



Roads and Maritime Services

Pacific Highway Upgrade, Nambucca Heads to Urunga Threatened Flora Offset Management Plan

October 2016

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1. Introduction

1.1 Background

Roads and Maritime Services (Roads and Maritime) is upgrading a section of the Pacific Highway between Nambucca Heads and Urunga (NH2U) as part of the Pacific Highway upgrade program funded by the Federal and NSW Governments (the Project).

The Project was referred to the Commonwealth in accordance with the requirements of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The Minister's approval was received on 21 November 2013 subject to a number of conditions being met. The EPBC Approval for the Project (EPBC 2013/6963) requires biodiversity offsets for threatened species calculated with reference to the *Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy* (DSEWPaC, 2012) (the policy).

GHD have prepared this 'Threatened Flora Offset Management Plan' report (TFOMP) for a biodiversity offset site containing populations of the Clear Milkvine also known as Slender Marsdenia (*Marsdenia longiloba*) and the Cryptic Forest Twiner also known as Woolls' Tylophora (*Tylophora woollsii*) to assist Roads and Maritime deliver the biodiversity offsets required for the Project. The TFOMP has been prepared in accordance with Condition 19 of the approval.

GHD previously prepared a 'Threatened Flora Offset Strategy' report (TFOS) for impacts on *Marsdenia longiloba* and *Tylophora woollsii*. The TFOS was prepared specifically to comply with Condition 18 of the approval (as varied on 13 May 2016):

"The person taking the action must provide for the Minister's approval a TFOS for the Clear Milkvine and Cryptic Forest Twiner, within 12 months of the date of this approval. The Minister will only approve the TFOS if it demonstrates how a threatened flora offset meeting no less than 90% of the direct offset requirements (as determined by the Department in accordance with the Offsets assessment guide) will legally be secured in perpetuity."

The TFOS outlined the approach to delivering biodiversity offsets for impacts on *Marsdenia longiloba* and *Tylophora woollsii* through identification and conservation of an appropriate offset site (or sites) containing populations and habitat for these plants in appropriate condition and size. A desktop assessment was undertaken to identify potential offset sites with the necessary attributes and field surveys of candidate offset sites were undertaken to identify offset sites containing populations of the affected threatened flora. Roads and Maritime have selected the most suitable of these candidate offset sites: a 59.8 hectare site that occurs within a 121 hectare parcel of land in the Boambee State Forest (the 'Boambee SF offset site'). Roads and Maritime have in-principle agreement from Forestry Corporation of NSW (FCNSW) that the site can be legally secured in perpetuity as a Flora Reserve to conserve populations of *Marsdenia longiloba* and *Tylophora woollsii* and their habitat as well as threatened species.

This TFOMP describes the extent and condition of *Marsdenia longiloba* and *Tylophora woollsii* populations and their habitat at the Boambee SF offset site and specifies the management framework to improve or maintain these values. In accordance with Condition 19 of the approval, the TFOMP includes details on the quality of the offset proposed, the baseline population and distribution of the affected threatened plants, management actions that will enable maintenance and improvement of habitat and a monitoring program to ensure the effectiveness of actions.

This TFOMP includes formal assessment of impacts and offset contributions using the 'Offsets assessment guide' that accompanies the offsets policy (DSEWPaC, 2012). The Offsets assessment guide utilises a balance sheet approach to measure impacts and offsets based on factors such as the extent and quality of habitat to be impacted by the Project, the extent and quality of habitat in the proposed offset area, the timing of delivery of offsets, the change in risk of impacts to the offset area with the conservation mechanism proposed and the confidence in the results. The Commonwealth Department of the Environment (the Department) will use the Offsets assessment guide and the data presented in this TFOMP to confirm that the Project will deliver appropriate biodiversity offsets in accordance with the policy.

The conditions of approval for the Project also state that direct offsets may also be discounted by 10% if the threatened plant translocation program is demonstrated to be successful. Nonetheless, the intention is to offset 100% of the Project's impacts on the affected threatened flora through direct offsets.

The TFOMP was first submitted to the Commonwealth Department of the Environment (the Department) on 2 October 2015. The TFOMP has been modified in line with comments received, which are presented in Appendix D.

Based on the offset assessment guide calculations included in this TFOMP and offset calculations for affected threatened fauna, a 59.8 hectare parcel of land in the Boambee SF offset site will be specifically set aside as the offset for the Project's impacts (the 'NH2U Boambee SF offset area'). This area includes 46.5 hectares of occupied habitat for *Marsdenia longiloba* and *Tylophora woollsii* that will comprise the offset area for the affected threatened plants. Habitat at the Boambee SF offset site that is outside of the NH2U Boambee SF offset area will be available to offset the biodiversity impacts of other projects.

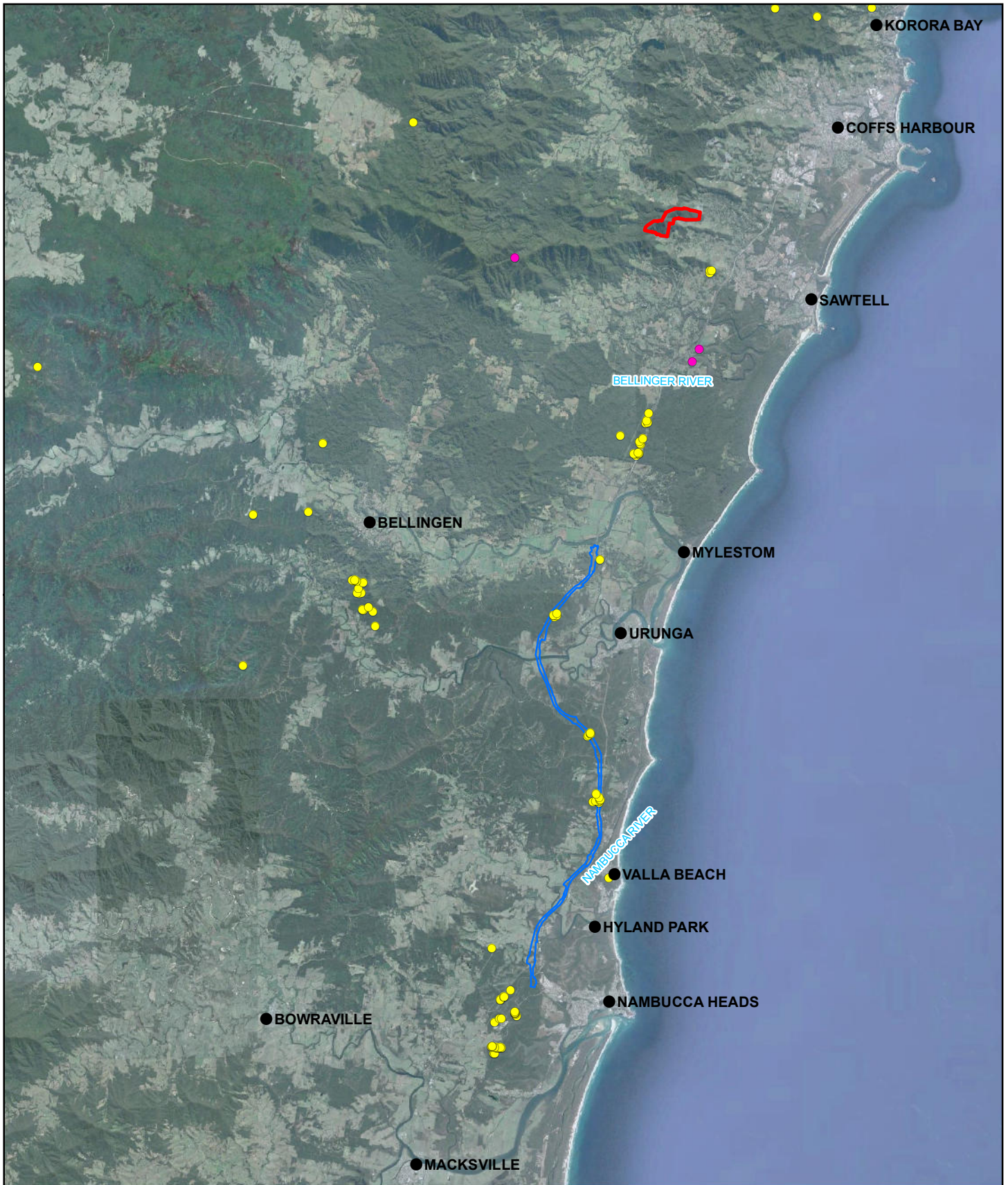
The TFOMP has been prepared in consultation with Dr Andrew Benwell who is a recognised specialist on the distribution and ecology of *Marsdenia longiloba* and *Tylophora woollsii* in the region. Dr Benwell has been assisting Roads and Maritime with surveys, assessments, impact assessments and a translocation program for these threatened plants across multiple projects for the Pacific Highway upgrade program. Dr Benwell has conducted targeted surveys for the threatened plants at the offset site, and used his knowledge and experience to help identify suitable habitat within the offset site and to define inputs to the offsets assessment guide.

1.2 Purpose of report

This TFOMP outlines the approach to the delivery of biodiversity offsets for the threatened plants impacted by the Project, and comprises:

- A description of the ecology of *Marsdenia longiloba* and *Tylophora woollsii* in relation to their biology, habitat requirements, conservation status and recognised threats, to inform the development of appropriate management actions.
- A description of the existing environment of the Boambee SF offset site, including land uses, landscape context, vegetation type and condition and the extent and quality of habitat for the affected threatened plants.
- An assessment of the current populations of *Marsdenia longiloba* and *Tylophora woollsii* at the offset site, including the number of stems recorded in field surveys and the distribution, size, age classes and apparent health of recorded stems.
- A description of the management of the offset site, including titling, the specific management measures proposed, roles, responsibilities and timelines for their implementation, funding arrangements, a monitoring and reporting program and how the management actions proposed will improve habitat quality for the threatened plants and manage threats to populations in accordance with Condition 19 of the approval.

- An assessment of the quality of the biodiversity offset proposed, including Offset assessment guide calculations to show that securing habitat for *Marsdenia longiloba* and *Tylophora woollsii* at the NH2U Boambee SF offset area, under the proposed management and conservation mechanism, could meet 100% of the Project's direct offset requirements in accordance with Condition 19b of the approval.
- Concluding statements demonstrating that the NH2U Boambee SF offset area could meet the Project's direct offset requirements (as determined by the Department in accordance with the Offsets assessment guide) and that the NH2U Boambee SF offset area will be legally secured in perpetuity in order to comply with Condition 18 of the approval.



Legend

- Boambee SF offset site
- Project site
- *Marsdenia longiloba*
- *Tylophora woolfsii*

1:230,477 (at A4)

0 0.75 1.5 3 4.5 6

Kilometers

Geographic Coordinate System

Horizontal Datum: Geocentric Datum of Australia 1994



Roads and Maritime Services
 Nambucca Heads to Urunga,
 Pacific Highway Upgrade
 Threatened Flora Offset Management Plan

Job Number	21-23829
Revision	A
Date	06 Oct 2016

Project site and proposed offset site

Figure 1

N:\AU\Sydney\Projects\2123829\GIS\Maps\Deliverables\TFOMP\21_23829_Z004_ProjectSite.mxd Level 15, 133 Castlereagh Street Sydney NSW 2000 T 61 2 9239 7100 F 61 2 9239 7199 E sydmail@ghd.com.au W www.ghd.com.au
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 Data Source: NSW Department of Lands: Cadastre - Jan 2011; Geoscience Australia: 250k Data - Jan 2011. Google Earth Pro 2010, 2013; NSW Government Office of Environment and Heritage Wildlife Atlas Created by:jrichardson

1.3 Methods

1.3.1 Desktop assessment

A desktop assessment was undertaken as part of the Threatened Flora Offset strategy (TFOS) (GHD, 2014) to identify potentially suitable offset sites for the Project. Geographic Information System (GIS) analysis was used to overlay property boundaries with recognised environmental predictors of habitat for *Marsdenia longiloba* and *Tylophora woollsii*. These data were analysed by GHD ecologists and Dr Benwell and used to identify a short list of potential offset sites. The GIS dataset and other results of the desktop assessment completed at the Boambee SF offset site for the TFOS were carried over into this TFOMP.

Additional desktop assessment was undertaken to help describe the ecology of the affected threatened flora, the existing environment of the offset site and to describe the presence and characteristics of local and regional populations of the affected threatened flora.

The following resources were reviewed:

- The OEH Threatened Species, Populations and Communities Database (OEH, 2015a, 2015b) and the Department's Species Profiles and Threats Database (DotE, 2015) and approved conservation advice (Threatened Species Scientific Committee, 2008a, 2008b) for general information about the ecology and biology of the affected threatened flora.
- The *Warrell Creek to Urunga Upgrade. Threatened Flora Management Plan* (Benwell, 2013) and *Nambucca Heads to Urunga Upgrade of the Pacific Highway Threatened Flora Translocation Project Annual Monitoring Report – Year 1* (Benwell, 2014) for information about the ecology and distribution of the regional populations of the affected threatened plants.
- Recovery plans for the affected threatened plants and scientific journal articles that have informed these plans, for specific information about the ecology and biology of the species, threats, conservation objectives and recovery actions.
- Other resources describing the existing environment of the offset site, including regional vegetation, soil landscapes and geology mapping.

1.3.2 Consultation

Roads and Maritime and other relevant stakeholders were consulted in developing this TFOMP, with particular focus on the titling and management framework that will be adopted at the site.

The main stakeholders involved were:

- Roads and Maritime Property Services, to confirm arrangements for the changes in tenure and titling and provision of funds for management.
- FCNSW, who will be responsible for managing the offset site, to confirm the existing management framework and the approach to future management and monitoring once the offset site has been set aside for conservation.

All stages of the TFOMP have been prepared in consultation with Dr Andrew Benwell who is a recognised specialist on the distribution and ecology of *Marsdenia longiloba* and *Tylophora woollsii* in the region.

1.3.3 Field surveys

Preliminary survey

A preliminary survey of the Boambee SF offset site was undertaken along with around 20 other potential offset sites to establish the presence of the threatened plants and their habitats. The

Boambee SF offset site was surveyed on foot by Dr Benwell for around eight person-hours over two days in April 2015.

The preliminary survey of potential offset sites comprised the following methodology:

- Ground truthing of broad-scale vegetation and habitat mapping included in the TFOS (GHD, 2014), and identification of likely habitat for the affected threatened plants.
- Targeted searches for threatened plants along broadly spaced meander traverses (i.e. parallel traverses approximately 50 metre apart) through appropriate habitat.
- Capture of GIS locations of clusters/individuals of threatened plants and general data such as species and approximate number of stems.

Roads and Maritime considered the size of the site, extent of habitat, current tenure, cost of land, cost of management etc. and determined that the Boambee SF offset site was the preferred offset site for the Project. Detailed surveys were then conducted to collect the data required to finalise this TFOMP.

Detailed survey

A detailed survey of the Boambee SF offset site was undertaken over six days in May 2015.

The targeted surveys of the offset site comprised the following methodology:

- Targeted searches for threatened plants along closely-spaced meander traverses (i.e. parallel traverses approximately 20 metres apart) through appropriate habitat. Survey intensity was increased at the locations of clusters/individuals of threatened plants identified in the preliminary survey and/or whenever threatened plants were located in order to obtain accurate counts of the numbers of stems at the site.
- Capture of GIS locations of individual threatened plants or clumps of closely spaced stems (i.e. <five metres apart) along with: a unique identifier for each point; species; number of stems; height; and plant health data where relevant.
- Sampling of five biometric plot/transects to describe the species composition, structure and condition of vegetation within the site with plot/transects placed within patches of occupied threatened plant habitat.
- Collection of Braun-Blanquet cover-abundance data within the 20 m x 20 m species richness plot component of the biometric plot/transects.
- Habitat assessment and general description of the existing environment of the offset site and condition of native vegetation.
- Mapping and assessment of weed infestations, cleared or modified native vegetation and any other areas that will require management at the offset site.
- Mapping of management features and attributes such as the location of proposed or existing fences and gates, signs, trails etc.

Additional targeted field surveys were undertaken within the Boambee SF in November 2015, mainly targeting fauna species within the WC2NH offset area. Surveys were undertaken by a specialist botanist and two zoologists over five days and four nights. These surveys revealed additional stems of the affected threatened plants at the Boambee SF offset site, including some within the NH2U Boambee SF offset area.

The results of the targeted field surveys are included in Appendix A.

1.3.4 Staff qualifications

Qualifications of ecologists and environmental management specialists that undertook field surveys and assisted with the preparation of this TFOMP are provided in Table 1. Flora and fauna surveys were conducted under a Section 132C scientific licence (SL100146) issued under the NSW *National Parks and Wildlife Act 1974* and complied with GHD's animal ethics Research Authority.

Table 1 Qualifications of staff

Name	Company	Position/Role	Qualifications	Years' Experience
Ben Harrington	GHD	Senior Ecologist / lead author of offset package. Desktop assessment, site surveys, offset calculations, preparation of offset package and management plan.	BSc, MSc (Physical Geography) NSW BioBanking Assessor Accreditation (number 0073)	13+ years
Dr Andrew Benwell	ECOS Environmental	Principal Botanist / lead botanist. Site surveys, vegetation assessment, specialist technical inputs regarding ecology of threatened plants.	Dip. Hort., Ba. Hons. (Biogeography). Phd (Plant ecology)	20+ years
Jayne Tipping	GHD	Principal Ecologist / technical reviewer. Independent specialist technical review of the offset package.	BSc (Ecology), MEnvLaw	23+ years
Lui Weber	Sole trader	Senior Botanist / field botanist. Site surveys, vegetation assessment.	BSc. Hons. (Botany),	8+ years
Rob Price	Wanungara	Senior Botanist / field botanist. Site surveys.	BSc (Botany). Cert II Land conservation and Restoration.	12+ years

1.4 Compliance with conditions of approval

This TFOMP has been prepared in accordance with Condition 19 of the approval. Table 2 summarises the requirements of Condition 19 along with the relevant sections of this TFOMP where each requirement is addressed.

