water quality management strategy which includes verification of the baseline biodiversity values and approaches presented in this Offset Plan and provides for definition of approach, erosion mitigation/remediation techniques and time and area bound work plans and targets.	Strategy developed by December 2022	Strategy documented
9.2	Fine scale erosion mapping	Fine scale map of areas of existing or potential erosion and structures or mitigation measures for controlling erosion-related risks to regeneration and revegetation strategy and other Offset Objectives.	Annual mapping in addition to ad hoc monitoring	Map of erosion areas in annual report
9.3	Implement soil and water quality management system	Minimise erosion and sediment transport through appropriate management techniques and maintenance/monitoring schedule. Minimise other impacts to water quality.	Ongoing implementation in line with strategy.	Report sediment and erosion control activities undertaken against strategy objectives in annual report.
9.4	Mitigate and/or remediate erosion	Implement erosion management controls and/or remediation for observed areas of erosion.	Baseline erosion mitigated by December 2024. Ongoing in response to annual mapping and ad hoc monitoring.	No significant erosion issues unmitigated

Note: a soil and water management strategy should be developed in accordance with the approaches, standards and guidelines specified above and consideration of complementary strategies and management actions presented in Chapter 5 of this plan.

## 6. Monitoring and reporting

### 6.1 Overview

Ongoing monitoring of the Offset Area will be required to support adaptive management and to demonstrate progress against the Offset Objectives. Monitoring of the implementation of the Offset Plan will involve the following main stages:

- Verification of the baseline biodiversity values and approaches presented in this Offset Plan;
- Continuous monitoring of the implementation of actions to support adaptive management and to demonstrate progress against planned targets;
- Delivery and outcomes of research programs;
- Annual inspection of the Offset Area to inform annual audits and reporting to Infrastructure on compliance with this Offset Plan;
- Five-yearly monitoring of performance against Offset Objectives, informing the five-yearly review and update of the Offset Plan;
- Completion survey, confirming delivery of the Offset Plan objectives and informing the approach to management of the Offset Area in perpetuity after the Offset Improvement Period; and
- Ongoing monitoring informing the approach to adaptive management of the Offset Area and maintenance of site quality improvements in perpetuity after the Offset Improvement Period.

Monitoring programs will be developed through the delivery of the Offset Plan. Reports must be prepared documenting the outcomes of monitoring and demonstrating performance against the Offset Objectives and other targets set in the Offset Plan and subsequent management strategies.

Milestones and deliverables linked to the implementation of the Offset Plan are outlined below. Delivery of monitoring programs should be linked to and inform these reporting requirements.

The results of periodic monitoring rounds and completion surveys are to be submitted by August of each milestone year, to coincide with BODP Implementation periods following the August 25 2018 approval of the BODP. Monitoring should be conducted in an ecologically appropriate season in the 12-months preceding August of each milestone year.

Table 6-1 Offset Plan deliverables program

Date	Milestones and deliverables
By 25/8/2022	<ul style="list-style-type: none"><li>• First annual Offset Plan audit report</li></ul>
By 23/12/2022	<ul style="list-style-type: none"><li>• Vegetation management strategy complete</li><li>• Ecological fire management strategy complete</li><li>• Fauna management strategy complete</li><li>• Soil and water management strategy complete</li><li>• Annual Offset Plan audit report</li></ul>
By 25/8/2023	<ul style="list-style-type: none"><li>• Year 5 review and update of Offset Plan and associated strategies and targets</li><li>• Fauna reintroductions plan complete</li><li>• Annual Offset Plan audit report</li></ul>

Date	Milestones and deliverables
By 25/8/2028	<ul style="list-style-type: none"> <li>• Year 10 review and update of Offset Plan and associated strategies and targets</li> <li>• Annual Offset Plan audit report</li> </ul>
By 25/8/2033	<ul style="list-style-type: none"> <li>• Year 15 review and update of Offset Plan and associated strategies and targets</li> <li>• Annual Offset Plan audit report</li> </ul>
By 25/8/2038	<ul style="list-style-type: none"> <li>• Completion Ecological Survey</li> <li>• Annual Offset Plan audit report</li> <li>• Confirmed delivery of Offset Objectives</li> </ul>
Post 26/8/2038	<ul style="list-style-type: none"> <li>• Maintenance of Offset Area</li> </ul>

Note: An Annual Offset Plan inspection and audit report would occur every year from 2022 up until the end of the Offset Improvement Period (nominally 2038).

## 6.2 Validation of the achievement of Offset Objectives

Specific Offset Objectives for each of the affected threatened biota are presented in [Table 4-1](#) to [Table 4-3](#) along with baseline and target site quality score values and a summary of the management and monitoring approach in this Offset Plan. Five-yearly monitoring is intended to coincide with the cycle of review and updates to the Offset Plan to validate achievement of the Offset Objectives.

Validation that the Offset Objectives are being met should be performed using the following monitoring framework:

- A plot-monitoring program;
- A landscape monitoring program; and
- Monitoring of specific management objectives and condition targets integrated with an adaptive management approach.

The management of the Offset Area should aim to ensure that the specific Site Condition Score Objectives for each of the affected threatened biota presented in [Table 4-1](#) to [Table 4-3](#) are met in each monitoring plot. Any exceptions to the achievement of these objectives within a plot should be documented and addressed as described in section 4.1. This must include clear documentation of the evidence used to define the monitoring exception and management response, and process for monitoring success of supplementary measures implemented to achieve the objective.

Management should aim to ensure that the specific Site Context Score Objectives for each of the affected threatened biota presented in [Table 4-1](#) to [Table 4-3](#) are met across the entire Offset Area as confirmed through the landscape monitoring program.

## 6.3 Inputs to adaptive management

Adaptive management frameworks should be designed with reference to AS/NZS ISO 14001:2016 (ISO 2016) and using the 'Plan-Do-Check-Act model' summarised in section 3.1. Monitoring should be designed in accordance with this approach in order to:

- Check: monitor and measure processes, and report against objectives; and
- Act: take actions to continually improve.

Day to day observations and scheduled inspections should be used to identify problems and target management effort to avert threats, including through monitoring of:

- Physical condition of fencing, gates, tracks and other infrastructure;



- Evidence of erosion;
- Evidence of pest fauna and especially concentrated activity such as dens, warrens or feral bee hives;
- New or increased weed infestations and flowering or fruiting of exotic plants in existing infestations;
- Prevailing weather conditions, including through the Keetch-Byram drought index, and consideration of implications for revegetation, fire management, fauna control and other weather dependant activities; and
- Any evidence of environmental degradation or threats to management objectives.