A table summarising Roads and Maritime's response to the Department's comments on the final draft TFOMP (issued on 2 October 2015) is presented in Appendix D.

Table 2 Compliance of the TFOMP with Condition 19 of the Minister's approval for the project

Condition	Relevant section in TFOMP
19. The person taking the action must provide a plan for the management and delivery of the offset requirements of the threatened flora offset to the Minister for approval no later than 30 June 2015. The Threatened Flora Offset Management Plan (TFOMP) must include, but need not be limited to:	
a) map(s) and shapefiles that clearly define the location and boundaries of the offset ;	See Figure 1 and Figure 2.
b) details on the quality of the offset ;	See Section 5, which describes the quality of the offset with reference to the EPBC Act offset policy and as supported by offset assessment guide calculations.
c) information about Clear Milkvine and Cryptic Forest Twiner (in relation to ecology, biology and conservation status) to inform appropriate management actions;	See Section 2.
d) performance objectives and management actions that will enable maintenance and enhancement of the Clear Milkvine and Cryptic Forest Twiner offset and habitat covered by the plan;	See Section 4 and Appendix B.
e) demonstration that any management actions to be undertaken will not adversely impact EPBC species (for example, this may apply to herbicide usage) ;	See Section 4.2.3.
f) a description of funding arrangements or agreements including work programs and responsible entities;	See Section 4.2.
g) an assessment of the baseline population and distribution for Clear Milkvine and Cryptic Forest Twiner within the offset, including: <ul style="list-style-type: none"> i. the number of plants protected and their location; ii. plant and habitat condition; and iii. age classes. 	See Section 3.5, Figure 4 and Appendix A – Table 1.
h) measures for regular monitoring of the status of individuals of Clear Milkvine and Cryptic Forest Twiner and their habitat as measured against the baseline population and distribution, including: <ul style="list-style-type: none"> i. fluctuations in population size and distribution; ii. life-cycle patterns; iii. habitat requirements; and iv. response to disturbances and/or management actions. 	See Section 4.3.

Condition	Relevant section in TFOMP
i) provisions to revise the approved TFOMP in response to the findings of research associated with condition 20 (h).	See Section 4.3.

1.5 Terms and definitions

The Boambee State Forest (SF) offset site	The site that will be set aside and managed as a biodiversity offset as part of this TFOMP. Also referred to as the 'offset site'.
DotEE	The Commonwealth Department of the Environment and Energy (the Department), formerly DotE.
DotE	The Commonwealth Department of the Environment (the Department)
DSEWPaC	The former Department of Sustainability Environment Water Populations and Communities, now the Commonwealth Department of the Environment
EPBC Act	The <i>Environment Protection and Biodiversity Conservation Act 1999</i>
FCNSW	Forestry Corporation of New South Wales
Flora reserve	An area that is set aside for the preservation of native flora under the Forestry Act
Forestry Act	The New South Wales <i>Forestry Act 2012</i>
NH2U	The Proposed upgrade of a section of the Pacific Highway between Nambucca Heads and Urunga that is the subject of EPBC Act approval EPBC 2013/6963 and this TFOMP. Also known as 'the Project'
NPW Act	The <i>National Parks and Wildlife Act 1974</i>
NPWS	The NSW National Parks and Wildlife Service
Roads and Maritime	Roads and Maritime Services NSW
TFOMP	Threatened Flora Offset Management Plan
TFOS	Threatened Flora Offset Strategy
the Department	the Commonwealth Department of the Environment, also abbreviated to 'DotE'
The Offset assessment guide	The spreadsheet offset calculator that accompanies the <i>Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy</i> (DSEWPaC 2012).
NH2U Boambee SF offset area	The 59.8 hectare area within the Boambee SF offset site that will be specifically set aside to offset impacts arising from the NH2U project including impacts on <i>Marsdenia longiloba</i> and <i>Tylophora woolfsii</i> . The remainder of the Boambee SF offset site will be set aside to offset impacts of other projects.

The EPBC Act offset policy	The <i>Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy</i> (DSEWPaC 2012).
the Project	The upgrade of a section of the Pacific Highway between Nambucca Heads and Urunga that is the subject of EPBC Act approval EPBC 2013/6963 and this TFOMP. Also known as 'NH2U'.
The Project footprint	The area of direct and indirect impacts arising from the Project.

1.6 Scope and limitations

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

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

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

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD as described in this report in Sections 2 to 4 and GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by Roads and Maritime Services, Dr Benwell, Forestry Corporation of NSW and others who provided information to GHD, which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which may have been included in the information provided by Roads and Maritime Services.

2. Ecology of the affected threatened flora

2.1 Overview

The following section provides information about *Marsdenia longiloba* and *Tylophora woollsii* in relation to the ecology, biology and conservation status of these threatened flora species, to inform the development of appropriate management actions.

The information about the ecology of the affected threatened flora presented below has been used to compile this TFOMP as follows:

- To describe the existing environment of the offset site, including the extent and quality of habitat resources and status of local populations (see Sections 3.4 and 3.5).
- To identify management actions appropriate to the life cycle, habitat requirements and threats to the persistence of these species (see Section 4).
- To determine the quality of the biodiversity offset that will be delivered by conservation of the NH2U Boambee SF offset area within the Boambee SF offset site (see Section 5).

2.2 *Marsdenia longiloba*

Marsdenia longiloba is a slender, rhizomatous (i.e. growing with multiple stems from a shared root system), perennial climber of the 'milk vine' group. This group comprise the Family Apocynaceae, previously placed in the Asclepiaceae. *Marsdenia longiloba* has opposite pairs of very finely pointed leaves which are an elongated heart-shape with a thin texture and 5-6 tiny glands at the base of the leaves. The stems of *Marsdenia longiloba* exude clear, watery sap when cut, unlike most of the milk vines which have milky sap. Clusters of small white star-shaped flowers are produced and are followed by long, narrow seed-capsules that split to release many seeds with tufts of long silky hair (DECC, 2005a) which suggests that seed spread is via wind.

2.2.1 Conservation status

Marsdenia longiloba is listed as a vulnerable species under the EPBC Act. *Marsdenia longiloba* is also listed as an endangered species under the NSW *Threatened Species Conservation Act 1995* (TSC Act) and as a vulnerable species under the Queensland *Nature Conservation (Wildlife) Regulation 2006*.

Marsdenia longiloba has been assigned to the 'Keep-watch' species management stream under the NSW Saving our Species program because relatively large populations of this species occur within reserves (e.g. up to 1000 individuals estimated to occur in Bongil Bongil and New England National Parks and over 1000 in Yabbra NP) where it is assumed that current management will be sufficient to secure the conservation of the species in NSW (OEH, 2015a).

2.2.2 Distribution and habitat

Marsdenia longiloba occurs as scattered populations from the coast to the Great Dividing Range, from the Hastings River north through the north coast of NSW and into south-east Queensland. Within this range it is conserved within the Lamington National Park (NP), Main Range NP, Mt Barney NP, and Toonumbar NP (Threatened Species Scientific Committee, 2008a) as well as Bongil Bongil NP, New England NP and Yabbra NP (OEH, 2015a).

It occurs in wet sclerophyll forest, on sheltered south-facing slopes or narrow gullies in hilly terrain (Benwell, pers. comm. 2014). *Marsdenia longiloba* is most frequently associated with forest dominated by Grey Gum (*Eucalyptus propinqua*), Tallowwood (*E. microcorys*), Narrow-leaved Ironbark (*E. crebra*) and White Mahogany (*E. acmenoides*). In the study area for the project, both species also occurred in forest dominated by Brushbox (*Lophostemon confertus*) Flooded Gum (*E. grandis*) or Blackbutt (*E. pilularis*) but much less frequently (Benwell, pers. comm. 2014).

Specific characteristics of the *Marsdenia longiloba* habitat recorded at the project site and the surrounding Nambucca - Coffs Harbour region included:

- Moderate to gentle, well drained slopes, often with a southerly aspect.
- A yellow to red clay podzol soil type formed on Permian metasediments.
- Topsoil that was slightly acidic (pH >6), 15-30cm deep, dark brown and rich in organic matter.
- Wet sclerophyll forest vegetation with an open to mid-dense rainforest understorey.
- Understorey vegetation that was moderately well lit and open, not dense or heavily shaded (Benwell, 2013).

The fine scale vegetation mapping of Coffs Harbour Local Government Area (LGA) (OEH 2012) identifies *Marsdenia longiloba* as a component species of two vegetation types:

- Coast and Hinterland Riparian Flooded Gum Bangalow Wet Forest (CH_WSF01)
- Northern Escarpment Blackbutt - Apple Wet Ferny Forest (CH_WSF09) (OEH, 2012).

Both of these vegetation types are present at the Boambee SF offset site and contained extensive areas of occupied *Marsdenia longiloba* habitat. *Marsdenia longiloba* was also recorded in other wet sclerophyll forest vegetation communities (see Sections 3.3 to 3.5).

2.2.3 Life history and population dynamics

The life history and population dynamics of the regional population of *Marsdenia longiloba* surrounding the project site and offset site have been studied in detail during translocation and monitoring programs completed for the Pacific Highway upgrade (Benwell and Watson 2011; Benwell, 2013). Specific attributes include:

- Discrete sub-populations and patches generally comprising several single-stemmed ramets (i.e. genetically identical stems) growing from a single branching underground rhizome (i.e. fibrous root system).
- Sub-populations may originate vegetatively from the same parent plant and spread over a considerable area (e.g. 0.04 hectares).
- Above ground stems are comparatively short-lived (1-10 years), while the rhizomes are probably more long-lived.
- The rhizomes are relatively thin, 10-30 cm long and generally grow horizontally within the topsoil before budding off and separating from the parent rhizome to form separate plants.
- Plants may die back to the rhizome and remain stem-less and dormant for at least two years.
- Most stems never grow more than 30 cm tall before dying back.
- Only large stems (i.e. >one metre tall) produce flowers and production of pods and seed is extremely rare; one pod was recorded during several years of monitoring at several

locations and a single pod was observed at the Boambee SF offset site during the current surveys.

- *Marsdenia longiloba* appears to rely on vegetative reproduction for population persistence with flowering and seed dispersal playing a minor role.
- *Marsdenia longiloba* stems are conspicuously absent from recently logged or burnt forest, although monitoring of translocation areas has shown that dormant rhizomes may be present in the soil. This suggests that conditions during early post-disturbance succession are not favourable for growth of *Marsdenia longiloba*, and stem growth may occur mainly during mid to late stages of succession (Benwell and Watson 2011; Benwell, 2013).

The specific response of *Marsdenia longiloba* to fire has never been monitored (Benwell and Watson 2011; Benwell, 2013) but it is generally assumed to be sensitive to fire (DECC, 2005a; Threatened Species Scientific Committee, 2008a).

2.2.4 Threats and recovery actions

The main identified threats to *Marsdenia longiloba* include localised extinction due to small population size; loss and fragmentation of habitat through land clearing for agriculture and urban development; invasion by introduced weeds, such as Lantana (*Lantana camara*); grazing and trampling by cattle; inappropriate fire regimes; and herbicide usage (DECC, 2005a; Threatened Species Scientific Committee, 2008a). Grazing, trampling and habitat degradation by feral herbivores would also be a threat to the species.

The approved conservation advice for *Marsdenia longiloba* identifies the following priority recovery and threat abatement actions that can be undertaken to support the recovery of the species and which are relevant to the management of the species at the offset site:

- Avert habitat loss, disturbance and modification by:
 - Monitoring known populations to identify key threats.
 - Monitoring the progress of recovery, including the effectiveness of management actions and the need to adapt them if necessary.
 - Marking all populations on roadsides, and ensuring road widening and maintenance activities (or other infrastructure or development activities) involving substrate or vegetation disturbance in areas where *Marsdenia longiloba* occurs do not adversely affect known populations.
 - Controlling access routes to suitably constrain public access to known sites on public land.
 - Minimising adverse impacts from land use at known sites.
 - Investigating formal inclusion of crown land in reserve tenure if possible.
- Avoid damaging wildfires or inappropriate fire regimes by:
 - Developing and implementing a suitable fire management strategy for *Marsdenia longiloba*.
 - Providing maps of known occurrences to local and state Rural Fire Services and seeking inclusion of mitigation measures in bush fire risk management plan(s), risk register and/or operation maps.
- Avoiding livestock impacts such as trampling, browsing or grazing by:
 - Managing total grazing pressure at important/significant sites through exclusion fencing or other barriers.
- Manage invasive weeds

- Implement the threat abatement strategies for the control of Lantana in the region.
- Identify, remove, and prevent introduction of weeds in the local area, which could become a threat to the *Marsdenia longiloba* using appropriate methods.
- Ensure chemicals or other mechanisms used to eradicate weeds do not have a significant adverse impact on the species (DECC, 2005a; Threatened Species Scientific Committee, 2008a).

Managing feral herbivores would also benefit the recovery of the species.

Marsdenia longiloba has been transplanted successfully from disturbance footprints as part of translocation programs and has been propagated successfully from rhizome pieces (Benwell and Watson 2011; Benwell, in. prep.).

2.3 Tylophora woollsii

Tylophora woollsii is a slender woody climber with a thin twining stalk that grows to three metres long. It is in the 'milk vine' group (Family Apocynaceae) along with the closely related *Marsdenia longiloba* described above. It has opposite, paired leaves on stalks 7 - 20 mm long, which are an elongated heart-shape with a firm texture. There are two to four tiny glands at the base of each leaf-blade and the stems exude a clear, watery sap if cut. The purple to red flowers are 5 - 6 mm in size, and are produced in late summer to autumn on zigzagging branched stalks growing from the leaf junctions. They are followed by narrow seed-capsules 5 - 8 cm long, which split to release many seeds, each of which has a tuft of silky hair (DECC, 2005b) which suggests that seed spread is via wind.

2.3.1 Conservation status

Tylophora woollsii is listed as an endangered species under the EPBC Act. *Tylophora woollsii* is also listed as an endangered species under the TSC Act and an endangered species under the Queensland *Nature Conservation Act 1992*.

Tylophora woollsii has been assigned to the 'Site-managed species' management stream under the Saving our Species program because it requires site-based management in order to secure it from extinction in NSW for 100 years (OEH, 2015b)(see Section 2.3.4 below).

2.3.2 Distribution and habitat

Tylophora woollsii occurs in northern NSW and the Darling Downs in south-east Queensland. NSW records are from the Coffs Harbour–Dorrigo area, the upper reaches of Taylors Arm near Nambucca Heads, and along the Queensland border near Tenterfield. It is known to occur in Bald Rock NP and Gibraltar Range NP (Threatened Species Scientific Committee, 2008b).

Tylophora woollsii occurs in wet sclerophyll forest or rainforest, on mid to upper slopes on sheltered south-facing slopes in hilly terrain (Benwell, pers. comm. 2014). This habitat has been described as brown clay over metasediments in wet sclerophyll forest at elevations between 10 and 750 metres (Quinn et al. 1995 quoted in Threatened Species Scientific Committee, 2008b). Targeted surveys conducted for translocation and monitoring programs suggest that the specific characteristics of the *Tylophora woollsii* habitat in the Nambucca - Coffs Harbour region are equivalent to that described for *Marsdenia longiloba* in Section 2.2.3 above (Benwell, 2013).

The fine scale vegetation mapping of Coffs Harbour LGA (OEH 2012) does not identify *Tylophora woollsii* as a component species in any vegetation communities (OEH, 2012) presumably because of the low abundance and cryptic character of the species.

2.3.3 Life history and population dynamics

Little is definitively known about the life history and population dynamics of *Tylophora woollsii* (Benwell, 2013).

As described above, the life history and population dynamics of the regional population of *Marsdenia longiloba* have been studied in detail during translocation and monitoring programs (Benwell and Watson 2011; Benwell, 2013). The two threatened plant species are physically similar, closely related, occupy the same areas of habitat and observation of flowering in translocated individuals has confirmed that some plants previously thought to be *Marsdenia longiloba* are in fact *Tylophora woollsii* (Benwell, pers. comm. 2014). Therefore, it is probably safe to infer the following life history attributes for *Tylophora woollsii*:

- Discrete sub-populations may originate vegetatively from the same parent plant and spread over a considerable area.
- Sub-populations are likely to comprise several single-stemmed ramets growing from a branching underground rhizome.
- Plants may die back to the rhizome and remain stem-less and dormant.
- It is likely to rely on vegetative reproduction for population persistence with flowering and seed dispersal playing a minor role since no flowers or pods have been recorded during several years of monitoring at several locations. Flowering has been recorded in translocated stems under nursery conditions (Benwell, pers. comm. 2014).

The specific response of *Tylophora woollsii* to fire has never been monitored (Benwell and Watson 2011; Benwell, 2013) but it is generally assumed to be sensitive to fire (DECC, 2005b; Threatened Species Scientific Committee, 2008b). The species should not be burnt more frequently than once every 25 years (NSW RFS, 2004, quoted in Threatened Species Scientific Committee, 2008b).

2.3.4 Threats and recovery actions

The main identified threats to *Tylophora woollsii* include timber harvesting operations, clearing for agriculture, cattle grazing, competition with weeds; physical damage, particularly to roadside populations due to vehicles and associated roadwork, root rot caused by the fungus *Phytophthora cinnamomi* (DECC, 2005b; Threatened Species Scientific Committee, 2008b) and inappropriate fire regimes (Forster, 2001, pers. comm. quoted in Threatened Species Scientific Committee, 2008b).

The approved conservation advice for *Tylophora woollsii* identifies the following priority recovery and threat abatement actions that can be undertaken to support the recovery of the species and which are relevant to the management of the species at the offset site:

- Avert habitat loss, disturbance and modification by:
 - Monitoring known populations to identify key threats.
 - Monitoring the progress of recovery, including the effectiveness of management actions and the need to adapt them if necessary.
 - Ensuring road-widening, maintenance and forestry activities involving substrate or vegetation disturbance in areas where *Tylophora woollsii* occurs do not adversely impact on known populations.
- Avoid damaging wildfires or inappropriate fire regimes by:
 - Developing and implementing a suitable fire management strategy for *Tylophora woollsii*.

- Providing maps of known occurrences to local and state Rural Fire Services and seeking inclusion of mitigation measures in bush fire risk management plan(s), risk register and/or operation maps.
- Avoid livestock impacts such as trampling, browsing or grazing.
- Manage invasive weeds by:
 - Developing and implementing a management plan for the control of invasive weeds in the region.
 - Integrating weed control works on public lands into regional works programs, as appropriate.
 - Ensuring chemicals or other mechanisms used to eradicate weeds do not have a significant adverse impact on the species (DECC, 2005a; Threatened Species Scientific Committee, 2008a).

Tylophora woollsii has been transplanted successfully from disturbance footprints as part of translocation programs and has been propagated successfully from rhizome pieces (Benwell and Watson 2011; Benwell, in. prep.).

Tylophora woollsii is a 'Site-managed species' under the Saving our Species program (OEH, 2015b). The Office of Environment and Heritage (OEH) has proposed five management sites where conservation activities need to take place to ensure the conservation of this species: Bald Rock NP in Tenterfield Local Government Area (LGA); Clouds Creek management site in Clarence Valley LGA; Kangaroo River State Forest in Clarence Valley LGA; Comboyne State in Greater Taree LGA; and Barrington Tops in Gloucester LGA (OEH, 2015b). Management actions and objectives proposed at these sites include:

- Reduce the risk of adverse fire at the site through active fire suppression and monitoring habitat.
- Minimise accidental damage on road/track edges through land manager consultation and monitoring disturbance impacts.
- Management of small population size by augmenting extant wild population(s) with seed banking.
- Tracking species abundance / condition over time through flora monitoring (OEH, 2015b).

3. Existing Environment of the Offset Site

3.1 Location and land use

The offset site is located in the Boambee SF at Boambee on the North Coast of NSW. It is in Coffs Harbour LGA. It is located around 6.5 kilometres west of the Pacific Ocean, 2.5 kilometres west of the Pacific Highway and 7 kilometres south-west of the city of Coffs Harbour. The site location relative to the Project footprint and the region is shown on Figure 1.

The Boambee SF offset site is accessed from the east via the suburb of Boambee and Wedds Road or South Boambee Road, or from the north via the village of Upper Orara and Fridays Creek Road. There is vehicle access around the northern boundary of the site via Fridays Creek Road and Peak Trail and partial access within the site via Perkins Road and the Foot Track. The site boundary and layout is shown on Figure 2.

The previous land use at the offset site was periodic timber harvesting as part of a State forest. Evidence of selective timber harvesting, track construction and partial clearing was observed during field surveys. Based on the presence of over mature and hollow-bearing trees, it appears that the site has never been clear-felled, however given the comparative scarcity of larger trees it is likely to have been harvested relatively intensively in the past.

Land uses surrounding the site include:

- Partially cleared rural residential land to the east, south-east and south.
- Banana plantations to the north of the eastern portion of the offset site and to the north-east.
- State forest to the north of the western portion of the offset site and to the north-west, west and south-west (see Figure 2).

3.2 Landscape context

The Boambee SF offset site is around 121 hectares in area and contains wet and dry sclerophyll forest and rainforest on steep, near-coastal hills on the east face of the Great Dividing Range. The site comprises steep to very steep, south or east draining slopes that are incised by multiple steep sided gullies. The underlying geology is Permian metasediments.

The eastern and south-eastern portions of the offset site, at lower elevations, fall within the 'Brooms Head – Kempsey Coastal Ramp' Mitchell landscape (DECC 2008a). This landscape comprises hills and low ranges of the coastal fall on Permian Phyllite and schistose sandstone. General elevation is 50 to 450m with local relief of up to 300m. Soils consist of thin, stony gradational loam and sandy loam on the slopes grading to yellow-brown texture-contrast soils on lower slopes and in valleys (DECC 2008b).

The western and northern portions of the offset site, at higher elevations, are part of the Nymboida Great Escarpment Mitchell landscape (DECC 2008a). This landscape comprises ranges, peaks and steep escarpments on Permian/Carboniferous volcanics within extensive area of moderately deformed Silurian-Devonian sedimentary rocks. General elevation is 400 to 1400m with local relief up to 500m. Soils vary from shallow gritty sandy loam through red and yellow earthy gradational profiles to deep siliceous sands and loams on valley floors (DECC 2008b).

There are extensive areas of rock outcrop and scree slopes at the site. Vegetation at the site varies in response to aspect and topographic position (see Section 3.3 below). The NH2U

Boambee SF offset area that contains the threatened plant habitat that will be set aside as the specific offset for the project is around 50 hectares in area and is located in the eastern portion of the Boambee SF offset site (see Figure 2).

The site is drained by a number of unnamed first and second order streams. These streams are bedrock confined, intermittent 'chain of pools' type drainage lines with sand or gravel substrate. They are generally in good condition with intact riparian and in stream vegetation, intact channel and bank structure, slight to moderate weed infestation and no visible evidence of poor water quality.

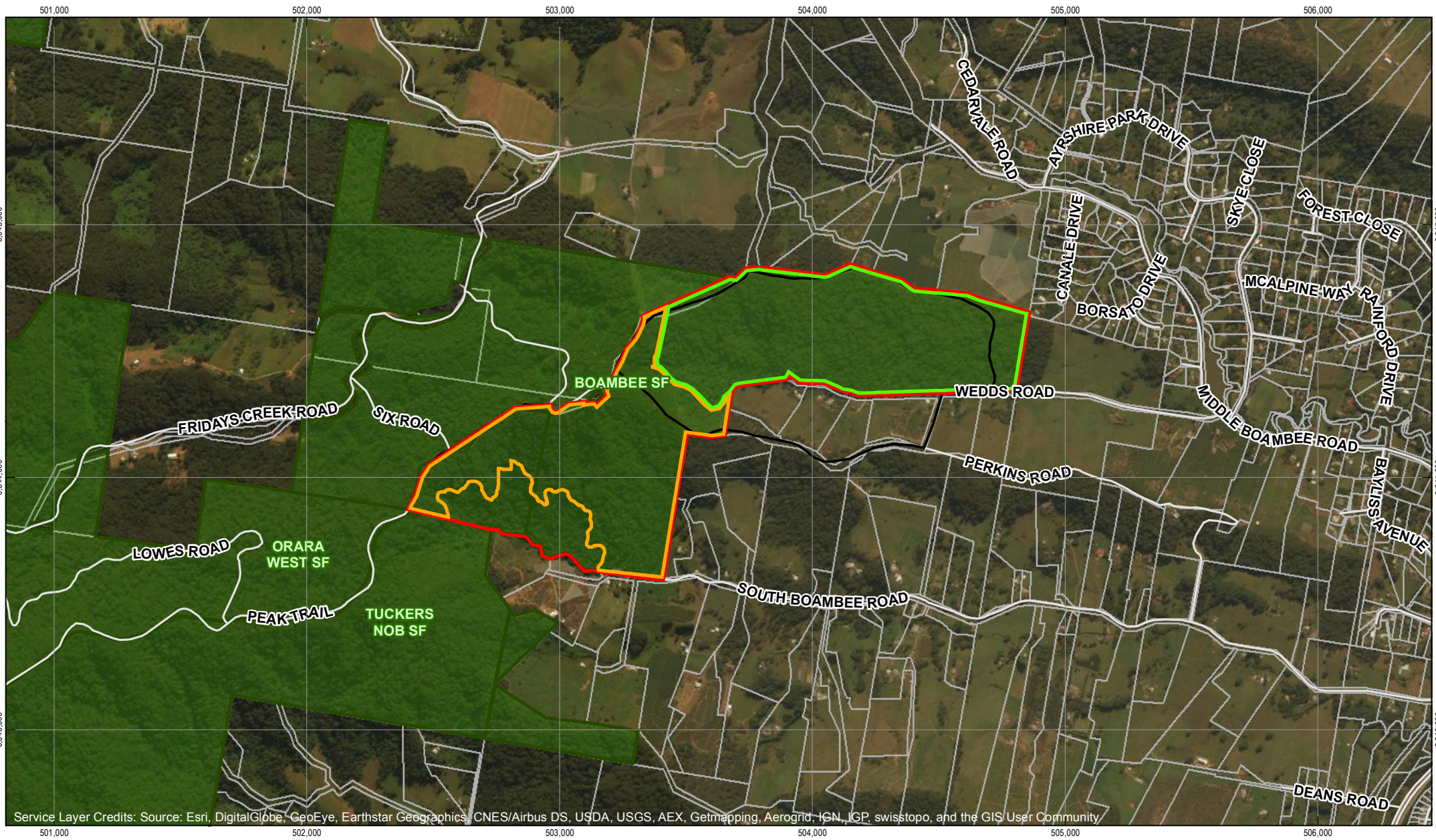
The offset site lies within a mapped regional fauna habitat corridor (Scotts et. al., 2000) that runs east-west connecting State forests to the west and south of the site with coastal vegetation to the east.

The Boambee SF offset site is part of a near continuous patch of native vegetation and habitat of many thousands of hectares. Partially cleared rural residential land in the locality of Boambee and the Pacific Highway to the east would comprise barriers to fauna movement and other ecological processes. Boambee SF and Tuckers Nob SF extend to the west of the offset site and beyond that there is an extensive network of native vegetation in national parks and State forests that stretches along the Great Dividing Range. The offset site is connected to this extensive area of habitat via continuous vegetation in Boambee SF. This vegetation is partially interrupted by small dirt or gravel tracks, including along the entire northern boundary of the site. These tracks would not comprise a significant gap in habitat and would not be a barrier to pollination, seed fall or other ecological processes in the life history of the affected threatened plants. There are partial barriers to the north, south and south-east associated with partially cleared and/or fenced private land, including banana plantations. Near continuous vegetation is present around or between these gaps in habitat (see Figure 2).

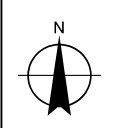
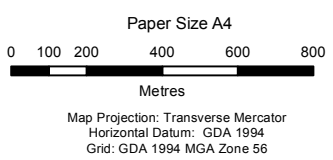
There is evidence of edge effects around the perimeter of the Boambee SF offset site where it adjoins disturbed, cleared land as well as along tracks. There is localised, moderate to severe weed infestation associated with these disturbed edges. These edges may also be less suitable habitat for *Marsdenia longiloba* and *Tylophora woollsii* because they tend to be drier and more exposed. *Marsdenia longiloba* and *Tylophora woollsii* stems were observed within around 20 metres of the boundary of the offset site and agricultural land and as close as two metres from tracks (see Figure 5) and so these edge effects appear to be having a minor overall impact on the quality of habitat. Weed management will be important for minimising these impacts and maintaining the quality of habitat.

The offset site comprises appropriately situated habitat for the long term maintenance of populations of the affected threatened flora. In this landscape context, the offset site comprises a valuable habitat link in terms of the extensive area of occupied habitat it encompasses, its position between the coast and ranges and as a conserved vegetated corridor around an area of rural residential development.

The 'Site context' component of current habitat quality at the offset site was scored as 7/10 in the offset assessment guide calculations (see Section 5.3.3). This score reflects the low perimeter to edge ratio of the offset site and that it adjoins an extensive area of native vegetation containing threatened plant habitat in State forests.



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LEGEND	
	Boambee SF offset site
	NH2U Boambee SF offset area
	WC2NH Boambee SF offset area
	State forest
	Four wheel drive track
	Unsealed road
	Public roads



Roads and Maritime Services Nambucca Heads to Urunga, Pacific Highway Upgrade Threatened Flora Offset Management Plan	Job Number 21-23829 Revision B Date 06 Oct 2016
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Offset site location Figure 2

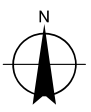
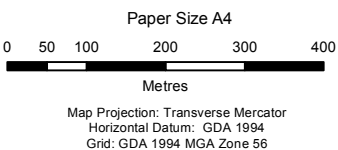
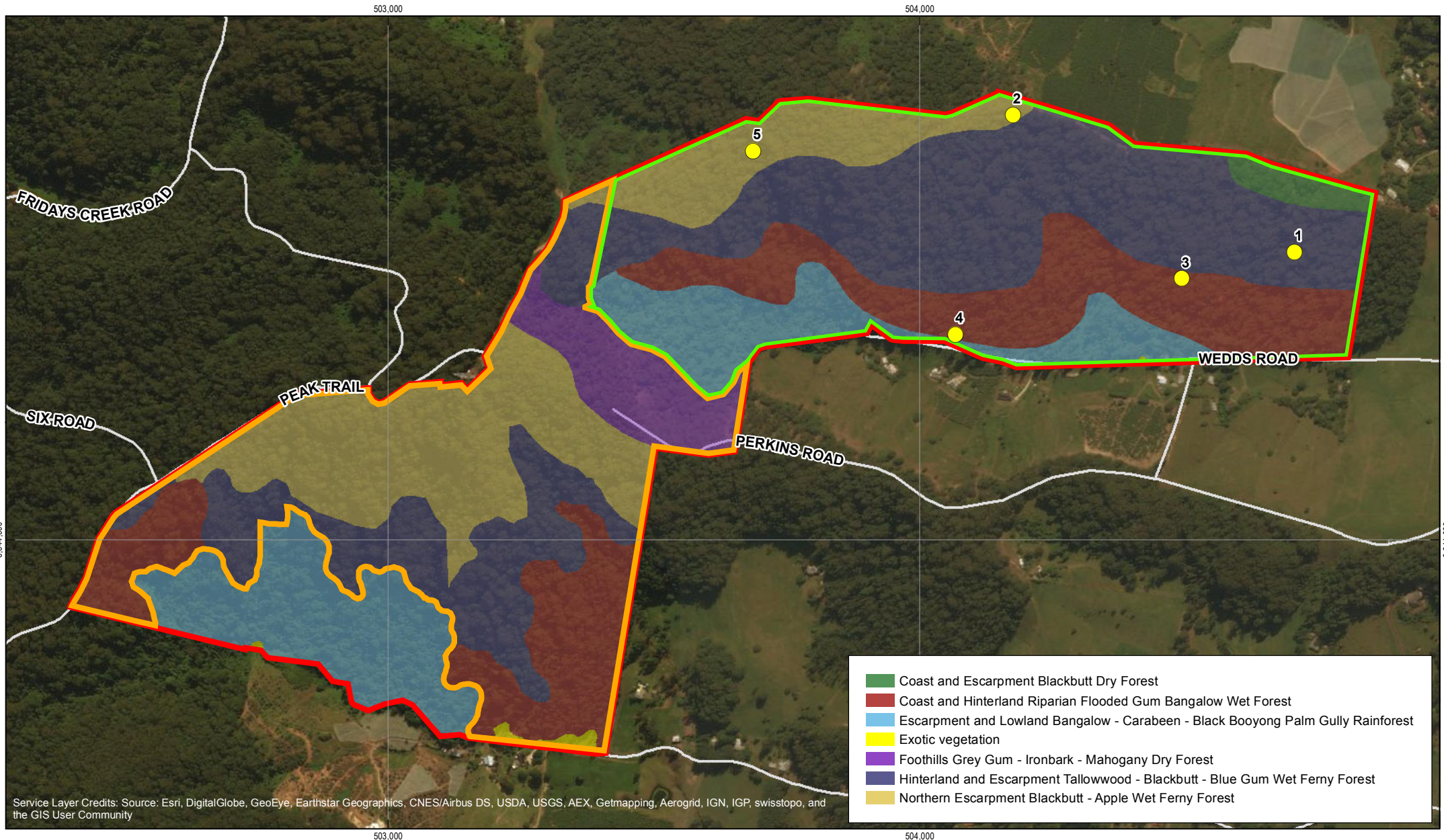
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 Data Source: NSW Department of Lands: Cadastre - Jan 2011; Geoscience Australia: 250k Data - Jan 2011.jrichardson

3.3 Vegetation

Vegetation types were mapped within the offset site by OEH (2012) and then ground truthed and converted to NSW vegetation types as part of the present study. Vegetation types within the offset site are shown on Figure 3 and summarised in Table 3. Plant species recorded in plot/transects sampled in these vegetation types are listed in Table 2 of Appendix A.