To achieve the overall increases in site quality scores required to meet the Offset Objectives, management actions and effort should be targeted to:

- Those areas where the greatest gains can be achieved; and
- Monitoring exceptions to the achievement of Offset Objectives revealed by the validation program described in section 6.2 above.

Shorter term and finer scale management objectives may be defined as part of the adaptive management of the site. Specific, time and area bound, and auditable monitoring programs should be developed to measure performance against these objectives.

The approach to monitoring performance against these objectives would involve *ad hoc* observations and compilation of sub-contractor statements, delivery plans, work diaries etc. in addition to formal monitoring. Wherever appropriate, monitoring should include mapping and periodic update of GIS layers.

The approach to monitoring performance against management objectives should include:

- Woodland and forest stand health monitoring and updated mapping, including observation of tree species richness and diversity of stem size classes relative to targets set for each stand;
- Monitoring of weed infestations and fine scale weed class mapping, including type, extent and intensity of infestations relative to baseline condition and targets appropriate to each weed class;
- Monitoring of revegetation, including cover, height and health of planted areas;
- Habitat resource census and updated mapping, including presence and abundance of habitat trees and fallen woody debris and performance against targets for delivery of supplementary resources;
- Inspection and mapping of ecological burn or bushfire affected areas, including documentation of ignition source, extent and fire impact severity;
- Macropod population monitoring relative to trigger values for population control based on carrying capacity under prevailing climatic conditions; and
- Monitoring of any additional specific management actions and time and area bound targets as required to achieve the Offset Objectives or to alleviate threats.

The design of monitoring programs must ensure the ability to detect and quantify change in the attributes of interest including through:

- Ensuring sufficient data points (i.e. replicates) are sampled to support statistical analysis and to account for spatial variability or observer bias;

- Collecting data on indicators as well as direct measurement of the Offset Objectives;
- Accounting for seasonal or practical limitations to the detectability of target attributes; and
- Comparison with control sites.

All monitoring and other data deliverables produced in implementing the Offset Plan must be delivered in Defence data formats for curation and integration into Defence business management systems. Current core systems include GIS data delivered in accordance with the Spatial Data Management Plan and environmental risk, incidents, monitoring, bushfire, biodiversity and biosecurity inventory data and management units in the Garrison and Estate Management System. All documents must be stored in the Defence file management system (currently Objective) to ensure suitable ongoing access and storage, and adherence with the National Archives Act.

#### 6.4 Publication of research

Defence will design and lead research, or partner with research and education organisations as appropriate to deliver scientifically robust and peer-reviewed ecological research publications. Research outcomes should be communicated and coordinated with existing conservation programs as well as adaptive management of the Offset Area.

Any research proposals should include a rigorous data collection and monitoring program to achieve the following objectives:

- Robust experimental design to support the publishing of research findings in peer-reviewed scientific journals;
- Practical research findings to inform future management decisions;
- Confirmation that the research would not threaten the Offset Objectives, consume undue management effort or cause negative impacts to the site, such as biosecurity risks; and
- Delivery of appropriate summary information for inclusion in periodic reports on implementation of the Offset Plan.

#### 6.5 Annual inspections and reporting

An inspection of the Offset Area should be undertaken at least once every 12 months from finalisation of the Offset Plan to monitor as a minimum:

- Physical condition of fencing and gates to determine whether they are maintained to a standard that can:
  - control human disturbance
  - control the movement of feral and overabundant native herbivores as required by the plan
  - control vertebrate pests as required by the plan;
- Any substantive human disturbance of the Offset Area;
- Evidence of erosion at new locations, or escalation of erosion at known sites;
- Implementation of management actions according to the timeframes specified in the plan;
- The effectiveness of the implementation of the management actions according to performance measures specified in the plan, including:

- the extent, health and condition of native vegetation in revegetation areas relative to targets set in the plan
- the extent and severity of weed infestations in weed control areas relative to targets set in the plan
- the condition of any supplementary habitat resources placed in accordance with the plan
- any other biodiversity values identified as indicators of performance against additional management actions
- The extent, fire impact severity and post-fire vegetation regeneration of any ecological burns implemented in accordance with the plan and/or any wildfires.

The annual inspection will be supported by the results of ongoing monitoring programs developed throughout the delivery of the Offset Plan.

Annual reporting must be undertaken to allow Infrastructure to report against the Offset Objectives under the Airport Plan and BODP.

As such, annual reporting of the Offset Area must:

- Contain the results of monitoring, inspections and audits undertaken during that year as part of the delivery of the Offset Plan.
- Provide a progress update of performance against the targets set in section 4.

The annual report will also assess the Offset Plan's ability to continue to meet the requirements of the BODP. This reporting requirement is intended to support compliance by Infrastructure with its obligations under Condition 39(3) of the Airport Plan.

## 6.6 Offset Plan review

This Offset Plan must be reviewed every five years to ensure that the requirements under the Airport Plan and BODP are able to be met. The review should, as a minimum, include updated mapping reflecting ongoing management of the site and a summary of performance against targets. The updated Offset Plan should reference annual reports and monitoring to document progress against the Offset Objectives set out in section 1.4. The required components of the Offset Plan review are summarised below.

### 6.6.1 Affected threatened biota

In order to confirm progress against Offset Objectives a), b) and c), the extent and quality of habitat for the affected threatened biota should be assessed and documented with reference to the methodology employed in the Initial Ecological Survey (GHD 2020) and this plan, including:

- Updated mapping of the Offset Area boundary, including any additional areas or other changes (noting that the Offset Area must include no less than 900 hectares of land);
- Updated mapping of the extent of Cumberland Plain Woodland and poorer-quality Cumberland Plain Woodland as shown on [Figure 4](#);
- Updated mapping of the extent of Grey-headed Flying-fox and Swift Parrot habitat as shown on [Figure 5](#);
- Updated assessment of the site condition component of habitat quality with reference to plot/transect data, EPBC Act rapid assessment plots and habitat assessments;
- Updated assessment of the site context component of habitat quality with reference to updated vegetation zone mapping and GIS analysis;

- Summary of relevant results of monitoring programs implemented;
- Compilation of data and comparison with the targets for improvements in habitat quality for the affected threatened biota set in section 4.1;
- Discussion of performance relative to targets for the affected threatened biota as appropriate to the timing of the review and the focus of adaptive management that may be required to address non-compliance with targets; and
- Updates to the quantum and/or timing of targets as required to reflect changes in site conditions or management approach (noting that any changes must reflect the requirement that the Offset Objectives are achieved in the time frames set in this plan).