Table 3 Vegetation in the Boambee SF offset site

Coffs Harbour LGA Vegetation Community (OEH 2012)	Condition	Area in Boambee offset site (ha)	Area in NH2U Boambee SF offset area (ha)	Coffs Harbour LGA Map Unit Code (OEH 2012)	Plant Community Type Code (OEH, 2014a)	Vegetation Formation
Hinterland and Escarpment Tallowood - Blackbutt - Blue Gum Wet Ferny Forest	Moderate/good	40.8	26.7	CH_WSF10	NR120	Wet sclerophyll forest
Northern Escarpment Blackbutt - Apple Wet Ferny Forest	Moderate/good	24.8	7.3	CH_WSF09	NR120	Wet sclerophyll forest
Coast and Hinterland Riparian Flooded Gum Bangalow Wet Forest	Moderate/good	25.6	14.8	CH_WSF01	NR159	Wet sclerophyll forest
Exotic vegetation	Low	0.4	0.1	CH_EX04	n/a	Exotic scrub
Coast and Escarpment Blackbutt Dry Forest	Moderate/good	1.5	1.5	CH_DOF01	NR117	Dry sclerophyll forest
Escarpment and Lowland Bangalow - Carabeen - Black Booyong Palm Gully Rainforest	Moderate/good	21.7	9.4	CH_RF11	NR111	Rainforest
Foothills Grey Gum - Ironbark - Mahogany Dry Forest	Moderate/good	6.2	0	CH_DOF05	NR263	Dry sclerophyll forest
Total		121	59.8			



LEGEND	
	Boambee SF offset site
	NH2U Boambee SF offset area
	WC2NH Boambee SF offset area
	Plot/transect
	Roads



Roads and Maritime Services Nambucca Heads to Urunga, Pacific Highway Upgrade Threatened Flora Offset Management Plan	Job Number 21-23829 Revision B Date 06 Oct 2016
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Vegetation Figure 3

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Data Source: NSW Department of Lands: Cadastre - Jan 2011; Geoscience Australia: 250k Data - Jan 2011.jrichardson

3.4 Habitat quality

The Boambee SF offset site was identified in the desktop review of potential offset sites conducted for the TFOS (GHD 2014). The criteria used to select the Boambee SF offset site as a candidate site were:

- Presence of sheltered, south facing slopes and presence of mapped wet sclerophyll forest as predictors of suitable habitat for *Marsdenia longiloba* and *Tylophora woollsii*.
- Large lot size, suitable tenure (i.e. State forest) and continuity with a large patch of vegetation, which are factors that make the site more suitable for effective management for conservation (GHD 2014).

The presence of suitable habitat was confirmed by a preliminary site survey conducted by Dr Benwell over two days in April 2015. Dr Benwell confirmed the presence of sheltered slopes and wet sclerophyll forest and recorded several *Marsdenia longiloba* and *Tylophora woollsii* stems across the site.

The extent and quality of habitat was confirmed through a detailed survey of the Boambee SF offset site over six days in May 2015. Targeted searches for threatened plants confirmed the presence of extensive local populations of *Marsdenia longiloba* and *Tylophora woollsii* (see Section 3.5). 'Occupied habitat' for the affected threatened plants was mapped around the clusters of stems that were directly observed and then extrapolated out to include continuous vegetation with appropriate structure, aspect and disturbance history and minor or localised weed infestation.

M. longiloba and *T. woollsii* recorded at the Boambee SF offset site and occupied habitat are mapped on Figure 4. The mapped area of occupied habitat is likely to contain more *M. longiloba* and *T. woollsii* stems than those directly recorded and shown on Figure 4 given the cryptic nature of the two plant species. The NH2U Boambee SF offset area has been selected and mapped around dense clusters of *M. longiloba* and *T. woollsii* stems and an extensive area of occupied habitat. The NH2U Boambee SF offset area contains around 46.5 hectares of occupied habitat.

'Potential / poorer quality threatened plant habitat' was mapped that contained less suitable aspects or vegetation structure, more recent disturbance or more severe and/or extensive weed infestation (see Figure 4). Areas of potential/poorer quality habitat in the NH2U Boambee SF offset area have not been included in offset assessment guide calculations but will still be managed as part of the offset site. Potential habitat will help maintain populations of *Marsdenia longiloba* and *Tylophora woollsii* by providing a buffer area around some of the occupied habitat at the site. Potential habitat may develop into occupied habitat in the future with active management as well as natural successional changes to vegetation structure. The NH2U Boambee SF offset area contains around 13.3 hectares of potential / poorer quality habitat.

There is a dry, north-facing slope in the central portion of the Boambee SF offset site that does not contain any occupied or potential habitat for *Marsdenia longiloba* and *Tylophora woollsii*. This area has been excluded from the NH2U Boambee SF offset area.

The baseline condition of occupied habitat in the NH2U Boambee SF offset area was assessed using BioBanking plot/transects and compared with benchmark data from matching NSW vegetation types (see Appendix A). Benchmarks are a quantitative measure of vegetation condition where there is relatively little evidence of modification by humans (DECC 2008) and provide a reliable measure of the relative condition of vegetation sampled by plot/transects. The plot/transect data confirmed that the vegetation associated with occupied habitat is in good condition with benchmark values for the majority of attributes in the majority of plot/transects that were sampled. Notably, native over storey cover was high (28.5% to 56% cover) and within

the range of benchmark values in all plot/transects which indicates mature forest and which will be contributing to a suitable microclimate for the affected threatened plants. One plot/transect was slightly below benchmark values for native species richness and a second had a low score for native mid storey cover. Four out of five of the plot/transects sampled featured minor weed infestation (4% to 8% cover) and one featured moderate infestation (23% cover), mainly associated with Lantana (*Lantana camara*).

Past timber harvesting at the site has had a negative impact on localised areas such as old timber harvesting tracks and log dumps. These areas are in various stages of regeneration but generally appeared to be developing well into native vegetation communities.

Based on the above assessment of habitat quality, the site condition component of the current habitat quality of the NH2U Boambee SF offset area was scored as 7/10 in the offset assessment guide calculations (see Section 5.3.3). This score reflects the presence of the key habitat attributes with some impact from weed infestation, timber harvesting and edge effects. The offset site is in better condition than the threatened plant habitat at the project site, which is probably because it was harvested less recently (Benwell, Dr A. pers. comm.).

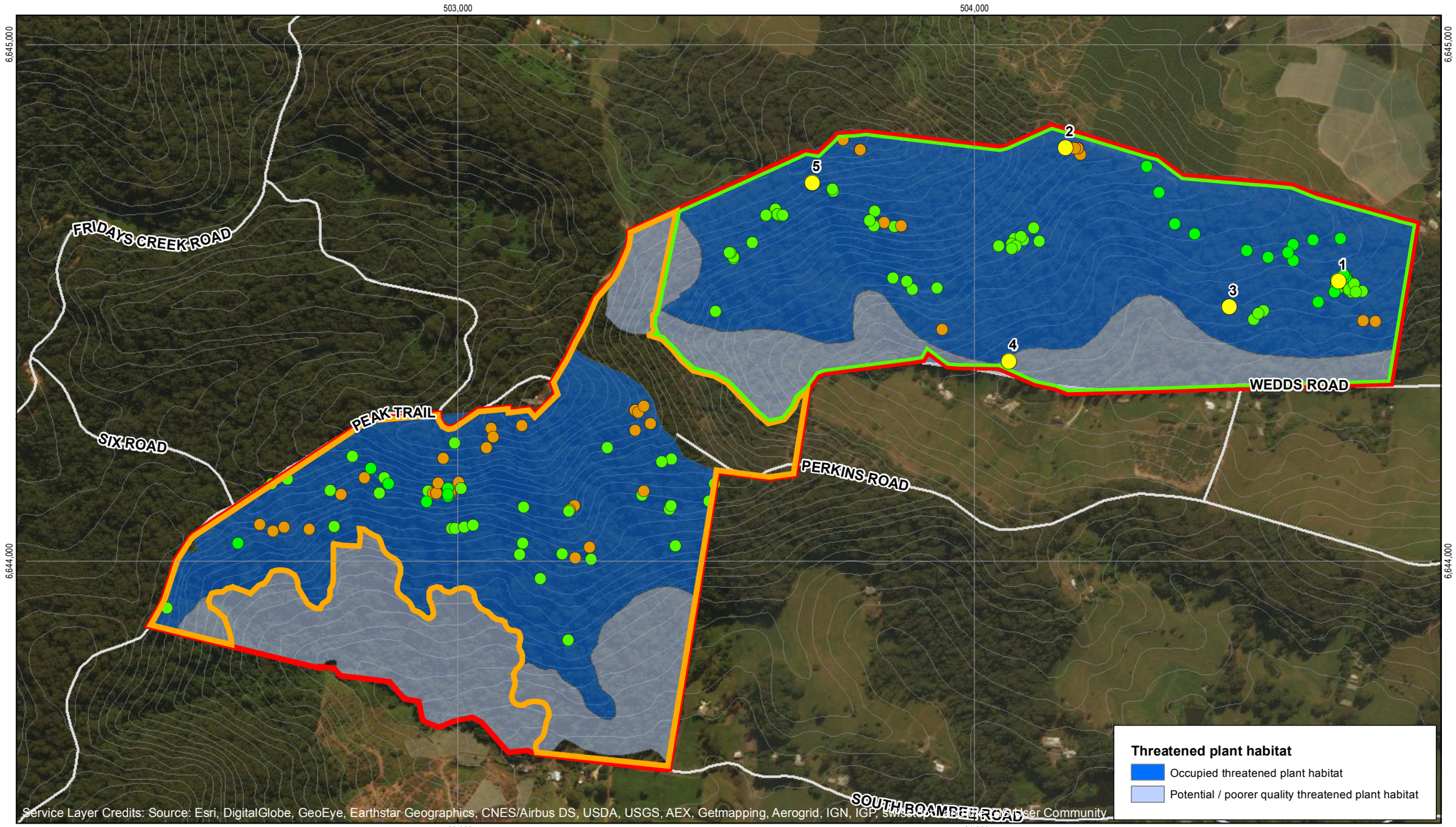
3.5 Populations of affected threatened plants

The field surveys of the Boambee SF offset site revealed extensive local populations of the affected threatened plants. Clusters of threatened plants observed during field surveys are shown on Figure 4 along with the extent of occupied threatened plant habitat and potential or poorer quality threatened plant habitat. Details of the threatened plants recorded are included in Table 1 of Appendix A, including the height and number of stems recorded at the location of each of the clusters of stems shown on Figure 4.

A total of 120 *Marsdenia longiloba* and 24 *Tylophora woollsii* stems were recorded in the 46.5 hectares of occupied habitat in the 'NH2U Boambee SF offset area' that will be set aside specifically to offset impacts of the Project based on the offset assessment guide calculations included in Section 5.6. A total of 210 *Marsdenia longiloba* and 83 *Tylophora woollsii* stems were recorded at the broader Boambee SF offset site, including the *Marsdenia longiloba* and *Tylophora woollsii* stems in areas that will be set aside to offset the impacts of other Roads and Maritime projects.

The numbers of stems of each species recorded should be treated as estimates because of the limitations associated with surveying these two species. Both species are cryptic and may have no, or very limited above ground tissue for much of the year. They are also very similar to one another and very rarely flower or set seed and so it can be difficult to distinguish the two species from one another in the field.

Based on the above assessment of the populations of threatened plants at the site, the species stocking rate component of the current habitat quality of the NH2U Boambee SF offset area was scored as 8/10 (see Section 5.3.3).

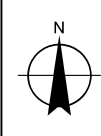


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Paper Size A4

Metres

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



LEGEND

- Boambee SF offset site
- Plot/transect
- Roads
- NH2U Boambee SF offset area
- Marsdenia longiloba*
- Contours
- WC2NH Boambee SF offset area
- Tylophora woollsii*



Roads and Maritime Services
Nambucca Heads to Urunga,
Pacific Highway Upgrade
Threatened Flora Offset Management Plan

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Revision	B
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Threatened plants **Figure 4**

4. Management of the Offset Site

4.1 Titling and funding arrangements

Secure titling for conservation is necessary to ensure that offset sites are protected in perpetuity and to support the 'averted risk' of the offset assessment guide calculations (see Section 5.6). The Boambee SF offset site will remain in the State forest estate and will be secured as a flora reserve and managed for conservation by FCNSW. The portion of the State forest within the Boambee SF offset site will be set aside as a flora reserve under the *Forestry Act 2012*. The Forestry Act requires the preparation of working plans for each flora reserve. The working plan specifies the activities that will be carried out in the flora reserve with the overall objective of the plan being the preservation of native flora. The working plan will exclude activities such as timber harvesting, mining, grazing and apiary that are inconsistent with the preservation of native flora and specify management measures such as weed management, fire management, track maintenance and erosion control.

Roads and Maritime will make an appropriate financial contribution to FCNSW to compensate for the loss of access to the timber resource and other economic potential within the flora reserve and to ensure that funds are available to manage the flora reserve for conservation.

Roads and Maritime and FCNSW have applied this approach to the 'Cairncross offset site' located within Cairncross SF, which has been set aside as an offset for impacts on threatened flora arising from the Oxley Highway to Kempsey stage of the Pacific Highway upgrade.

4.2 Working plan

4.2.1 Overview

This section describes the management of the NH2U Boambee SF offset area and how the management actions proposed will improve habitat quality for the threatened plants and manage threats to populations. Management actions have been identified based on the ecology of *Marsdenia longiloba* and *Tylophora woollsii*, known threats to populations and habitat and the current site conditions at the NH2U Boambee SF offset area. These management actions will be applied across the entire Boambee SF offset site once it is included in offset package(s) for other projects and will be coordinated with FCNSW management of adjoining State forests. The NH2U Boambee SF offset area will be managed in accordance with the *Managing our forests sustainability: Forest Management Zoning in NSW State Forests* (State Forests NSW 2000) manual (the FMZ manual) provisions for FMZ1 (Flora reserves).

The main identified threats to *Marsdenia longiloba* include localised extinction due to small population size; loss and fragmentation of habitat through land clearing for agriculture and urban development; invasion by introduced weeds, such as Lantana; grazing and trampling by cattle; inappropriate fire regimes; and herbicide usage (DECC, 2005a; DEH, 2008). Identified and potential threats to *Tylophora woollsii* include forest operations; clearing for agriculture; cattle grazing; competition with weeds; physical damage, particularly to roadside populations due to vehicles and associated roadwork; and root rot caused by the fungus *Phytophthora cinnamomi* (DECC, 2005b).

The habitats where *Marsdenia longiloba* and *Tylophora woollsii* were recorded in the Project footprint included moderately disturbed and degraded areas impacted by weed invasion, logging activities, fire and cattle grazing (GHD, 2013a). The majority of individuals were recorded in better quality pockets of native vegetation cover. Similarly, the affected threatened plants were only recorded in better condition habitat in around 20 candidate offset sites that were surveyed in the early stages of the preparation of this TFOMP. The affected threatened

plants were not recorded in recently harvested State forests or areas with severe Lantana infestation despite the presence of otherwise suitable habitat. These observations reconfirm that improvement in the quality of habitat through management of weeds and exclusion of logging and grazing is likely to increase the number of individuals of these species.

The likely effect of management actions on the quality of habitat for these threatened plants and the viability of plant populations is summarised below. Based on the proposed management of the offset sites an increase in habitat quality score with offset has been entered in the offset assessment guide calculations (see Section 5.3).

4.2.2 Management strategies

Table 4 outlines broad management strategies and related actions for the NH2U Boambee SF offset area and how they will improve the condition and security of threatened flora populations and their habitat. An overview of these management strategies and how they relate to the site and to populations of the affected threatened flora is provided below. The following sections provide specific detail of the management actions that will be performed, including a plan for their delivery, a works program and the minimum standards and objectives that will be achieved. Property management actions are illustrated on Figure 5.

Table 4 Effect of management strategies on habitat and populations of threatened plants in the NH2U Boambee SF offset area

Management strategy	Effect on <i>Marsdenia longiloba</i> and <i>Tylophora woollsii</i> habitat	Effect on <i>Marsdenia longiloba</i> and <i>Tylophora woollsii</i> populations
Property maintenance (establishment and maintenance of appropriate fences, gates and signs, removal of rubbish, maintenance of tracks).	Maintenance and improvement of habitat. Facilitation of other management strategies. Reduced risk of impacts from inappropriate public access, rubbish dumping or grazing.	Reduced risk of harm to individual plants. In the longer term, potential increase in the extent or abundance of plants through facilitation of other management strategies.
Retention of regrowth and remnant native vegetation.	Maintenance and improvement of habitat. Potential increase in the area of habitat through succession of some dry sclerophyll forest vegetation in suitable landscape positions towards climax wet sclerophyll forest or rainforest communities.	Reduced risk of harm to individual plants. In the longer term, potential increase in the extent or abundance of plants.
Regeneration of cleared or low condition vegetation.	Improved quality and viability of retained habitat through reduced edge effects. In the longer term, increased extent of habitat.	In the longer term, potential increase in the extent or abundance of plants.
Fire management (exclusion of fire from occupied habitat, fuel reduction in adjoining vegetation).	Maintenance of natural vegetation structure and microclimate in occupied habitat (i.e. fire sensitive wet sclerophyll forest and rainforest). In the longer term, potential increase in the extent of habitat through succession towards climax rainforest communities.	Reduced risk of harm to individual plants. In the longer term, potential increase in the extent or abundance of plants.
Weed control, especially control of Lantana.	Maintenance and improvement in the quality of habitat by increasing the extent, health and productivity of native vegetation and restoring natural vegetation structure and microclimate.	Reduced competition for space, light, nutrients and water. Likely increase in the extent or abundance of plants.

Management strategy	Effect on <i>Marsdenia longiloba</i> and <i>Tylophora woollsii</i> habitat	Effect on <i>Marsdenia longiloba</i> and <i>Tylophora woollsii</i> populations
Exclusion of timber harvesting.	Improved health and productivity of native vegetation and restoration of natural vegetation structure and microclimate. Reduced risk of secondary impacts such as erosion and sedimentation and transmission of weeds or disease.	Reduced risk of harm to individual plants. Likely increase in the extent or abundance of plants.
Exclusion of domestic grazing and management of human disturbance.	Improved health and productivity of native vegetation. Reduced risk of secondary impacts such as erosion and sedimentation and transmission of weeds or disease.	Reduced risk of harm to individual plants through herbivory or stock trampling. Likely increase in the extent or abundance of plants.
Control of pest fauna (deer, rabbits, pigs, feral cattle).	Improved health and productivity of native vegetation. Reduced risk of secondary impacts such as erosion and sedimentation and transmission of weeds or disease.	Reduced risk of harm to individual plants through herbivory or trampling. Likely increase in the extent or abundance of plants.

Exclusion of timber harvesting and other harmful activities

The majority of the Boambee SF offset site is currently within FMZ 4 ‘General Management’ and is available for timber harvesting and other activities that are likely to harm the affected threatened plants and/or reduce the quality of habitat. The offset site will be changed to FMZ 1 ‘Special Protection’ and protected as a Flora Reserve. Activities that are not permitted in a Flora Reserve include timber harvesting, removal of forest products and materials and grazing by domestic stock (State Forests NSW, 2000). This titling mechanism is highly unlikely to be ever overturned to permit timber harvesting or other damaging activities. This scenario supports the ‘risk of loss’ calculations that are included in the Offset assessment guide calculations (see Section 5.4).

Property maintenance

The NH2U Boambee SF offset area is currently State forest and comprises remnant and regenerating native vegetation with small areas of cleared or degraded land. The entire site will be maintained as native vegetation. Infrastructure such as signs and access tracks will be maintained to support these land uses as shown on Figure 5. This infrastructure is important to clearly define the conservation area, exclude harmful activities and facilitate efficient management.

Public access is permitted to the Boambee SF. Access from public roads is indirect and not clearly sign posted and so visitation rates are likely to be relatively low. Potential public access is unlikely to reduce the value of the site as a biodiversity offset provided that harmful activities or threats such as camping, fires, domestic animals, walking or driving off marked trails etc. are excluded. These activities are routinely prohibited in Flora Reserves (State Forests NSW 2000). There are no gates at the boundaries of the Boambee SF offset site because public access is not restricted to the State forest. Appropriate signage will help to exclude these potentially harmful activities. A total of six signs are shown on Figure 5, including signs outside of the NH2U Boambee SF offset area. These signs have been included in this TFOMP and the management budget for the NH2U Boambee SF offset area so that signage will be established around the broader Boambee SF offset site at the time of the establishment of the Flora Reserve that encompasses the entire Boambee SF offset. Other management activities that will

occur in the Boambee SF offset site, but outside the NH2U Boambee SF offset area, will be included in separate offset packages and management plans linked to other projects.

The NH2U Boambee SF offset area contained small areas of dumped building refuse and other rubbish at the location shown on Figure 5. The site management budget will include funds to ensure that rubbish will be removed to avoid the risk of contamination or physical injury to plants or animals. Where woody debris is mixed with inorganic rubbish or crosses proposed access tracks or fence lines it will be moved to the nearest practical area of retained or regenerating vegetation to function as a habitat resource. Woody debris moved in this way will be moved so as to minimise disturbance of vegetation and surface soil and placed as naturally as possible (i.e. not stacked).

There is an existing network of access tracks across the site (see Figure 5). These tracks are likely to be adequate for weed management, fire management, monitoring and other activities. These tracks will be maintained in their current state as single lane, dirt or gravel tracks. Track maintenance will occur within the entire NH2U Boambee SF offset area and from the site boundary to the nearest junction with a public road.

The majority of the perimeter of the Boambee SF offset site adjoins intact native vegetation. Given the impacts associated with fence construction, the risk of injury to native fauna from fences and the surrounding land uses, no additional perimeter fence construction is proposed. The eastern and north-eastern boundaries of the NH2U Boambee SF offset area adjoin private agricultural land with livestock (see Figure 5). Annual inspection and maintenance of these fences is proposed to ensure exclusion of any neighbouring livestock. This activity will be done in partnership with neighbours.

Conservation and improvement of habitat

Conservation and management of the NH2U Boambee SF offset area will improve the quality of habitat for the affected threatened flora and reduce the impact of threats.

The majority of the site contains near-intact vegetation or mature regeneration. There are small areas of cleared land associated with previous timber harvesting or cleared trail margins. Each of these areas featured natural regeneration, including the majority of canopy species, a mix of mid storey and groundcover species and overall high native species richness. This natural regeneration is likely to continue and so no supplementary planting or seed broadcasting is proposed.

Weed control will be an important part of conserving threatened plant habitat at the site and will comprise three main activities:

- Treatment of localised, severe noxious weed infestations, especially Lantana in the areas shown on Figure 5. Treatment of Lantana will be an important management action because this weed species can form particularly severe infestations in wet sclerophyll forest and rainforest habitat and is identified as a specific threat to *Marsdenia longiloba* and *Tylophora woollsii* (DECC, 2005a; DECC, 2005b). This activity will be required in the first two years of the implementation of this plan.
- Targeted threatened plant monitoring and bush regeneration of occupied habitat. This activity will be coordinated with the monitoring program outlined in Section 4.3 and will comprise targeted treatment of weeds in the immediate vicinity (2m radius) of identified stems of *Marsdenia longiloba* and *Tylophora woollsii* to remove specific threats to the health and vigour of individual plants.
- Broad-scale weed monitoring and bush regeneration activities throughout the entire site. This will include treatment of localised, minor infestations of weeds throughout the site. This activity will be required throughout all native vegetation for a minimum of 20 years.

More intensive weed management activities may be required from time to time if severe infestations are detected.

Weed control will be conducted with reference to the locations of weed infestations shown on the property action plan (see Figure 5). Weed control will also consider the locations of threatened plants shown on Figure 4 and/or the results of the monitoring program outlined in Section 4.3. No weed spraying will be undertaken in the vicinity of identified stems of *Marsdenia longiloba* and *Tylophora woollsii* or other threatened plants. Alternative weed control methods such as hand weeding or targeted herbicide application (cut and paint, stem scrape etc.) will be performed in the vicinity of threatened plants.

A detailed weed control plan, incorporating prescriptive weed control methods and performance targets, is included as Appendix B.

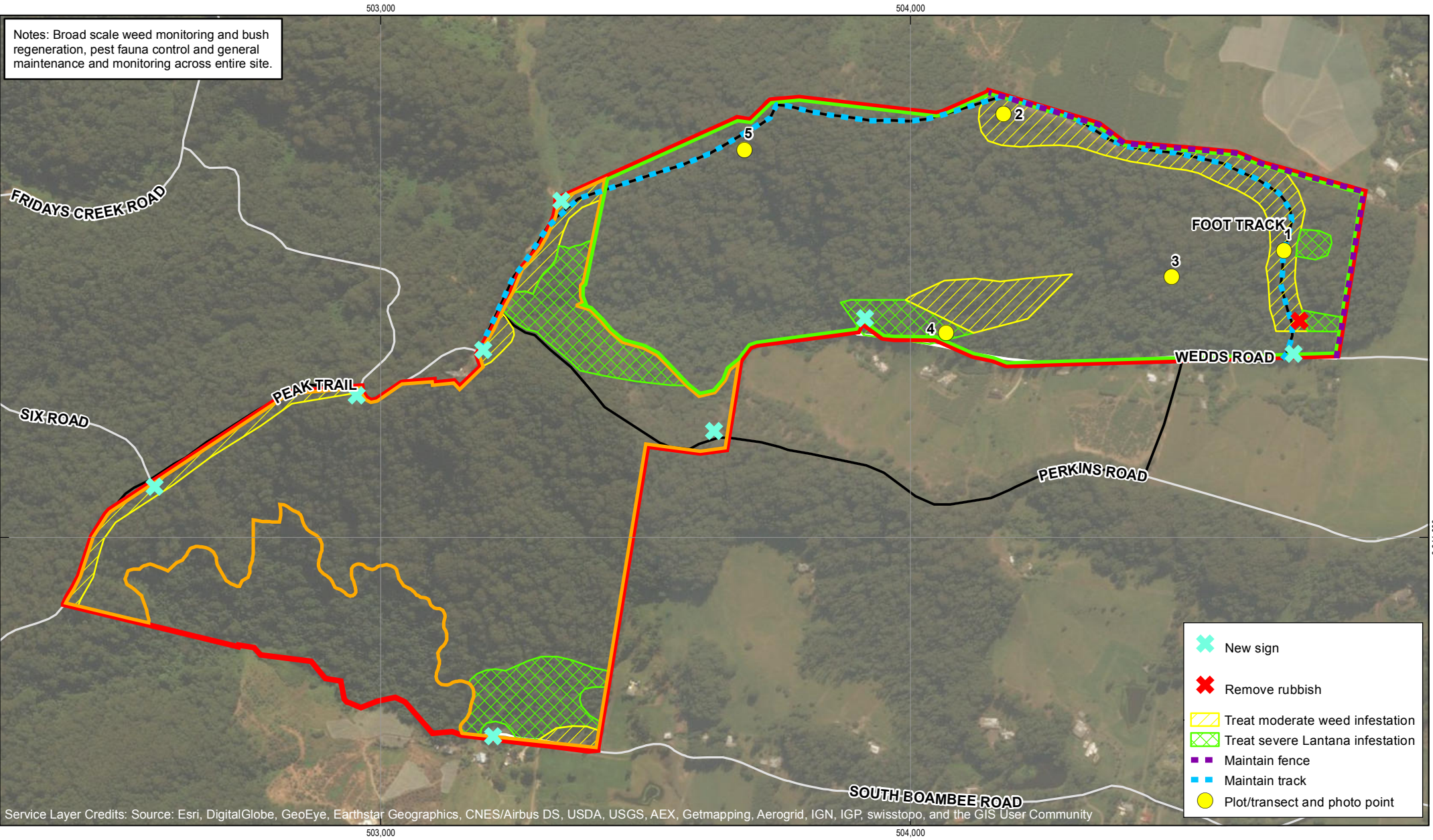
Pest fauna control

Feral herbivores will be managed through a trapping and shooting program and in accordance with the *NPWS North Coast Regional Pest Management Strategy: 2012-2016* (OEH, 2012). Pest fauna populations will be monitored in consultation with the Local Land Services control officer using techniques such as setting of camera traps, setting up of sand pits with bait stations and free feed and coordination with ongoing control programs as appropriate. Pest fauna control programs will be developed in response to monitoring and in consultation with the Local Land Services and will be consistent with the regional strategy (OEH, 2012). This activity will be coordinated with group control programs that include pest fauna control on the site and adjoining properties. Coordination with group control programs is likely to increase the effectiveness of pest fauna control (Thorman, M., local land services, pers. comm.)

Fire management

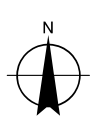
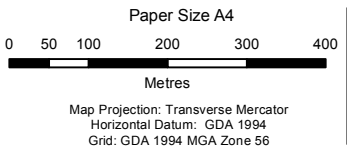
Fire management is likely to play an important role in the management of offset sites for these threatened plants. *Marsdenia longiloba* and *Tylophora woollsii* are sensitive to fire (DECC, 2005a; DECC, 2005b) and the species' preferred wet sclerophyll forest and rainforest habitat would also be sensitive to inappropriate fire regimes. Too frequent or extensive fire would result in a shift to more open dry sclerophyll vegetation types which would be unsuitable habitat. Guidelines suggest that *Tylophora woollsii* should not be burnt more frequently than once every 25 years (NSW RFS, 2004 quoted in DEH, 2008).

There will be two components of purposeful fire management at offset sites: suppression of wildfire and exclusion of fire from occupied habitat; and fuel reduction in adjoining vegetation to reduce the likelihood and intensity of accidental fire. This fire management regime will help maintain the vegetation structure and microclimate in occupied habitat (i.e. fire sensitive wet sclerophyll forest and rainforest) and reduce the risk of harm to individual plants and populations.



Notes: Broad scale weed monitoring and bush regeneration, pest fauna control and general maintenance and monitoring across entire site.

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community



LEGEND	
 	Boambee SF offset site
 	NH2U Boambee SF offset area
 	WC2NH Boambee SF offset area
	Four wheel drive track
	Unsealed road
	Public road



Roads and Maritime Services Nambucca Heads to Urunga, Pacific Highway Upgrade Threatened Flora Offset Management Plan	Job Number 21-23829 Revision B Date 06 Oct 2016
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Property Action Plan Figure 5

4.2.3 Management actions plan

Table 5 presents the specific actions required to implement the strategies described above, including specifications, standards, objectives and timeframes for delivery. Property management actions are illustrated on Figure 5. FCNSW have provided in-principle agreement for management funding, to be provided by Roads and Maritime. FCNSW will manage the NH2U Boambee SF offset area as part of a Flora Reserve within the State forest estate in line with the FMZ manual (State Forests NSW 2000) this TFOMP and other relevant legislative requirements.

Table 5 Boambee SF offset site management actions plan

Activity	Quantity	Activity details	Performance target	Corrective actions	Timeframe
Sign installation and maintenance	Signs shown on Figure 5.	Installation, monitoring, repair and maintenance of the signs shown on Figure 5 to prevent unauthorised public access. Signs to be clear and legible. Signs must be permanent and clearly identify the name of the site, that it is a Flora reserve, that unauthorised public access is prohibited, that rubbish dumping and domestic animal access is prohibited and that activities like weed spraying, baiting or shooting may occur on site.	Signs to be legible. Exclusion of unauthorised public access and damaging activities.	Maintenance and/or replacement of signs.	Installation by June 2017. Maintenance ongoing as required.
Maintenance of fences.	Fence lines shown on Figure 5.	Annual (as a minimum) dedicated monitoring and routine inspection of perimeter fences, gates and signs to prevent public or stock access. Repair and maintenance as required to correct issues identified during monitoring. To be done in partnership with neighbours.	Fences to be fully functional. Exclusion of livestock.	Maintenance and/or replacement of fence lines. To be done in partnership with neighbours.	Annual dedicated monitoring and routine inspection during other activities. Additional monitoring as required after bushfires, extreme weather, flooding etc. Maintenance ongoing as required.

Activity	Quantity	Activity details	Performance target	Corrective actions	Timeframe
Rubbish removal	At the locations shown on Figure 5. Entire site as required	Rubbish at the location shown on Figure 5 to be characterised by an appropriately qualified specialist and a safe and sustainable plan for its removal prepared. The removal plan is to include due consideration of any hazardous materials (e.g. asbestos sheeting). Identify dumping hotspots. Install signs. Use cameras to identify and prosecute offenders. Remove illegally dumped materials using staff and/or specialised contractors during Clean-up Australia Day if appropriate.	Safe and sustainable removal of all rubbish at the location shown on Figure 5.	Characterisation and removal of rubbish as required.	Completion of removal of rubbish shown on Figure 5 by June 30 2017. Bi-annual camera monitoring, annual clean-up Australia day. As required for identified hazardous materials.
Track upgrade and maintenance	Tracks shown on Figure 5	All tracks shown on Figure 5 to be maintained if deemed necessary for management purposes such as fire management. Roads not required are to be closed. Roads are to be maintained to FCNSW Fire management standards as single-lane, gravel or dirt tracks along with appropriate surface water and sediment controls where required.	Maintenance of access for management and fire control activities.	Quarterly monitoring. Entire perimeter and strategic internal trails open and ready prior to each fire season.	At least annually, prior to each fire season. Additional maintenance as required to achieve performance targets.

Activity	Quantity	Activity details	Performance target	Corrective actions	Timeframe
Treatment of noxious weeds in accordance with the weed control plan (Appendix B).	Moderate and severe infestations shown on Figure 5	Treatment of noxious weeds is to be undertaken in accordance with Section 4.2.2, Appendix B and the regional and forest management strategies. No weed spraying undertaken in the vicinity (2 m radius) of identified stems of <i>Marsdenia longiloba</i> and <i>Tylophora woollsii</i> .	Eradication of noxious weeds and control of environmental weeds in the areas indicated on Figure 5 specifically comprising: <ul style="list-style-type: none"> • No dense infestations of any weed species present. • No mature or seeding woody weed species present. • No weeds to be touching or overshadowing threatened plants. • Removed weed cover is being replaced by regenerating native plants species derived from the surrounding local vegetation communities, including recruitment of a range of understorey, mid-storey and canopy species. 	Additional control rounds as required to achieve performance targets.	Two control rounds, in spring or autumn, completed by end 2018.

Activity	Quantity	Activity details	Performance target	Corrective actions	Timeframe
Targeted threatened plant monitoring and bush regeneration of occupied habitat	Occupied habitat in the vicinity of threatened plants shown on Figure 4 and any additional threatened plants identified during monitoring rounds.	Targeted treatment of noxious and environmental weeds in the immediate vicinity (2 m radius) of identified stems of <i>Marsdenia longiloba</i> and <i>Tylophora woollsii</i> in accordance with the weed control plan (Appendix B). Hand weeding or targeted herbicide application (cut and paint, stem scrape etc.) only. This activity will be coordinated with the monitoring program outlined in Section 4.3.	Confirmation that the threatened plant populations shown on Figure 4 are being maintained or improved. Confirmation of stem densities and health of plants. Suppression of weeds in occupied habitat to achieve: achieve: <ul style="list-style-type: none"> • No dense infestations of any weed species present. • No mature or seeding woody weed species present. • No exotic vines to be encroaching into native mid-storey or canopy. 	Additional weed control rounds as required to achieve performance targets. Additional research and consultation as required to identify causes of any observed decline in plant health or abundance and to identify appropriate management responses.	Five annual monitoring / control rounds, in Summer, completed by February 2021. Additional monitoring and control rounds as required to achieve performance targets.