#### 6.6.2 Plants, animals and their habitat

In order to confirm progress against Offset Objective d), five-yearly monitoring rounds and updates to the Offset Plan should include survey and credit calculations with reference to the BBAM to demonstrate that management zones are on a trajectory towards the anticipated gain in site value and/or to target adaptive management as required. The extent and site quality of plants, animals and their habitat should be assessed and documented with reference to the methodology employed in the Initial Ecological Survey (GHD 2020) and this plan, including:

- Updated mapping of vegetation zones as shown on [Figure 3](#) and associated management zones;
- Updated mapping of the extent of threatened plant populations as shown on [Figure 4](#) and assessment of the abundance and health of these populations;
- Updated mapping of habitat resources and threatened fauna observations revealed by research programs or incidental records as shown on [Figure 5](#);
- The results of plot/transect surveys, including, as a minimum resampling of the baseline plots sampled in the Initial Ecological Survey and a duplicate set of plot/transects stratified between vegetation zones according to the BBAM;
- Updated landscape assessment according to the BBAM;
- Calculation of site quality scores according to the BBAM;
- Summary of relevant results of monitoring programs;
- Compilation of data and comparison with the targets for site quality scores set in [Table 4-4](#), and the anticipated outcomes for threatened flora populations in [Table 4-5](#) and threatened fauna populations in [Table 4-6](#);
- Discussion of performance relative to targets for plants, animals and their habitat as appropriate to the timing of the review and the focus of adaptive management that may be required to address non-compliance with targets; and
- Updates to the quantum and/or timing of targets as required to reflect changes in site conditions or management approach (noting that any changes must reflect the requirement that the Offset Objectives are achieved in the time frames set in this plan).

#### 6.6.3 Threats and restoration opportunities

In order to confirm progress against Offset Objective e), the status of threats and restoration opportunities and the implementation of management actions should be assessed and documented with reference to this plan, including:

- Updated mapping of management units as shown on [Figure 7](#);



- Updated mapping of management actions as shown on [Figure 8](#), including weed classes, erosion, waste, any other relevant mapping (revegetation areas, the fauna reintroduction area etc) and any other features as advised by Defence (remediation areas, fencing, tracks etc);
- Summary of relevant results of monitoring programs and completion criteria for works implemented;
- Compilation of data and comparison with the targets for threats and restoration opportunities set in [Table 4-7](#), completion criteria for management actions set in Chapter 5 and any other relevant targets set in strategies developed for the Offset Area;
- Discussion of performance relative to targets for threats and restoration opportunities as appropriate to the timing of the review and the focus of adaptive management that may be required to address non-compliance with targets;
- Updates to the quantum and/or timing of targets as required to reflect changes in site conditions or management approach (noting that any changes must reflect the requirement that the Offset Objectives are achieved in the time frames set in this plan); and
- Updates to the management units and actions as required to reflect changes in site conditions or management approach (noting that any changes must reflect the requirement that the Offset Objectives are achieved in the time frames set in this plan).

## 6.7 Completion Ecological Survey

A Completion Ecological Survey must be completed at the end of the Offset Improvement Period using the methodology employed in the Initial Ecological Survey. The purpose of the Completion Ecological Survey is to demonstrate that the Offset Objectives, and by extension the requirements of the Airport Plan and BODP, have been met.

The Completion Ecological Survey should, as a minimum, include updated mapping and survey data reflecting ongoing management of the site and a summary of performance against targets. The Completion Ecological Survey should also reference annual reports and monitoring to document performance against the Offset Objectives as appropriate.

Performance against the Offset Objectives should be assessed and documented as follows:

- In order to confirm completion of Offset Objectives a), b) and c) the extent and quality of habitat for the affected threatened biota and performance against targets for improvements in habitat quality should be assessed and documented using the approach for Offset Plan reviews set out in section 6.6.1;
- In order to confirm completion of Offset Objective d), the extent and site quality of habitat for plants and animals and performance against targets should be assessed and documented using the approach set out in section 6.6.2;
- In order to confirm completion of Offset Objective e), the status of threats and restoration opportunities and the completion of management actions should be assessed and documented using the approach set out in section 6.6.3;
- Compilation of data and assessment conclusions and discussion of performance relative to the Offset Objectives; and
- Clear concluding statements demonstrating that the Offset Objectives have been met and that the management of the Offset Area should proceed to the maintenance period; or
- Clear statements of non-compliance and the recommended approach to meeting the Offset Objectives, including extension to the Offset Improvement Period and associated focus of adaptive management and updates to the quantum and/or timing of targets to reflect the new management approach.

## 6.8 Record keeping

Appropriate record keeping facilitates both reporting and auditing. Records and data must allow reporting against the Offset Objectives to then inform reporting against the BODP objectives. Records of works performed in the Offset Improvement Period should be captured in the Defence data management system at the time of capture, in a format that enables accuracy of GIS data. Data (including spatial data) must also be able to be retained and extracted to facilitate area-based calculations and tracking of targets.

## 6.9 Auditing

Infrastructure will arrange periodic audits of the implementation of this Offset Plan to support Infrastructure's own obligations for the implementation of the BODP. Defence must provide support for these independent compliance audits to be undertaken so as to support the obligations in Condition 30(11) of the Airport Plan - Infrastructure must implement the approved BODP and ensure that an independent audit of the BODP implementation is conducted in respect of:

- the 12-month period commencing with the approval of the BODP; and
- each subsequent 18-month period until all biodiversity offsets required by the BODP have been secured or implemented; and
- submit a report of each audit that is carried out to Environment within six months of the end of the period in respect of which the audit was conducted.

A 2019 BODP implementation report was prepared and submitted for the 12-month period commencing with the approval of the BODP, specifically 25 August 2018 to 25 August 2019. The 2019 BODP implementation report was finalised on 24 February 2020 that included an estimate of the quantum of offset secured at the Offset Area based on incomplete drafts of this Offset Plan and the Initial Ecological Survey report.

A 2021 BODP implementation audit report would be prepared for the 18-month period that follows the initial 12-month period that commenced with the approval of the BODP, specifically 25 August 2019 to 25 February 2021. The audit report would need to be submitted to Environment prior to 25 August 2021 (that is within six months of the end of the period in respect of which the audit was conducted). Defence must provide data and communicate as required and in a timely fashion to assist Infrastructure to comply with the BODP and Airport Plan conditions.

If audit findings have recommendations relating to the content of this Offset Plan, the plan should be reviewed and updated as reasonably required, including as a minimum at five-yearly Offset Plan reviews. Audit results should be presented in the annual report to Infrastructure.