Activity	Quantity	Activity details	Performance target	Corrective actions	Timeframe
Broad scale weed monitoring and bush regeneration in accordance with the weed control plan (Appendix B).	Entire site	Monitoring of native vegetation throughout the offset site. Treatment of noxious and environmental weeds is to be undertaken in accordance with Section 4.2.2 and Appendix B, and the regional and park management pest management strategies. No weed spraying undertaken in the vicinity of identified stems of <i>Marsdenia longiloba</i> and <i>Tylophora woollsi</i> . Weed management activities are to be undertaken by suitably qualified operators. Operators are to provide report of works undertaken, which includes mapping of area treated, primary species treated and photo monitoring points.	FCNSW is expected to make a reasonable effort to eradicate noxious weeds and control environmental weeds in the site and achieve: <ul style="list-style-type: none"> • No dense infestations of any weed species present. • No mature or seeding woody weed species present. • No weeds to be touching or overshadowing threatened plants. • Removed weed cover is being replaced by regenerating native plants species derived from the surrounding local vegetation communities, including recruitment of a range of understorey, mid-storey and canopy species. 	Additional control rounds as required to achieve performance targets.	Once yearly (spring), for a minimum of 20 years.
Pest fauna control	Entire site	Dedicated monitoring of pest herbivore populations (e.g. goats, pigs, rabbits) in consultation with the Local Land Services control officer and including techniques such as setting of camera traps, setting up of sand pits with bait stations and free feed and coordination with ongoing control programs as appropriate. Pest fauna control at least every two years undertaken by appropriately licensed and qualified staff where possible. Control programs to be developed in consultation with the Local Land Services officer and to be consistent with regional plans and programs.	FCNSW must make a reasonable effort to control pest fauna in the Conservation Area. Monitoring and the level of local activity (presence of neighbourhood baiting programs etc.) will help inform the level of effort necessary. FCNSW must monitor the site at least once every two years.	Pest control and monitoring to be reviewed annually. Adjustments implemented and documented.	Monitoring, followed by a pest fauna control round, at least once every two years or as required, for a minimum of 20 years.

Activity	Quantity	Activity details	Performance target	Corrective actions	Timeframe
Wildfire suppression	1-2 per annum (on average)	Suppress wildfires as necessary quickly and efficiently.	Fires kept small and/or cool. Fire not allowed to spread into occupied threatened plant habitat or from State forest to other tenure, where possible.	Review fuel management strategy if frequency or intensity of wildfires increases.	Ongoing as required.
Fuel management	Entire site. Coordinated with management programs in surrounding State forests	Identification of fuel management strategies including formal lodgement of Asset Protection Zones and Strategic Fire Advantage Zones (APZ/SFAZ) with the regional Bush Fire Management Committee	Formal lodgement of FCNSW strategies into the regional Bush Fire Management Plan.	Fuel management activities to be reviewed annually. Adjustments implemented and documented.	Ongoing as specified in the regional Bush Fire Risk Management Plan
General conservation, maintenance and monitoring.	Monitoring across entire site. Management actions applied to any identified problem areas.	Exclude activities that would result in impacts on habitat for the affected threatened flora, including timber harvesting, vehicle based camping, domestic animal access, apiary or uncontrolled public access. Facilitate and monitor natural regeneration and development of habitat resources in accordance with the monitoring program (see Section 4.3). Identify and monitor threats and impacts to biodiversity values (e.g. wildfire, erosion, harmful activities on adjoining properties). Identify and map problem areas and undertake appropriate corrective actions.	The current extent and condition of native vegetation and occupied threatened plant habitat is improved or maintained. Native vegetation cover values for all strata are maintained (see Appendix A for benchmark strata cover targets). FCNSW must comply with their management plan and provide monitoring results for: - vegetation and habitat condition - weed control - pest fauna control - any identified threats and impacts to biodiversity values that are not covered in this plan and appropriate corrective actions - any specific management actions for the reporting year.	In the event of unscheduled timber harvesting or other damaging human activities additional rounds of weed control and the other activities listed above must be performed to ensure regeneration to the pre-disturbance state. Management activities and monitoring results to be reviewed annually. Supplementary management actions must be implemented in identified problem areas (e.g. soil stabilisation works in identified erosion areas). Adjustments must be implemented and documented.	Yearly monitoring report for a minimum of 20 years.

4.2.1 Management actions program

Activity	Works timing (periods for actions to be completed by FCNSW)												Timeframe
	2017				2018				Ongoing				
	Jan-Mar	Apr-Jun	July-Sep	Oct-Dec	Jan-Mar	Apr-Jun	July-Sep	Oct-Dec	Jan-Mar	Apr-Jun	July-Sep	Oct-Dec	
Gate and sign installation													Ongoing as required.
Rubbish removal													Completion of removal of rubbish shown on Figure 5 by June 30 2017. Ongoing as required.
Track maintenance													Ongoing as required.
Treatment of noxious weeds													Two control rounds, in spring, completion by end 2018.
Threatened flora population monitoring													Once yearly in February, for a minimum of five years.
Vegetation and habitat monitoring													Once yearly in October, for a minimum of five years.
Weed monitoring and bush regeneration													Once yearly in spring, for a minimum of 20 years.
Pest fauna control													Monitoring and pest fauna control rounds two-yearly or as required for a minimum of 20 years.
General conservation, maintenance and monitoring													Yearly monitoring reports for a minimum of 20 years.

4.3 Monitoring program

4.3.1 Overview

The FCNSW will monitor biodiversity values at the Boambee SF offset site as part of their management of the State forest. Monitoring will include an annual assessment of the general extent and quality of habitat for the affected threatened flora and the effectiveness of management actions for a minimum of 20 years. The following monitoring programs will apply to the offset site:

- Threatened flora population monitoring, comprising an annual monitoring program to be completed by FCNSW ecologists or a suitably qualified subcontractor, for a minimum of five years.
- Vegetation and habitat monitoring, comprising a monitoring program to be completed by the FCNSW annually, for a minimum of 20 years and including preparation of annual overviews of the condition of vegetation and habitat.
- Weed control and bush regeneration monitoring, comprising a monitoring program to be completed by the FCNSW annually
- Pest fauna control monitoring, involving documenting of control activities for a minimum of 20 years.

These monitoring activities and reports are described below.

This TFOMP will be reviewed and revised in response to the findings of the monitoring program. Updates to the TFOMP will include locations and descriptions of:

- Any additional threatened flora stems recorded.
- Any additional threats or management issues observed.
- Corrective actions.
- Any changes to timeframes, including potential extensions to the end date for monitoring or implementation.

4.3.2 Threatened flora populations

Targeted threatened flora population monitoring will be completed by FCNSW ecologists or a suitably qualified subcontractor, annually in Summer, ideally in January or February, for a minimum of five years. Surveys will be timed to coincide with the species' flowering times: *Tylophora woolsii* flowers in summer and autumn, usually between January and March; *Marsdenia longiloba* flowers in Summer (noting that both species flower very rarely). The team of specialists responsible for this management action will need to have strong field plant identification skills, demonstrated experience at identifying *Marsdenia longiloba* and *Tylophora woolsii* and bush regeneration skills.

Monitoring of threatened flora populations will comprise:

- Targeted searches for threatened plants with reference to the known locations of clusters of threatened plants and occupied habitat shown on Figure 4 and listed in Appendix A.
- Confirmation of the presence of the known clusters of threatened plants shown on Figure 4 and listed in Appendix A and identification of any additional clusters and documentation of the number of stems, apparent health of stems, evidence of fruiting or flowering and presence of weed infestation or other threats.

- Targeted treatment of weeds as required in the immediate vicinity (2m radius) of identified stems of *Marsdenia longiloba* and *Tylophora woollsii*. This will comprise hand weeding or targeted herbicide application (cut and paint, stem scrape etc.) only.
- Documentation of any additional weed control rounds or other corrective actions that are recommended to respond to observed threats to the threatened plant populations.

As stated in Table 5, additional monitoring and control rounds will be performed as required to achieve performance targets, specifically:

- Confirmation that the threatened plant populations shown on Figure 4 (and any additional stems revealed by monitoring) are being maintained or improved.
- Confirmation of stem densities and general health of plants (noting that both species routinely die back to underground tissue and so plant health is not readily measurable for individual plants and should be considered at a population scale).
- Suppression of weeds in occupied habitat.

The management and monitoring will focus on maintaining a resident population of the threatened plants, maintaining the overall area of occupied habitat and managing known threats such as weeds. Additional research and consultation will be completed as required to identify causes of any observed population-scale decline in plant health or abundance and to identify appropriate management responses.

Five years is the 'Offset calculator – Time horizon – Time until ecological benefit' value that was entered in the Offset assessment guide calculations and so this is the critical period after which it is necessary to confirm that the biodiversity offset has been delivered as planned. If the performance targets are not met after five years then the program will be extended by another year. Corrective actions will be implemented in the additional year, including additional research and consultation as required to identify causes of any observed decline in plant health or abundance and to identify appropriate management responses. Performance targets will be reassessed at the end of the additional year and the program extended again if required.

4.3.3 Vegetation and habitat

FCNSW will monitor biodiversity values at the NH2U Boambee SF offset area as part of their management of the Flora Reserve. A vegetation and habitat monitoring program will be completed by FCNSW annually, for a minimum of 20 years. A vegetation and habitat condition report will be prepared annually.

The annual monitoring of vegetation and habitat condition by the FCNSW will comprise:

- Monitoring of the five photo points at the locations of the five plot/transects sampled in the baseline field surveys to record the condition of habitat and the effectiveness of management actions. Photo point locations will be way pointed using a GPS and marked with star pickets to facilitate locating during subsequent monitoring events and consistent photo capture. A portrait photo (illustrating vegetation structure) and a landscape photo (illustrating ground cover) should be taken and notes taken on general vegetation condition, extent of weed infestation, ground cover, any management issues such as erosion or dieback, disturbance by pest fauna and any observed change since the last monitoring round.
- Resampling of the five plot/transects at each of the five photo point locations sampled in the baseline field surveys and comparison with benchmark values for each vegetation type and the results of previous surveys.

- A summary of general observations of vegetation condition, degree of weed infestation, any management issues such as erosion or dieback and any observed change since the last monitoring round across the entire site.
- Description of any observed management problems or threats and proposed remedial action as required.

Baseline plot/transect data are included in Appendix A. Baseline photo point monitoring results are included in Appendix C.

4.3.4 Weed monitoring and bush regeneration

A weed monitoring and bush regeneration program will be implemented by FCNSW for a minimum of 20 in accordance with the weed control plan (Appendix B). Appropriately qualified weed control and bush regeneration contractors will monitor weed populations and the success of bush regeneration activities at the NH2U Boambee SF offset area as part of their weed management activities. A weed monitoring and bush regeneration report will be prepared annually.

The annual weed monitoring and bush regeneration report will comprise:

- A summary of activities completed in the preceding year.
- Updated maps of the type and extent of weed infestations present at the site, prepared with reference to Figure 5.
- Mapping of the areas treated, primary species treated and photo monitoring points.
- A summary of performance against the targets specified in the weed control plan (Appendix B).
- A summary of any corrective actions required, such as additional weed control rounds to achieve performance targets.
- Additional research and consultation as required to identify causes of any observed decline in native vegetation health or cover and to identify appropriate management responses.

The baseline weed monitoring results are as shown on Figure 5 and reported in the plot/transect data in Appendix A and baseline photo point monitoring results are included in Appendix C.

4.3.5 Pest fauna control

FCNSW will conduct dedicated monitoring of pest fauna populations (e.g. goats, pigs, rabbits) and prepare summary reports every two years. The monitoring program will be developed in consultation with the Local Land Services control officer and include techniques such as setting of camera traps, setting up of sand pits with bait stations and free feed and coordination with ongoing control programs as appropriate. Each monitoring round will be followed by a round of pest fauna control, principally targeting feral herbivores and undertaken by appropriately licensed and qualified staff where possible. Any baiting undertaken will be conducted according to best practice standards. Control programs will be developed in consultation with the Local Land Services officer and will be consistent with regional plans and programs.

A brief pest fauna control report will be prepared comprising:

- Dates and locations of monitoring activities.
- Numbers and species of animals recorded during monitoring.
- Dates and locations of pest fauna control activities.

- A brief description of group control programs encompassing the site or other relevant programs coordinated by Local Land Services and related to the pest control activities on site.
- Numbers and species of animals captured or killed during pest fauna control activities.
- Incidental observations of native animals.
- A summary of general observations of pest fauna abundance and activity throughout the preceding 24 months.

5. Quality of Offset

5.1 Overview

This section provides detail about the quality of the biodiversity offset that is presented to compensate for the Project's impacts on the affected threatened flora. The DSEWPaC (2012a) policy requires a formal assessment of impacts and offset contributions using the 'Offsets assessment guide'. The Offsets assessment guide utilises a balance sheet approach to measure impacts and offsets. According to the EPBC Act Environmental Offsets Policy (DSEWPaC 2012), controlled actions requiring offsets must achieve a minimum 90 per cent 'direct offset'. Direct offsets are defined as 'those actions that provide a measurable conservation gain for an impacted protected matter'. A conservation gain for the protected matter may be achieved by measures such as:

- Improving existing habitat.
- Creating new habitat.
- Reducing threats.
- Averting the loss of a protected matter or its habitat that is under threat.

Separate data are entered in the Offsets assessment guide for each of the species that may be impacted by the Project however offset contributions for separate species may be grouped when it is appropriate to do so. Circumstances where this may be appropriate include where the MNES have similar ecology or habitat requirements and where these requirements can be demonstrated to be met by a single offset. In these instances, the species with the greatest offset requirement determines the offset for the project. *Marsdenia longiloba* and *Tylophora woollsii* occur in the same habitat within the Project site and surrounding region (Benwell, pers. comm. 2014). *Marsdenia longiloba* is listed as a vulnerable species and *Tylophora woollsii* is listed as an endangered species under the EPBC Act. The offsets policy requires that offsets are calculated for the species with the greatest conservation significance (i.e. the endangered species *Tylophora woollsii* in this instance). Therefore, a single set of Offset assessment guide calculations was performed for both species, based on the removal of 36 hectares of habitat for an endangered species and conservation of habitat in an offset site.

The other values that were entered in the Offset assessment guide were derived based on the threatened species impact assessments for the Project (GHD, 2013a, 2013b, 2013c), threatened flora management plan (Benwell 2013), additional consultation with Dr Benwell and the results of field surveys in the NH2U Boambee SF offset area. The desktop assessments, field surveys, habitat assessments and management action plans presented above provide further support for these offset calculations. The following section states how a conservation gain for the affected threatened flora will be achieved through the measures proposed and how this direct offset will be delivered in accordance with the policy. The conditions of approval for the Project also state that direct offsets may also be discounted by 10% if the threatened plant translocation program is demonstrated to be successful.

A detailed description of the Offset assessment guide calculations and how data was derived is provided below.

5.2 Summary of Impacts

5.2.1 Project description

The Project represents the northern section (Nambucca Heads to Urunga) of the Upgrade of the Pacific Highway between Warrell Creek and Urunga (WC2U) on the mid north coast of NSW. The WC2U upgrade has been approved under Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act) and is being implemented in two stages: the northern (Nambucca Heads to Urunga) section and the southern (Warrell Creek to Nambucca Heads) section. The two stages are considered separate projects and are referred to as the Warrell Creek to Nambucca Heads (WC2NH) Upgrade and the Nambucca Heads to Urunga (NH2U) Upgrade.

The Project comprises a 22 kilometre upgrade of the Pacific Highway from west of Nambucca Heads to the Waterfall Way interchange at Raleigh north of Urunga (Figure 1). The action has a southern upgrade section from west of Nambucca Heads to north of Valla, and a northern bypass section around Urunga and includes:

- Four lane divided carriageways, with provision for upgrade to six lanes.
- Controlled access to the upgrade at three designated interchanges, providing grade separation of all local roads which cross the upgrade, and an alternative route for local traffic through the provision of service roads.
- Twin highway bridges at 11 locations.
- Six overbridges.
- Three service road bridges.
- A combined light and heavy vehicle rest area at the Nambucca Heads Interchange.
- Noise mitigation measures.
- A range of fauna-impact mitigation features, including structures to provide for the movement of fauna across the road reserve.
- Emergency U-turn and median crossovers at approximately 2.5 km intervals.
- Retention of the existing Pacific Highway as a continuous road for local and regional traffic. No diversions are proposed.
- A range of water quality management measures, including catch drains to divert clean water around the road reserve, landscape and vegetation treatments to assist in reducing water quality impacts and sediment basins to intercept run-off before discharging into sensitive natural watercourses.

A detailed description of the Project is included in the EPBC Act referral (GHD, 2013a).

5.2.2 Removal of threatened plants and habitat

Construction of the Project removed stems of *Marsdenia longiloba* and *Tylophora woollsii* and habitat for both species that occur within the Project footprint. *Marsdenia longiloba* and *Tylophora woollsii* occur in essentially the same habitat within the Project site: wet sclerophyll forest, on sheltered south-facing slopes or narrow gullies in hilly terrain (Benwell, pers. comm. 2014). They are most frequently associated with forest dominated by Grey Gum-Tallowwood-Ironbark-White Mahogany. Both species also occur in forest dominated by Flooded Gum or Blackbutt, but much less frequently. *Tylophora woollsii* extends further into drier upper slope open forest than *Marsdenia longiloba*, but overall the distribution of these two species overlaps in most areas of occupied habitat within the Project site. Habitat for these species is frequently

described as comprising rocky, scree slopes in the setting described above (for example DECC, 2005a); however, this association does not appear to be supported in the study area for the Project (Benwell, pers. comm. 2014).

Of the native vegetation types recorded in the Project site, most of the 'Moist Open Forest – White Mahogany/Grey Gum/Ironbark' association (an estimated 80%) represents potential habitat for both species plus a small percentage of Flooded Gum (estimated 10%) and Blackbutt (estimated 10%) dominated forest (GHD, 2013a). These percentages are based on observations made during targeted survey of the distribution of the subject species within these forest types undertaken for the Environmental Assessment for the proposed upgrade (GHD, 2013a), the translocation program and general observations during other field investigations by Dr Benwell. Correcting for these percentages, the estimated area of potential habitat for these two species to be removed for the Project was about 36 ha. Roads and Maritime and their contractors have appropriate safeguards in place to ensure that the Project did not remove more than 36 ha of habitat for these threatened plants in accordance with Condition 1 of the approval. Therefore, for the purposes of this TFOMP, the Project's impacts have been calculated as the removal of 36 ha of habitat for *Marsdenia longiloba* and *Tylophora woollsii*.