Records should be retained and made available to auditors. The subject of audits may vary according to risk. Audit criteria should be developed against the requirements of the BODP and the targets and associated management objectives and completion criteria described in this plan.

## 7. References

AECOM 2018, *Soil testing assessment, Naval Guided Weapons Maintenance Facility, Defence Establishment Orchard Hills*

AECOM 2019, *Stage 1 Preliminary Site Investigation*, Defence Establishment Orchard Hills (0899)

AFL 2019a, *Ecological Report Cumberland Plains Woodlands Biodiversity Offset DEOH, Ecological Monitoring – Flora Surveys*. Australian Facilities Landscape. Report prepared for BGIS.

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## 8. Annex A. Plan Amendments in Response to Independent Verifier comments.

The Offset Plan was reviewed by an independent verifier commissioned by Infrastructure. Comments were reviewed and actioned by the Defence Assistant Director Environment and Heritage Policy and GHD, and a number of edits and improvements were made in response to those comments.

The comment related to offset approval conditions, governance or approaches directed or endorsed by the regulator, and that were outside the remit of a technical document review. And related to this, the comment did not take into account the specific role of the Offset Plan in overall Offset Area management. The Offset Plan has a specific role to set down site condition, improvement targets and classes of actions to achieve a suitable offset outcome. Management and governance of the Offset Area is not set down in the plan and is directed or agreed through approval conditions, the MoU between Defence and Infrastructure, and the scope and contract management arrangement with parties undertaking offset management works. Critically, the DEOH working group consisting of Defence, Infrastructure and optional Environment representatives provides the core governance oversight for day-to-day operational management of the site by Defences

Number	Independent Verifier comment/recommendation	Response	Where addressed in Offset Plan
1	<p>There is limited information within Table 5.4 on how the areas identified for maintaining native grasslands vs areas proposed for revegetation will be quantified against the completion criteria for total native vegetation cover within the Offset Area objectives of Table 4.1.</p> <p><b>The Offset plan should clarify commitments to include native grasslands in vegetation cover estimates or commitment to maintain minimum areas of vegetation cover within regeneration area.</b></p>	<p>Additional clarification provided that native vegetation cover targets are to be measured in 'patches' of native vegetation which may include areas with gaps in over-storey vegetation up to 100 m wide providing for: maintenance of species rich grasslands; and canopy cover of &gt;10% when measured across the entire patch.</p>	<p>Table 4.1 Table 5.5 Notes before Table 5.5</p>
2	<p>The proposed <i>Management of Native Blackthorn scrub</i> needs to be supported by detailed baseline monitoring against local reference benchmarks and trial results. This type of management requires demonstrated evidence of ecological improvements in diversity and species richness of native flora and fauna and an understanding of impacts to weed and pest species within the offset.</p> <p><b>Consider removing the management of Overabundant Native Blackthorn cover from Table 4.1 Offset Plan Objectives until research trials can demonstrate improvement and no detrimental impact on understorey diversity and cover and specifically fauna habitats for Cumberland Plain Land Snail and Woodland Birds.</b></p>	<p>Offset Plan modified to include: Research based trial of potential for management of Native Blackthorn cover to help realise Offset Objectives and avoid detrimental effects; and</p> <p>Nominal offset objectives for Overabundant Native Blackthorn cover to be implemented as appropriate to the outcomes of trials.</p>	<p>Table 5.3 and notes before Table 5.3 Table 5.4 Removed as an Offset Objective for Cumberland Plain Woodland in Table 4.1.</p>

Number	Independent Verifier comment/recommendation	Response	Where addressed in Offset Plan
3	<p><b>Provide clear definition of the 'long term benefit' that is expected beyond the 20 year Offset Improvement Period.</b></p> <p><b>Provide clear and consistent commitment within the MOU on the proposed conservation agreement, security mechanisms and timeframes that will apply 'in perpetuity' protection of the offset area.</b></p> <p><b>Incorporate commitment and/or approach to long term security beyond 20 years if the Offset Improvement Period done not meet completion criteria within the 20 year timeframe.</b></p>	<p>No change. The 'Long-term benefit' is delivered by the improvement of site conditions and ongoing maintenance provided for explicitly within the MoU between Defence and Infrastructure. The comment did not take into account the role of the Offset Plan in overall Offset Area management. The Offset Plan has a specific role to set down site condition, improvement targets and classes of actions to achieve a suitable offset outcome. Management and governance of the Offset Area is not set down in the plan and is directed or agreed through approval conditions, the MoU between Defence and Infrastructure, and the scope and contract management arrangement with parties undertaking offset management works. Critically, the DEOH working group consisting of Defence, Infrastructure and optional Environment representatives provides the core governance oversight for day-to-day operational management of the site by Defences</p>	N/A
4	<p><b>The conservation outcomes for the Offset area need to clearly define what are permissible activities within the Offset Area and ideally commit to restricting the direct impact on the biodiversity values within the offset area.</b></p>	<p>The goal of offset management is to achieve and environmental benefit and outcome. As long as offset objectives are achieved, it is irrelevant what activities occur in the Offset Area. Activity controls will be put in place by Defence to ensure this is the case. However, this outside the requirement of the offset plan, and does not rely on pre-determining a list of permissible activities.</p> <p>The Offset Objectives prescribe the conservation outcomes for the Offset Area. The Offset Area will be actively managed to achieve the Offset Objectives Core activities related to achieving the Offset Objectives are presented in Chapter 5.</p>	Section 1.4 Chapter 5
5	<p><b>The management action 8.1 in Table 5.10 be undertaken as a priority or prior to implementation of the offset plan to quantify and provide certainty of potential contamination risk areas within the offset area. Remediation activities should be planned such that the actual remediation and any follow-up biodiversity enhancements can be completed prior to the end of year 20.</b></p>	<p>The action is valid as stated in the plan, and the timing, as per above, Needs to be dictated by ensuring that targets and environmental outcomes can be achieved. The verifier's comment is correct in that earlier action will provide greatest flexibility in delivery of the offset. However, the Offset Plan need not be prescriptive in this matter, as the degree of contamination (if any) is purely speculative and may have no impact whatsoever on offset delivery.</p>	N/A
6	<p>Table 4.1 outlines the proposed offset objectives including Start and Future quality scores, monitoring frameworks and key management actions.</p>	<p>The offset plan does not seek to define gains (and therefore greater separation between scores) for all aspects of the existing vegetation. This is a function of the generally good baseline condition over</p>	Section 1.4 Chapter 4