As of September 2016 vegetation clearing for construction of the Project has been substantially completed. Roads and Maritime have calculated the extent of clearing of specific vegetation and habitat types that has occurred. As of September 2016, the Project has cleared 34.1 hectares of habitat for *Marsdenia longiloba* and *Tylophora woollsii* (see Table 1). There may be some minor clearing still required as part of the Project, however Roads and Maritime shall ensure that the total clearing of habitat for *Marsdenia longiloba* and *Tylophora woollsii* remains less than 36 hectares.

Table 6 Area of potential habitat for *Marsdenia longiloba* and *Tylophora woollsii* removed for the Project

Vegetation Community	Total area of impact (ha)	Estimated Loss of potential habitat (ha)
Open Forest – Blackbutt	98.01	9.8
Moist Forest – Flooded Gum	11.88	1.19
Moist Forest – White Mahogany/Grey Gum/Ironbark	28.89	23.11
Total	138.78	34.10

Determining the precise numbers of individual *Marsdenia longiloba* and *Tylophora woollsii* directly impacted or avoided by construction has not been possible due to the limitations on surveying these two species. Both species are cryptic and may have no, or very limited above ground tissue for much of the year. They are also very similar to one another and difficult to distinguish on the basis of leaf characteristics. The flowers of the two species are very different, but are rarely seen. The sparseness and cryptic appearance of these two species makes detection difficult so that comprehensive survey data would require metre by meter searching of the ground. Repeated surveys of the Project footprint have been conducted and are likely to have detected the great majority of stems that were affected though it was not always possible to discriminate between the two species. Distinguishing the two species may not be crucial for impact calculation, offsetting and management purposes, as they share common habitat (Benwell, 2013).

Prior to clearing activities all identified stems of *Marsdenia longiloba* and *Tylophora woollsii* within the direct and indirect impact zones were translocated to a Roads and Maritime-owned property to the north of the Kalang River. The estimated numbers of stems translocated were:

- 83 *Marsdenia longiloba*.
- 66 *Tylophora woollsii* (Benwell, 2014.).

It is important to note, that the majority of impacts on *Tylophora woollsii* were due to a dense cluster of ~50 stems in a small area at a single location just north of Nambucca Heads. Most stems were less than 30cm tall and only a few were >2m tall. The concentration of stems in a small area and the presence of rhizomes in this species indicate that the stem cluster is a clone of stems that has arisen by vegetative reproduction, or budding off the underground rhizome system. The actual number of genetically different individuals is therefore likely to be substantially less (Benwell, 2013).

Given the uncertainty about the exact number of individuals of each species impacted by the Project that is described above, area of habitat has been identified as the most appropriate means of assessing the quantum of offsets required. The Department has previously expressed a preference for species offsets to be calculated based on the area of habitat removed, rather than the number of individuals, given that there is the possibility for understatement of the number of individuals impacted due to survey limitations (Boraso, C, DotE, email of 20 November 2014).

The extent of clearing of habitat to date (34.1 hectares as shown in Table 1) is less than the 36 hectare estimate used in offset calculations. Further minor clearing may be required, however, Roads and Maritime and their contractors had appropriate safeguards in place to ensure that the Project did not remove more than 36 ha of habitat for these threatened plants in accordance with Condition 1.

5.3 Habitat quality

5.3.1 Approach

Habitat quality was scored out of ten to provide the inputs to the offset assessment guide calculations. There are three site characteristics that may contribute to habitat quality, which must be ranked according to their relative importance in the offset calculations based on the ecology of the relevant species (DSEWPaC, 2012) (i.e. their relative contribution to the total score out of 10). Each of the three attributes was given equal weighting based on consultation with Dr Benwell.

Each characteristic was then scored based on the site surveys, research carried out by the project team and consultation with Dr Benwell as follows:

- Site condition scored according to the presence of the key habitat attributes (vegetation type and structure, steep, hilly topography and sheltered aspect) and the general quality and condition of native vegetation and habitat resources.
- Site context scored according to continuity of native vegetation and connectivity with other areas of *Marsdenia longiloba* and *Tylophora woollsii* habitat.
- Species stocking rate scored according to the presence and abundance of *Marsdenia longiloba* and *Tylophora woollsii*.

The aggregate site quality scores for the Project clearing footprint and NH2U Boambee SF offset area are presented below. All site quality scores were derived in consultation with Dr Benwell based on the results of the site surveys, habitat assessments, literature review and his

expert knowledge of the species. These values have been entered in the offset assessment guide calculations that are presented in Section 5.6.

5.3.2 Quality of habitat in the Project clearing footprint

'Impact calculator - quantum of impact – quality' (i.e. the quality of habitat in the Project clearing footprint) was scored as 6/10 (rounded to the nearest whole number), comprising:

- Site condition 6/10, reflecting the presence of the key habitat attributes with some impact from weed infestation, grazing, timber harvesting and edge effects.
- Site context 5/10, reflecting the proximity of much of the Project footprint to the Pacific Highway or other disturbed, cleared land.
- Species stocking rate 8/10, reflecting the fact that the 36 hectares of habitat that has been included in offset calculations contains known local populations of these species, including dense clusters of stems.

5.3.3 Quality of occupied habitat in the NH2U Boambee SF offset area

'Offset calculator – start area and quality – start quality' for habitat in the NH2U Boambee SF offset area was calculated as 7/10 (rounded to the nearest whole number), comprising:

- Site condition 7/10, reflecting the presence of the key habitat attributes with some impact from weed infestation, timber harvesting and edge effects but in better condition than the project site given the time since the site was last harvested. The site condition score incorporates comparison of BioBanking plot/transects sampled in the offset area with benchmark data from matching NSW vegetation types (see Section 3.4).
- Site context 7/10, because the site has a low perimeter to edge ratio and adjoins an extensive area of native vegetation containing threatened plant habitat in State forests.
- Species stocking rate 8/10, because the offset site contains local populations of *Marsdenia longiloba* and *Tylophora woollsii* as confirmed through targeted field surveys (see Section 3.4).

'Offset calculator - future quality without offset' for occupied habitat in NH2U Boambee SF offset area was estimated at 7/10 (rounded to the nearest whole number), comprising:

- Site condition 6/10, reflecting a decline in the condition of the key habitat attributes through ongoing weed infestation, inappropriate fire regimes and edge effects.
- Site context 7/10, reflecting unchanged or minor changes in the continuity of native vegetation because substantial areas of native vegetation will be maintained in State forests adjoining the site and broad scale land clearing is unlikely to occur on adjoining private land.
- Species stocking rate 7/10, reflecting a likely decline in the health or abundance of threatened plant populations as a function of habitat degradation and direct impacts such as weed infestation, inappropriate fire regimes and edge effects.

'Offset calculator - future quality with offset' for occupied habitat in the NH2U Boambee SF offset area was estimated at 8/10 (rounded to the nearest whole number), comprising:

- Site condition 8/10, reflecting improvements in the quality of the key habitat attributes through purposeful management of fire, exclusion of timber harvesting, treatment of weed infestations and management of pest fauna.
- Site context 7/10, reflecting unchanged or minor changes in the continuity of native vegetation since the site is already almost completely covered by native vegetation.

- Species stocking rate 8/10, which is unchanged because of uncertainty about the rate of increase in the extent or abundance of the threatened plants as a function of habitat improvement and exclusion of direct impacts.

The scores presented above have been selected based on field survey results, the experience and judgement of Dr Benwell with regard to the ecology of these species and the experience of GHD ecologists in preparing similar biodiversity offset strategies.

5.4 Contribution of the conservation mechanism to the offset

The proposed conservation and titling arrangements for the NH2U Boambee SF offset area will achieve a conservation gain for the affected threatened flora through the following measures specified in the policy:

- Reducing threats.
- Averting the loss of a protected matter or its habitat that is under threat (DSEWPac 2012).

The offset site is part of the Boambee SF and is under the management of Forestry Corporation of NSW (FCNSW). Forest Management Zoning (FMZ) is a land classification system that sets out in a map format the way that FCNSW intends to manage forests across the State forests estate. The FMZ system clearly sets aside those areas that are set aside for conservation and those areas that are available for other activities, including timber harvesting (State Forests NSW 2000).

The majority of the NH2U Boambee SF offset area is currently within FMZ 4 'General Management' and is available for timber harvesting and other activities (State Forests NSW 2000) that are likely to harm the affected threatened plants and/or reduce the quality of habitat. The Boambee SF offset site contains high quality Blackbutt (*Eucalyptus pilularis*) regrowth with considerable timber value (Williams J., FCNSW pers. comm.) and would be likely to be harvested in the short to medium term.

Timber harvesting is included as a threat in the listing advice and recovery plans for the affected threatened flora (DECC 2005a; 2005b; Threatened Species Scientific Committee 2008a, 2008b) and these species were not recorded from recently harvested State forests that were surveyed as candidate offset sites (GHD, in prep b). Timber harvesting would directly harm individual plants and create an open, sunny microclimate that will not be suitable habitat. Timber harvesting would be likely to have a significant impact on populations of the affected threatened flora and result in the long-term loss of occupied habitat for *Tylophora woolfsii* and *Marsdenia longiloba*.

The habitat affected by timber harvesting would not be permanently removed, however the key habitat resources that are important to populations of the affected threatened species would not regenerate within the 'Risk related time horizon' included in the calculations (20 years). This scenario supports the 80% 'risk of loss' value that is included in the Offset assessment guide calculations for the affected threatened plants.

The offset site will be changed to FMZ 1 'Special Protection' and protected as a Flora Reserve. Timber harvesting and other potentially damaging activities will be excluded. The land that is dedicated as a Flora Reserve will not be limited to exclude any land lying below the surface of the land pursuant to Section 16 (2) of the Forestry Act (i.e. mining will be prohibited within or below the Flora Reserve). This conservation mechanism is highly unlikely to be overturned to permit damaging activities; subject to the Forestry Act, a Flora Reserve cannot be revoked wholly or in part otherwise than by an Act of Parliament. This has been the case where several Flora Reserves previously declared in State forest are now within National Parks due to the surrounding forest being included in the National Park Estate.

There are currently 72 Flora Reserves declared on State forest in NSW. Areas within these zones are designed to meet the requirements of JANIS dedicated (formal) reserves in the National Forest Policy Statement and as such are equivalent to IUCN Protected area categories I, II, III or IV. The NSW OEH recognises that as a conservation mechanism, Flora Reserves offer a similar level of security and protection to biodiversity as National Parks and Nature Reserves (OEH, 2011).

The Flora Reserve that will encompass the Boambee SF offset site will be delimited by hard boundaries such as roads, drainage lines, fences and the State forest boundary and will be readily identified and avoided in the planning and harvesting processes. FCNSW files have no records of a Flora Reserve being breached by any harvesting operations or management activities.

Gazettal of a Flora Reserve containing the NH2U Boambee SF offset area will see 46.5 hectares of occupied habitat for the affected threatened flora conserved which would otherwise be under threat of timber harvesting. Given the strength of the conservation associated with a Flora Reserve a 3% residual risk of loss with the offset site conservation mechanism in place has been entered in the Offset assessment guide calculations.

5.5 Contribution of management actions to the offset

The NH2U offset site will be managed in perpetuity for biodiversity conservation and to protect the affected threatened flora and their habitats. Specific management actions have been proposed that will improve the extent or quality of habitat for the affected threatened flora and/or reduce threats. The field surveys and desktop assessments described above have confirmed that the NH2U Boambee SF offset area contains habitat in good condition with some impacts from timber harvesting, weed infestation and edge effects. Current and potential threats to threatened flora at the offset site include weed infestation, pest fauna and degradation of habitat through human activities. These degrading factors and threats are likely to continue and in the case of edge effects and weed infestation would intensify without active management in the short term. The proposed management actions will help avoid a decrease in the current habitat quality at the NH2U Boambee SF offset area and achieve a future increase in habitat quality. The specific relationships between proposed management actions, the type of conservation gain according to the policy (DSEWPac 2012) and the likely effect on populations and/or habitat for the affected threatened flora are presented in Table 4. Section 4.2 presents the plan and program for delivering management actions and Section 4.3 states how the effectiveness of management actions will be monitored.

5.6 Offset assessment guide calculations

The EPBC Act Offset package for the Project will comprise the conservation and management of around 46.5 hectares of occupied or potential habitat for *Marsdenia longiloba* and *Tylophora woollsii* at the NH2U Boambee SF offset area. This offset area is less than the estimated offset area of 140 hectares of habitat that was included in the TFOS (GHD, 2014). A smaller area is required to offset 100% of the Project's impacts because of the specific characteristics of the NH2U Boambee SF offset area, including the quality of habitat, potential for management to improve the quality of habitat and averted risk of loss of habitat due to timber harvesting. The quality of habitat at the NH2U Boambee SF offset area and the potential for improvement through management has been verified through field surveys. The data that were entered in the preliminary Offset assessment guide calculations are summarised in Table 7 along with the justification for the attribute values that were entered and the estimated percentage of the direct offset requirement for each MNES that will be met by this Offset strategy. Based on these calculations the NH2U Boambee SF offset area will meet 102% of the Project's EPBC Act offsetting requirements for *Marsdenia longiloba* and *Tylophora woollsii* as direct offsets.

Table 7 Attribute values entered in the Offset assessment guide calculations

Offset assessment guide attribute	Value	Justification
Impact Calculator - Quantum of impact - Area	36 hectares	Removal of less than 36 hectares of occupied habitat for <i>Tylophora woollsii</i> and <i>Marsdenia longiloba</i> as documented in GHD (2013c) and Benwell (2014.). To date the Project has removed around 34.1 hectares of occupied habitat. Roads and Maritime have appropriate safeguards in place to ensure that the Project removed less than 36 hectares of occupied habitat for both species in accordance with the conditions of approval.
Impact Calculator - Quantum of impact – Quality	6/10	The Project footprint contains occupied habitat for known populations of these species key habitat attributes with some impact from weed infestation, grazing, timber harvesting and edge effects generally close to the Pacific Highway or other disturbed, cleared land (GHD, 2013c; Benwell (2014.)). Further justification for this value is provided in Section 5.3.2.
Offset calculator – Time horizon –Risk related time horizon	20 years	The NH2U Boambee SF offset area will be protected and managed in perpetuity as a Flora Reserve. 20 years is the maximum timeframe for averting loss in the guide.
Offset calculator – Time horizon – Time until ecological benefit	5 years	The NH2U Boambee SF offset area contains native vegetation in moderate to good condition that will be managed through exclusion of timber harvesting, treatment of severe noxious weed infestations in the first two years and ongoing bush regeneration and treatment of pest fauna. Ecological benefits will be achieved in the short term, nominally five years. Conversely a tangible reduction in the quality of habitat through timber harvesting, increased weed infestation and edge effects, human impacts or fire is likely within five years if the offset area was not conserved in a Flora Reserve.
Offset calculator -Future area and quality without offset – Risk of loss without offset	80 %	The majority of the NH2U Boambee SF offset area is currently within FMZ 4 ‘General Management’ (see Figure 6) and is available for timber harvesting and other activities that are likely to harm the affected threatened plants and/or reduce the quality of habitat. The NH2U area contains high quality regrowth with considerable timber value (Williams J., FCNSW pers. comm.) and would be likely to be harvested in the short to medium term.
Offset calculator -Future	3 %	The NH2U Boambee SF offset area will be

Offset assessment guide attribute	Value	Justification
area and quality with offset – Risk of loss with offset		protected and managed in perpetuity as a Flora Reserve. The Flora Reserve that will encompass the Boambee SF offset site will be delineated by hard boundaries such as roads, drainage lines, fences and the State forest boundary and as such will be readily identified and avoided in the planning and harvesting processes. FCNSW files include no records of a Flora Reserve being breached by any harvesting operations or management activities. The NSW OEH recognises that as a conservation mechanism, Flora Reserves offer a similar level of security and protection to biodiversity as National Parks and Nature Reserves (OEH, 2011).
Confidence in result – averted loss of offset	95 %	A Flora Reserve is one of the strongest conservation covenants available in NSW and will be supported by implementation of the Forestry Management Zoning system and a reserve specific works plan to exclude harmful activities.
Offset calculator – Start area and quality – Area	46.5 hectares	The area of habitat at the NH2U Boambee SF offset area was confirmed through detailed field surveys, including targeted searches for threatened plants and mapping of vegetation type and condition. Occupied and potential habitat was mapped in consultation with Dr Benwell and based on observed threatened plant locations, vegetation type and topographic position.
Offset calculator – Start area and quality – Start quality	7/10	The offset site contains occupied habitat, as part of a large patch of vegetation that is in good condition with some impacts from timber harvesting, weed infestation and edge effects. Further justification for this score is provided in Section 5.3.
Offset calculator -Future area and quality without offset – Future quality without offset (1-10)	7/10	Habitat in the NH2U Boambee SF offset area would continue to deteriorate through impacts from weed infestation, edge effects, pest fauna, inappropriate fire regimes etc. if not set aside for conservation. These impacts would probably not be sufficient to drop site quality an entire point. Further justification for this score is provided in Section 5.3.
Offset calculator -Future area and quality with offset – Future quality with offset (1-10)	8/10	Habitat in the offset site(s) will be managed as described in Section 4 and a tangible improvement in the quality of habitat and viability of plant populations will be achieved. Further justification for this score is provided in Section 5.3.

Offset assessment guide attribute	Value	Justification
Confidence in result – change in quality	75 %	A modest increase in site quality is predicted. The link between the predicted improvement in the quality of habitat and viability of threatened flora populations through management actions is described in Section 5.3. 75% is a reasonable level of confidence in the effectiveness of the gains to be achieved through excluding timber harvesting, grazing or other damaging activities and the effectiveness of the proposed environmental management actions.
Percentage of impact offset	102.28 %	

Based on the offset assessment guide calculations summarised above the 46.5 hectares of habitat in the NH2U Boambee SF offset area could offset 102.28 % of the Project’s impacts on *Marsdenia longiloba* and *Tylophora woollsii*.