Number	Independent Verifier comment/recommendation	Response	Where addressed in Offset Plan
	<p>For many of the objectives there is a significant overlap in Start, 10 year and 20-year score values, however there is little clarity in how these will be reconciled and related to monitoring. Currently many of the objective Start values could be considered within the range of the 10 and 20 year values with no meaningful improvement. This is particularly the case for:</p> <ul style="list-style-type: none"> <li>- Ground cover species richness</li> <li>- Ground cover</li> <li>- High threat exotic species of plants</li> </ul> <p><b>Clarification is required on how the ranges for individual values presented for each objective can clearly define gains at 10 and 20 years, or greater separation between Start and Futures scores is required.</b></p>	<p>much of the Offset Area. Note that only modest gains are set in the Offset Objectives: 2 overall for CPW, 1 for the fauna with much of this gain associated with treatment of localised management issues such as weed infestations <i>or</i> landscape scale increases in over storey cover and connectivity. The management approach is geared towards maintenance (rather than substantial improvement) of many other attributes and the objectives reflect this.</p>	
	<p><b>Clearly define if targets for 10 and 20 years are to be demonstrated across all monitoring sites, a representative sample of monitoring sites or some average across management zones.</b></p>	<p>Additional detail has been provided with regards to the framework for plot-based monitoring, including requirement that the specific Site Condition Score Objectives for each of the affected threatened biota presented in Table 4 1 to Table 4 3 are met in each plot sampled in the plot-monitoring program and the required response to exceptions.</p>	<p>Section 4.1 Section 6.2</p>
	<p><b>Further clarity on how the targeted gains in site value scores presented in Table 4.4 (e.g. poor condition CPW can increase in site value score from 35 to 72) are aligned with the performance outcomes in Table 4.1.</b></p>	<p>In the event of any disagreement between the values in Table 4 4 and the Offset Objectives set in section 4.1, the Offset Objectives for the affected threatened biota set in section 4.1 have precedence.</p>	<p>Section 4.2.1</p>
7	<p>The start quality score requires at least 1 hollow in 4 out of 12 plots sampled. This is then extrapolated to a future target of 1 HBT, nest box or artificial hollow per ha in treed areas by year 10 and the same target in year 20.</p> <p><b>It is unclear why density metric changed from one HBT or hollow in a 20 x 50 m plot to one HBT or hollow per ha? It is also noted that one HBT or hollow per ha is actually very low.</b></p> <p><b>The offset objective for hollow bearing trees (HBT) requires clarification.</b></p>	<p>Target amended to 'At least 10 HBTs, artificial hollows or nest boxes per hectare across treed areas of related vegetation zones (equivalent to at least one hollow measured in 50 m x 20 m plot).'</p>	<p>Table 4.1</p>
8	<p>Many of the offset objectives to be measured can be significantly impacted by seasonality. However, Table 4.1 indicates 10 year and completion ecological surveys are to be undertaken in Winter (August) outside of the optimal period for detection for many species.</p> <p><b>Clearly set seasonality controls in the monitoring framework and actions that tie this into offset objectives and values.</b></p>	<p>Monitoring should be conducted in an ecologically appropriate season in the 12-months preceding August of each milestone year. Section 4.1 and 6.1 updated to clarify.</p>	<p>Section 4.1 Section 6.1</p>
9	<p>There are also issues by comparing future values with a single-year baseline. Vegetation quality can vary significantly from year to year due to a range of factors, such as</p>	<p>The baseline for the Offset Objectives was set based on the Initial Ecological Survey as required by the MOU and the BODP. The monitoring and reporting framework</p>	<p>Chapter 6</p>

Number	Independent Verifier comment/recommendation	Response	Where addressed in Offset Plan
	<p>rainfall, browsing pressure, temperature extremes, or a host of other stochastic effects that have nothing to do with management. For example, 2019 was at the end of a drought year, and if baseline surveys were repeated in Spring 2020 they would likely show an increase in the density and diversity of understorey species. If such a repeat survey was conducted in 5 or 10 years time and it coincided with a similarly good year, it would indicate success at achieving or moving towards achieving the 20-year targets. The discussion of <i>Dillwynia tenuifolia</i> in Section 4.2.2 demonstrates this issue at the site.</p> <p><b>As a matter of urgency, additional baseline surveys be considered and undertaken in Spring 2020 or other times as appropriate for the relevant indicator to establish a rolling or cumulative baseline that is more representative of current conditions.</b></p>	for the Offset Area will include continuous monitoring to inform adaptive management and annual inspections and reporting. These additional monitoring activities will assist in compiling a cumulative baseline and with the interpretation of the achievement of Offset Objectives in the context of prevailing environmental conditions.	
	<b>Consider monitoring and performance targets be included within the Offset plan for woodland birds and CPLS.</b>	No specific targets or monitoring requirements have been set for woodland birds and CPLS as they are not a specific subject of the Offset Objectives in the MOU. It is assumed that targets for broad ecological restoration and threat mitigation activities will be appropriate to conserve these species and their habitats. It is noted that These threatened species would be an appropriate target of research to demonstrate co-benefits of achieving the Offset Objectives	Section 3.6 Section 4.2.3 Section 6.4
10	<p>Section 4.2.3. discusses how threatened terrestrial fauna species will benefit from management actions to CPW at the offset site and the CPLS, Southern Myotis, woodland birds and microbats are specifically mentioned. However, there is little detail given about the specific management actions that will benefit these species.</p> <p><b>Consider providing more specific details of the type, intensity and timing of actions that will benefit these species be given to provide further clarity and confidence that they will benefit in the way and to the extent expected.</b></p>	<p>The MOU does not require specific, measureable benefits for these biota. This is consistent with the NSW Framework for Biodiversity Assessment (FBA) and BioBanking Assessment Methodology which do not require specific consideration of these biota beyond the calculation of credits and assumed increase in site quality scores via site-scale management actions.</p> <p>It is noted that these threatened species would be an appropriate target of research to demonstrate co-benefits of achieving the Offset Objectives.</p>	Section 4.3.1 Section 3.6 Section 6.4
	<p>Table 4-4 'Management Zones' is confusing. Only some management zones are included and it is unclear why they are ordered as they are. Furthermore, the text in the column 'Management Zone' for Veg Zone 1 is written as a goal (i.e. maintain and enhance good condition ... woodland...) while the text in the same column for Veg Zone 2 is written as an</p>	<p>Vegetation / management zone ID numbering is consistent with the zone IDs at the airport site for the purposes of the offset calculations presented in the BODP. Zones 3 and 4 are not present at Orchard Hills.</p> <p>All management zones present at Orchard Hills are included in the table.</p> <p>Management zones are ordered by NSW broad vegetation type (i.e. MZ1, MZ2 and MZ10 are all HN528).</p>	Section 4.2.1 Table 4-4

Number	Independent Verifier comment/recommendation	Response	Where addressed in Offset Plan
	action (i.e. Targeted supplementary planting in ... woodland...). <b>Please clarify.</b>	The descriptor 'Maintain and enhance...' reflects the default increase in site values within a management zone. The descriptors 'Regeneration of...', 'Revegetation of...' reflect active restoration.  The text in section 4.2.1 and the columns headed 'Management unit(s)' and 'Summary of management approach' make the above points clear.	
	<b>Clarify the method to estimate current HBT values, justify the ecological basis for the future HBT target, and the actual numerical targets for HBTs and fallen logs.</b>	Target amended to 'At least 10 HBTs, artificial hollows or nest boxes per hectare across treed areas of related vegetation zones (equivalent to at least one hollow measured in 50 m x 20 m plot).' Numerical targets for HBTs and logs are according to the plot/transect methodology. See response above regarding plot-monitoring program.	Section 4.1 Table 4-1
	<b>Clarify the different role or function of different fences now and over the next 20 years.</b>	Perimeter and security fencing are excluded from the implementation of the Offset Plan, but are activities coordinated by Defence to ensure compatibility with implementation of the Offset Plan.  Pest-proof fencing to support the fauna reintroduction program will be identified and mapped as part of the future implementation of that program.  Known, obsolete fencing is identified for removal in the Offset Plan.	Table 5-10 Table 5-11 Figure 8
	<b>Consider including some biological parameters to demonstrate the positive effects of reducing light pollution, rather than just measuring light levels.</b>	Wording amended to make it clearer that 'Consideration of light pollution sources <i>and their impact on habitat quality for nocturnal fauna ...</i> ' includes consideration of biological parameters as well as light level auditing.	Section 5.4 Table 5-6
11	There are many references throughout the plan to things that 'should' be done, rather than 'will' or 'must' be done.  <b>Further consideration be given to terms used to ensure there is no ambiguity in the actual commitments being made.</b>	The requirement for any specific action or method of improvement should not be restrictive in the plan. The core requirement set down in the Offset Plan is to achieve targets. The plan should allow for innovation and evolving best practice in undertaken works to achieve targets, preferably resulting from trials and actions undertaken on DEOH.  Further control on management activities is set down in contracts between Defence and parties undertaking management actions. This allows flexibility to propose and undertake effective adaptive-management based on evolving knowledge of the site.	N/A
12	The identification of key threats to the implementation of the Offset plan and providing indicative guidance on requirements for responding or dealing with these threats is partially discussed in Table 4.7 which lists the Offset Plan Objectives –	Table 4-7 does not list threats to the achievement of Offset Objectives; it lists threats to biodiversity values in general. It does not replicate table 4-1 to 4-3, it lists objectives for matters not covered for MNES in earlier tables (eg tree species	Section 4.3.1 Table 4-7

Number	Independent Verifier comment/recommendation	Response	Where addressed in Offset Plan
	<p>threats and restoration opportunities. However, Table 4.7 is limited in the identification of these threats and appears to replicate sections of Table 4.4.</p> <p><b>Consider incorporating a dedicated section describing the potential risks to successful management actions and factors likely to enhance or impede the effective long-term provision of suitable habitat(s) for threatened species and the restoration of Cumberland Plain Woodland.</b></p> <p><b>This section should also outline the corresponding description of the contingency measures that could be implemented to mitigate these risks. An indicative example is provided below:</b></p>	<p>richness in vegetation zones 6 and 10 noting they are neither CPW nor Swift Parrot/GHFF habitat).</p> <p>Clarifying text added: "This section outlines consideration of matters that will require management at the Offset Area but which are not specifically linked to the biodiversity targets set in these preceding sections, collectively referred to as 'threats and restoration opportunities'."</p>	
	<p><b>The adaptive management framework needs further specific detail and commitments to ensure it achieves what it has the potential to deliver.</b></p>	<p>The adaptive management framework has been developed to guide the implementation of the Offset Plan by the Offset Contractor(s). Specific detail and commitments will be developed by Offset Contractor(s) as directed by Defence.</p>	<p>Section 3.1 Section 3.2 Figure 6</p>
13	<p>Fundamentally, one of the objectives of the offset plan should be to 'learn while doing', and this paradigm or philosophy should be embedded in every action, decision and evaluation at the site. For example, research is discussed as being 'facilitated where appropriate' but there is little to no discussion or recognition of the fundamental and critical role of evidence-based decision making or using scientific trials to inform management actions. The role and priority of applied research to inform management and maximise the likelihood of success is not sufficiently stressed and embedded within the plan. For example, Section 3.6 in the Plan that addresses research is less than 1 page in length and primarily addresses a few high level topics. Row 1.3 in Table 5-3 talks about facilitating opportunities to undertake research, rather than embedding research into the monitoring framework. <b>Consider making applied research and 'to learn while doing' fundamental to achieving the plan by embedded more holistically into the framework and approach to achieving the offset outcomes.</b></p>	<p>The Offset Plan states that: '... it is required that the Offset Improvement Period is used to promote and facilitate research in line with the Offset Objectives'. 'Any research proposals should include a rigorous data collection and monitoring program to achieve...Practical research findings to inform future management decisions'.</p> <p>These references provide a high level framework for the role of research, with the specific integration of research-based trials with management responses to be defined through the implementation of the plan.</p> <p>Also note that each of the management actions presented in chapter 5 includes reference to development of strategies and approaches in responses to monitoring / research.</p>	<p>Sections 3.1 Section 3.6 Section 6.3 Section 6.4 Chapter 5</p>
14	<p>In contrast, Section 6.3, under the heading 'Publication of Research' states that Defence will design and lead research or partner with research and education organisations to deliver scientifically robust and peer-reviewed publications. This is commendable and should be encouraged and supported.</p> <p><b>This section should also be expanded as described above and below to fully integrate and embed applied research into the management of the site.</b></p>	<p>As above, this section provides the framework for the role of research, with the specific integration of research-based trials with management responses to be defined through the implementation of the plan.</p>	<p>Section 6.3</p>



Number	Independent Verifier comment/recommendation	Response	Where addressed in Offset Plan
15	<p>Monitoring is used in the plan as a means of detecting and measuring a change in the status of an attribute, but not to identify or explain the reasons for that change. The issue with this is best explained through a negative result. Let's assume that the condition of the CPW is not improving after 10 years of management actions and money intended to improve it. At year 10, Defence need to decide what should happen next to achieve the necessary improvement in the condition of the CPW in order to meet the offset obligations. With basic monitoring, all we know is that condition has not improved, and at Year 10 we bring in experts and we try to figure out and guess as to what should be done next. If the management was set up as a testable experiment from the outset, then Defence would likely have information to inform the next steps. For example, there might be some debate initially about the most effective approach to establish trees in CPW, with some evidence suggesting direct seeding on scalped soil is the best approach, other evidence suggesting direct seeding in deep ripping, planting tube stock or planting advanced trees. Setting this up as a trial with the intention to learn while doing would involve setting up multiple replicate areas and apply different approaches in each. Using this approach, trees get planted AND we learn about the effectiveness of different approaches, including under different climatic conditions (i.e. rainfall). Then at year 10, we would have reliable information to make evidence-based decisions about next steps. This approach may have been the intention of using an adaptive management framework, but it is not explicitly stated.</p> <p><b>Consider making the plan be more explicit around the proposed monitoring being integrated with experiments as a means to test and thus improve the effectiveness of management actions.</b></p>	<p>The Offset Plan clearly states the requirement for an adaptive management framework, as informed by research-based trials, in addition to the core monitoring required to demonstrate achievement of the Offset Objectives.</p> <p>Note African Love Grass Control trials are already underway.</p>	<p>Section 3.1 Section 6.3 Section 6.4</p>
16	<p>Section 4.3.5 gives a number of small-scale examples of trials with multiple replicates being used to test effectiveness of different weed control methods. This is to be commended and should be the norm, rather than the Project No PS113470 Western Sydney International (Nancy-Bird Walton) Airport Biodiversity Offset Delivery Plan (BODP) Offset Plan Independent Review Department of Infrastructure, Transport, Regional Development and Communications WSP October 2020 Page 11 exception. However, priority should be given to always maximising the power of the study designs as the 2nd last paragraph in this section states that different treatments were compared to a [presumably single] control plot.</p>	<p>The Offset Plan states that 'Any research proposals should include a rigorous data collection and monitoring program to achieve... Robust experimental design to support the publishing of research findings in peer-reviewed scientific journals'.</p> <p>Specific reference to the fauna reintroductions '... run as scientific trials, with research findings an intended outcome of the reintroduction in accordance with section 6.4' added to section 5.8.</p>	<p>Section 5.8 Section 6.3 Section 6.4</p>

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	<b>All studies should be designed with the help of biometricians or statistical experts to ensure they are able to detect significant effects. The plan should explicitly state that the fauna reintroductions (Section 5.8) must be run as scientific trials, with learning as an intended outcome of the reintroduction.</b>		
17	<p>The plan only gives indicative examples or suggestions of management actions and leaves the specific actions up to contractors or Defence to encourage innovation. This is appropriate because it encourages innovation, but the plan does need specific guidance and commitments to ensure the innovation is properly developed, tested, evaluated and reported.</p> <p><b>The plan requires more detail in this area to increase surety that innovation will incorporate robust evaluation to be reliable.</b></p>	<p>As per comment 11. The requirement for any specific action or method of improvement should not be restrictive in the plan. The core requirement set down in the Offset Plan is to achieve targets. The plan should allow for innovation and evolving best practice in undertaken works to achieve targets, preferably resulting from trials and actions undertaken on DEOH.</p> <p>Further control on management activities is set down in contracts between Defence and parties undertaking management actions. This allows flexibility to propose and undertake effective adaptive-management based on evolving knowledge of the site.</p>	
18	<p>There is no mention of statistical power when designing the monitoring. Statistical power is the ability to detect and measure a change in an attribute of interest and there are at least two ways in which this matters. The first is when the score of the attribute varies among observers – and % cover of plants is a classic example of this – and the target is to see a small % change in cover. For example, Table 4-7 states that the 10-year goal for the % cover of exotic plant infestations is that no areas will have &gt;31% cover. This level of specificity is difficult to measure accurately and any change can be masked by observer error alone. This is especially problematic over a longtime frame when multiple observers are likely to be doing the observations. The second example is when something is difficult to measure accurately – such as plants that are only detectable for a short period of time in some years, or a species of wildlife that is hard to observe. In these situations, it is very difficult and expensive to get enough data points to detect a trend and be confident of that trend. And in both cases, the risk for the offset plan is that if statistical power is not considered in the design of the monitoring program, there is a high likelihood that Defence will be unable to demonstrate that its offsetting obligations have been met.</p> <p><b>The solutions to low statistical power are numerous and include the collection of more data points (i.e. replicates), using different sampling methods, collecting data on indicators rather than the variable of</b></p>	<p>Additional reference to the need for the design of monitoring programs to ensure the ability to detect and measure a change in an attribute of interest has been added to section 6.3.</p> <p>Further, section 6.4 of the Offset Plan states that ‘Any research proposals should include a rigorous data collection and monitoring program to achieve... Robust experimental design to support the publishing of research findings in peer-reviewed scientific journals’.</p> <p>Consideration of statistical power is implicit in this approach.</p>	<p>Section 6.3</p> <p>Section 6.4</p>

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	<b>interest, and/or changing the study design by including measurements before the intervention and/or at control sites (i.e. BACI). This needs to be addressed in detail in the plan.</b>		
19	There is no discussion of data analysis techniques. Note that the exact method of data analysis is going to depend on the data collected and this is still unclear, and thus it is premature to attempt to specify this. <b>The plan should explicitly state that it is an expectation that data analysis should be conducted using state of the art approaches and techniques, thus giving certainty around the intent – which is best practise.</b>	As above, the Offset Plan states that ‘Any research proposals should include a rigorous data collection and monitoring program to achieve... Robust experimental design’.  Consideration of state-of-the-art techniques and approaches is implicit in this approach.	Section 6.3 Section 6.4
20	Some of the attributes of interest (i.e. indicators) are vague and undefined in the plan e.g. stand ‘health’ of CPW. What exactly does that mean? How would it be measured? Stand health can be very different from an arboriculture and tree health perspective vs an ecological perspective, where unhealthy trees with rot and decay provide excellent habitat for wildlife.  <b>Please specify or provide guidance on how ‘health’ and other similarly vague attributes are defined.</b>	‘Stand health’ is a summary term to assist with concise mapping and tabulation of a range of issues. The relevant criteria are described in the Offset Plan (see row 1.2 in table 5.3). Additional definition of factors likely to contribute to better and poorer quality stand health have been added to section 5.2. It should also be noted that stand dieback can result from a variety of factors, and respond to a similar variety of treatments, and so the Offset Plan purposefully avoids prescriptive definition.	Section 5.2 Table 5.3
	<b>Clarify the use of the terms ‘monitoring’ and ‘evaluation and ensure each is used appropriately in the plan.</b>	The Offset Plan does not use the term ‘evaluation’. The Offset Plan refers only to monitoring against the Offset Plan objectives and various targets set throughout the plan. No further action proposed.	Chapter 6
	<b>The monitoring and evaluation program should have the flexibility be adapted over time to pick up new and important matters of interest.</b>	The Offset Plan requires that an adaptive management framework is applied such that continual feedback directs the activities that are undertaken to promote continual improvement. The monitoring and management framework presented in the plan provides flexibility for delivery and “Monitoring of any additional specific management actions and time and area bound targets as required to achieve the Offset Objectives or to alleviate threats”.	Section 3.1 Chapter 3 Section 6.1
	The 6th column of Table 4-6 is called monitoring framework – when really it is actually methods. A framework is much broader and includes the approach to evaluation, understanding how the system functions, study design etc.  <b>Rephrase this section of the table to accurately reflect the contents.</b>	‘Monitoring framework’ column removed, reflecting the fact that the approach to monitoring will be defined in a future Fauna Reintroduction Plan.	Table 4-6
21	There has been significant research and writings on the design and management of successful long-term monitoring programs in recent years by numerous authors (e.g. Lindenmayer and Likens 2010).	The Offset Plan states that “Defence will design and lead research, or partner with research and education organisations as appropriate to deliver scientifically robust and peer-reviewed ecological research publications. Research outcomes should	Section 6.3 Section 6.4

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	<p><b>Further consideration could be given to developing a detailed monitoring framework within the Offset plan regarding relevant literature and consideration of the following:</b></p> <p><b>1: The identification of good questions that can evolve over time. The questions need to be more than simply – does attribute X increase over time – to something that is of interest scientifically and can inform future management in a meaningful and cost-effective way.</b></p> <p><b>2: Use a conceptual model to describe how the system operates and thus identify the attributes to both manage and measure and the timing of those measurements. For example – measuring habitat condition at 5-yearly intervals might make for a neat program, but if the natural annual variation in condition is massive, then any change from year to year could occur by chance, and not be a result of investment in management. In these cases, maybe monitoring needs to happen every year or every second year.</b></p> <p><b>3: Use a scientifically robust study design. For example, simply measuring the occupation of some natural or artificial hollow doesn't really provide opportunity to learn about whether Myotis prefers certain hollow types or positions of hollows. Ideally, the study would include control sites, replication of treatments, and data collected before and after treatment.</b></p> <p><b>4: Long-term monitoring programs are notoriously difficult to manage over the long-term. Engaging different consultants to do monitoring at different times is problematic, despite the intention of them measuring the same things in exactly the same way. Effective long-term monitoring programs require excellent and long-term partnerships.</b></p> <p><b>5: Equally important to partnerships is the need for a dedicated leader within Defence to manage the program and manage the monitoring and evaluation as an integral component of the approach to management – not just a way to evaluate success.</b></p> <p><b>6: The data and observations need to be carefully stored and curated. The loss of data is a significant risk on long-term monitoring projects, and it is acknowledged this is briefly mentioned in Section 6.7. While the exact method to be used does not need to be detailed here, the critical importance of data storage MUST be stressed so that it is given the due diligence required.</b></p>	<p>be communicated and coordinated with existing conservation programs as well as adaptive management of the Offset Area”.</p> <p>As above, the Offset Plan states that “Any research proposals should include a rigorous data collection and monitoring program to achieve... Robust experimental design”.</p> <p>The various considerations raised by the reviewer are supported by this approach and will be specifically considered addressed by the Offset Contractor and Defence in developing monitoring programs.</p> <p>Additional text has been added to describe formal data requirements “All monitoring and other data deliverables produced in implementing the Offset Plan must be delivered in Defence data formats for curation and integration into Defence business management systems. Current core systems include GIS data delivered in accordance with the Spatial Data Management Plan and environmental risk, incidents, monitoring, bushfire, biodiversity and biosecurity inventory data and management units in the Garrison and Estate Management System. All documents must be stored in the Defence file management system (currently Objective) to ensure suitable ongoing access and storage, and adherence with the National Archives Act.”</p>	



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	<p><b>7: The data collected needs to be used regularly and frequently. If the data that is collected isn't analysed and used regularly, then it doesn't contribute to inform management actions, and is thus not cost-effective</b></p> <p><b>8: Acceptance that ways to measure particular attributes and analyse data will change over the next 20 years. The plan needs to specify that such changes are to be avoided if possible, or if not, that it doesn't jeopardise the final outcome and there will need to be a period of calibration where data are measured using both the old and new technique.</b></p> <p><b>One approach to reduce the risk that Defence will be unable to reliably demonstrate the necessary increases in offset scores is to establish a scientific advisory committee with expertise in study design and statistical data analysis and modelling to ensure that all monitoring is scientifically robust and co-ordinated across the site.</b></p>		
22	<p>It is assumed that the plots that were used to establish the baseline are in the most appropriate locations and stratified across the site (e.g. by vegetation type/structure/age, species richness, topography, past land etc) to most accurately and confidently measure changes over time. The initial plots were selected and used to get an understanding of the current conditions of the site, but it is conceivable that they are not optimised to measure and track changes over time and thus enable Defence to confidently conclude their offset obligations have been met.</p> <p><b>Consider reviewing the location and stratification of the current monitoring locations to ensure they are optimised for future evaluation and if necessary, additional plots be added to complement the existing ones.</b></p>	<p>Plots were stratified in order to provide the baseline for the Offset Objectives under the MOU, and to inform offset calculations in the Initial Ecological Survey report and 2020 BODP Implementation report.</p> <p>It is anticipated that monitoring locations will be evaluated and are likely to be expanded in the broader monitoring program implemented by the Offset Contractor to support adaptive management and research, including as a minimum:</p> <ul style="list-style-type: none"> <li>- longitudinal sampling of the original plots</li> <li>- sampling of duplicate plots at randomized locations</li> <li>- sampling of additional plots in the event of monitoring exceptions to the achievement of Offset Objectives.</li> </ul>	<p>Section 4.1</p> <p>Section 6.2</p> <p>Section 6.3</p>

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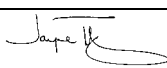
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