Habitat at the Boambee SF offset site that is outside of the NH2U Boambee SF offset area will be available to offset the biodiversity impacts of other proposals.

6. Conclusions

Clearing for construction of the Project has removed stems of *Marsdenia longiloba* and *Tylophora woollsii* and around 34.1 hectares of occupied habitat for both species. Roads and Maritime have appropriate safeguards in place to ensure that the Project would remove less than 36 hectares of occupied habitat for both species in accordance with the conditions of approval. Biodiversity offsets are required to compensate for residual impacts on these threatened plants and to comply with the EPBC Act conditions of approval for the Project. This 'Threatened Flora Offset Management Plan' report (TFOMP) has been prepared in accordance with Condition 19 of the approval.

A desktop assessment was undertaken to identify potentially suitable offset sites containing habitat for *Marsdenia longiloba* and *Tylophora woollsii* (GHD, 2014). Field surveys of candidate offset sites were undertaken to identify populations of *M. longiloba* and *T. woollsii* and estimate the extent of occupied habitat for the affected threatened plants.

Roads and Maritime have selected the most suitable of these candidate offset sites: a 121 hectare parcel of land in the Boambee State Forest (the 'Boambee SF offset site'). A 59.8 hectare parcel of land in the Boambee SF offset site will be specifically set aside as the offset for the Project's impacts on *Marsdenia longiloba* and *Tylophora woollsii* (the 'NH2U Boambee SF offset area'). The NH2U Boambee SF offset area contains 46.5 hectares of occupied habitat for the affected threatened flora. Roads and Maritime will ensure that the NH2U Boambee SF offset area is legally secured in perpetuity as a Flora Reserve to conserve populations of *Marsdenia longiloba* and *Tylophora woollsii* and their habitat as well as other threatened biota.

In accordance with Condition 19 of the approval, the TFOMP includes details on the quality of the offset proposed, the baseline population and distribution of the affected threatened plants, management actions that will enable maintenance and improvement of habitat and a monitoring program to ensure the effectiveness of actions. The TFOMP describes the extent and condition of *Marsdenia longiloba* and *Tylophora woollsii* populations and their habitat at the NH2U Boambee SF offset area and specifies the management and monitoring framework to improve or maintain these values. Specific management actions have been proposed to conserve the local populations of the affected threatened flora and mitigate threats, including weed infestation, edge effects, uncontrolled wildfire and timber harvesting. This TFOMP will be reviewed and revised in response to the findings of the monitoring program.

The majority of the NH2U Boambee SF offset area is currently within Forestry Management Zone 4 – 'General Management' and is available for timber harvesting and other activities that are likely to harm the affected threatened plants and/or reduce the quality of habitat. The entire Boambee SF offset contains high quality Blackbutt (*Eucalyptus pilularis*) regrowth with considerable timber value (Williams J., FCNSW pers. comm.) and would be likely to be harvested in the short to medium term. The NH2U Boambee SF offset area will be changed to FMZ 1 'Special Protection' and protected as a Flora Reserve. This titling mechanism is highly unlikely to be overturned to permit damaging activities. This scenario supports the 'risk of loss' values that are included in offset calculations.

This TFOMP includes formal assessment of impacts and offset contributions using the 'Offsets assessment guide' that accompanies the offsets policy (DSEWPoC, 2012). The Offsets assessment guide utilises a balance sheet approach to measure impacts and offsets based on factors such as the extent and quality of habitat to be impacted by the Project, the extent and quality of habitat in the proposed offset area, the timing of delivery of offsets, the change in risk of impacts to the offset area with the conservation mechanism proposed and the confidence in the results. These data have been compiled based on desktop assessment of the ecology of the

threatened flora, detailed field survey of the offset site, consultation with FCNSW and consultation with Dr Andrew Benwell, who is a recognised specialist in the ecology of the species.

Based on the offset assessment guide calculations included in this TFOMP conservation and management of 46.5 hectares of habitat for the affected threatened flora at the NH2U Boambee SF offset area as part of a Flora Reserve will offset around 102% of the Project's residual impacts on these species. Habitat at the Boambee SF offset site that is outside of the NH2U Boambee SF offset area will be available to offset the biodiversity impacts of other proposals.

Upon approval of this TFOMP, Roads and Maritime will liaise with FCNSW to arrange for protection of the preferred offset sites in perpetuity through gazettal of a Flora Reserve containing the NH2U Boambee SF offset area. The consultation process is well underway in order to comply with Condition 18 of the approval.

Conservation and management of the NH2U Boambee SF offset area in accordance with this TFOMP will improve the viability of populations of *Marsdenia longiloba* and *Tylophora woollsii* and ensure that Roads and Maritime comply with the conditions of approval for the Project.

7. References

Cover photo *Marsdenia longiloba* (main image) and *Tylophora woollsii*. Photo supplied by Dr Andrew Benwell and edited and reproduced for this report with his permission.

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Appendices

Appendix A – Field survey results

Appendix A Table 1 Threatened plants recorded in the Boambee SF offset site

Species	Stems	Sample ID	Eastings	Northings	Height (m)	Age class	Health	Offset area
<i>Marsdenia longiloba</i>	2	ML_B47x	503499	6644483	0.3, 0.15	Adult	Apparently healthy	NH2U Boambee SF offset area
<i>Marsdenia longiloba</i>	1	ML-210	503526	6644597	2	Adult	Apparently healthy	NH2U Boambee SF offset area
<i>Marsdenia longiloba</i>	1	ML-209	503528	6644597	<0.1	Seedling	Apparently healthy	NH2U Boambee SF offset area
<i>Marsdenia longiloba</i>	1	ML-206	503534	6644586	<0.1	Seedling	Apparently healthy	NH2U Boambee SF offset area
<i>Marsdenia longiloba</i>	1	ML-207	503534	6644588	<0.1	Seedling	Apparently healthy	NH2U Boambee SF offset area
<i>Marsdenia longiloba</i>	1	ML-208	503534	6644588	<0.1	Seedling	Apparently healthy	NH2U Boambee SF offset area
<i>Marsdenia longiloba</i>	1	ML-205	503570	6644616	0.2	Seedling	Apparently healthy	NH2U Boambee SF offset area
<i>Marsdenia longiloba</i>	1	ML-202	503597	6644670	0.2	Seedling	Apparently healthy	NH2U Boambee SF offset area
<i>Marsdenia longiloba</i>	1	ML-203	503597	6644670	<0.1	Seedling	Apparently healthy	NH2U Boambee SF offset area
<i>Marsdenia longiloba</i>	1	ML-186	503615	6644681	0.2	Adult	Apparently healthy	NH2U Boambee SF offset area
<i>Marsdenia longiloba</i>	1	ML-187	503615	6644681	0.1	Seedling	Apparently healthy	NH2U Boambee SF offset area
<i>Marsdenia longiloba</i>	1	ML-188	503615	6644681	0.1	Seedling	Apparently healthy	NH2U Boambee SF offset area
<i>Marsdenia longiloba</i>	1	ML-189	503615	6644681	0.2	Adult	Apparently healthy	NH2U Boambee SF offset area
<i>Marsdenia longiloba</i>	1	ML-190	503615	6644681	0.1	Seedling	Apparently healthy	NH2U Boambee SF offset area
<i>Marsdenia longiloba</i>	1	ML-200	503619	6644671	0.2	Adult	Apparently healthy	NH2U Boambee SF offset area

Species	Stems	Sample ID	Eastings	Northings	Height (m)	Age class	Health	Offset area
<i>Marsdenia longiloba</i>	1	ML-201	503619	6644671	0.3	Adult	Apparently healthy	NH2U Boambee SF offset area
<i>Marsdenia longiloba</i>	1	ML-199	503620	6644670	0.2	Adult	Apparently healthy	NH2U Boambee SF offset area
<i>Marsdenia longiloba</i>	1	ML-198	503621	6644669	0.4	Adult	Apparently healthy	NH2U Boambee SF offset area
<i>Marsdenia longiloba</i>	1	ML-204	503629	6644669	<0.1	Seedling	Apparently healthy	NH2U Boambee SF offset area
<i>Marsdenia longiloba</i>	1	ML-193	503725	6644721	0.6	Adult	Apparently healthy	NH2U Boambee SF offset area
<i>Marsdenia longiloba</i>	2	ML-191	503726	6644717	0.2x2	Seedling	Apparently healthy	NH2U Boambee SF offset area
<i>Marsdenia longiloba</i>	1	ML-192	503727	6644716	1	Adult	Apparently healthy	NH2U Boambee SF offset area
<i>Marsdenia longiloba</i>	3	TW-120	503797	6644659	1.4, 0.4, 0.2	2 x adults, 1 seedling	Apparently healthy	NH2U Boambee SF offset area
<i>Marsdenia longiloba</i>	2	TW-119	503805	6644649	2.2, 1	Adult	Apparently healthy	NH2U Boambee SF offset area
<i>Marsdenia longiloba</i>	3	TW-118	503807	6644678	3.8, 0.5, 0.4	Adult	Apparently healthy	NH2U Boambee SF offset area
<i>Marsdenia longiloba</i>	1	ML-122	503843	6644548	1.6	Adult	Apparently healthy	NH2U Boambee SF offset area
<i>Marsdenia longiloba</i>	3	ML-115	503845	6644648	0.4, 0.2, 2.2	Adult	Apparently healthy	NH2U Boambee SF offset area
<i>Marsdenia longiloba</i>	1	ML-124	503869	6644541	1.5	Adult	Apparently healthy	NH2U Boambee SF offset area
<i>Marsdenia longiloba</i>	2	ML-123	503880	6644526	1.2, 0.6	Adult	Apparently healthy	NH2U Boambee SF offset area
<i>Marsdenia longiloba</i>	2	ML-125	503928	6644529	0.7, 6	Adult	Apparently healthy	NH2U Boambee SF offset area
<i>Marsdenia longiloba</i>	2	ML-113	504047	6644610	2, <0.1	Seedling	Apparently healthy	NH2U Boambee SF offset

Species	Stems	Sample ID	Eastings	Northings	Height (m)	Age class	Health	Offset area
								area
<i>Marsdenia longiloba</i>	1	ML-114	504072	6644606	0.3	Adult	Apparently healthy	NH2U Boambee SF offset area
<i>Marsdenia longiloba</i>	1	ML-111	504072	6644614	0.9	Adult	Apparently healthy	NH2U Boambee SF offset area
<i>Marsdenia longiloba</i>	3	ML-109	504078	6644624	0.3, 0.6, 0.4	Adult	Apparently healthy	NH2U Boambee SF offset area
<i>Marsdenia longiloba</i>	5	ML-112	504080	6644610	<0.1x5	Seedling	Apparently healthy	NH2U Boambee SF offset area
<i>Marsdenia longiloba</i>	2	ML-110	504090	6644629	1.3, 0.2	Adult	Apparently healthy	NH2U Boambee SF offset area
<i>Marsdenia longiloba</i>	1	ML-108	504095	6644621	1.6	Adult	Apparently healthy	NH2U Boambee SF offset area
<i>Marsdenia longiloba</i>	2	ML-107	504115	6644645	1.2, 1.0	Adult	Apparently healthy	NH2U Boambee SF offset area
<i>Marsdenia longiloba</i>	4	ML-106	504126	6644619	0.2, 0.3x2, 0.4	3 x seedlings, 1 x adult.	Apparently healthy	NH2U Boambee SF offset area
<i>Marsdenia longiloba</i>	1	ML-99	504333	6644764	0.4	Adult	Apparently healthy	NH2U Boambee SF offset area
<i>Marsdenia longiloba</i>	1	ML-100	504357	6644714	0.3	Adult	Apparently healthy	NH2U Boambee SF offset area
<i>Marsdenia longiloba</i>	1	ML-101	504388	6644653	0.2	Adult	Apparently healthy	NH2U Boambee SF offset area
<i>Marsdenia longiloba</i>	1	ML-102	504426	6644634	0.4	Adult	Apparently healthy	NH2U Boambee SF offset area
<i>Marsdenia longiloba</i>	3	ML-103	504527	6644601	0.2, 0.4, 0.6	Adult	Apparently healthy	NH2U Boambee SF offset area
<i>Marsdenia longiloba</i>	1	ML-174	504540	6644468	4	Adult	Apparently healthy	NH2U Boambee SF offset area
<i>Marsdenia longiloba</i>	1	ML-175	504549	6644479	1	Adult	Apparently healthy	NH2U Boambee SF offset area

Species	Stems	Sample ID	Eastings	Northings	Height (m)	Age class	Health	Offset area
<i>Marsdenia longiloba</i>	1	ML-173	504559	6644485	0.5	Adult	Apparently healthy	NH2U Boambee SF offset area
<i>Marsdenia longiloba</i>	1	ML-26	504568	6644588	0.6	Adult	Apparently healthy	NH2U Boambee SF offset area
<i>Marsdenia longiloba</i>	1	ML-24	504606	6644597	0.3	Adult	Apparently healthy	NH2U Boambee SF offset area
<i>Marsdenia longiloba</i>	1	ML-22	504616	6644612	0.3	Adult	Apparently healthy	NH2U Boambee SF offset area
<i>Marsdenia longiloba</i>	2	ML-23	504617	6644582	0.5 x 2	Adult	Apparently healthy	NH2U Boambee SF offset area
<i>Marsdenia longiloba</i>	1	ML-21	504655	6644622	0.3	Adult	Apparently healthy	NH2U Boambee SF offset area
<i>Marsdenia longiloba</i>	3	ML-29	504665	6644502	0.4 x 2, 0.2	Adult	Apparently healthy	NH2U Boambee SF offset area
<i>Marsdenia longiloba</i>	2	ML-17	504697	6644521	0.1, 0.2	Seedling	Apparently healthy	NH2U Boambee SF offset area
<i>Marsdenia longiloba</i>	1	ML-137	504700	6644533	<0.1	Seedling	Apparently healthy	NH2U Boambee SF offset area
<i>Marsdenia longiloba</i>	1	ML-127	504700	6644546	1.4	Adult	Apparently healthy	NH2U Boambee SF offset area
<i>Marsdenia longiloba</i>	1	ML-136	504703	6644528	0.4	Adult	Apparently healthy	NH2U Boambee SF offset area
<i>Marsdenia longiloba</i>	1	ML-138	504704	6644532	0.4	Adult	Apparently healthy	NH2U Boambee SF offset area
<i>Marsdenia longiloba</i>	1	ML-139	504704	6644533	<0.1	Seedling	Apparently healthy	NH2U Boambee SF offset area
<i>Marsdenia longiloba</i>	1	ML-140	504704	6644533	0.7	Adult	Apparently healthy	NH2U Boambee SF offset area
<i>Marsdenia longiloba</i>	1	ML-20	504708	6644624	0.3	Adult	Apparently healthy	NH2U Boambee SF offset area
<i>Marsdenia longiloba</i>	1	ML-128	504709	6644544	1.6	Adult	Apparently healthy	NH2U Boambee SF offset

Species	Stems	Sample ID	Eastings	Northings	Height (m)	Age class	Health	Offset area
								area
<i>Marsdenia longiloba</i>	1	ML-141	504711	6644531	1.4	Adult	Apparently healthy	NH2U Boambee SF offset area
<i>Marsdenia longiloba</i>	1	ML-129	504711	6644544	<0.1	Seedling	Apparently healthy	NH2U Boambee SF offset area
<i>Marsdenia longiloba</i>	1	ML-130	504712	6644540	0.4	Adult	Apparently healthy	NH2U Boambee SF offset area
<i>Marsdenia longiloba</i>	1	ML-133	504713	6644539	0.3	Adult	Apparently healthy	NH2U Boambee SF offset area
<i>Marsdenia longiloba</i>	1	ML-134	504713	6644539	<0.1	Seedling	Apparently healthy	NH2U Boambee SF offset area
<i>Marsdenia longiloba</i>	1	ML-135	504713	6644539	<0.1	Seedling	Apparently healthy	NH2U Boambee SF offset area
<i>Marsdenia longiloba</i>	1	ML-144	504713	6644539	1.4	Adult	Apparently healthy	NH2U Boambee SF offset area
<i>Marsdenia longiloba</i>	1	ML-131	504713	6644540	0.3	Adult	Apparently healthy	NH2U Boambee SF offset area
<i>Marsdenia longiloba</i>	1	ML-132	504713	6644540	<0.1 scrambling	Adult	Apparently healthy	NH2U Boambee SF offset area
<i>Marsdenia longiloba</i>	1	ML-19	504715	6644554	0.3	Adult	Apparently healthy	NH2U Boambee SF offset area
<i>Marsdenia longiloba</i>	1	ML-143	504716	6644538	1	Adult	Apparently healthy	NH2U Boambee SF offset area
<i>Marsdenia longiloba</i>	2	ML-18	504718	6644550	0.4, 0.6	Adult	Apparently healthy	NH2U Boambee SF offset area
<i>Marsdenia longiloba</i>	1	ML-145	504719	6644541	0.7	Adult	Apparently healthy	NH2U Boambee SF offset area
<i>Marsdenia longiloba</i>	1	ML-147	504721	6644544	0.4	Adult	Apparently healthy	NH2U Boambee SF offset area
<i>Marsdenia longiloba</i>	1	ML-148	504721	6644544	<0.1	Seedling	Apparently healthy	NH2U Boambee SF offset area

Species	Stems	Sample ID	Eastings	Northings	Height (m)	Age class	Health	Offset area
<i>Marsdenia longiloba</i>	1	ML-149	504721	6644544	<0.1	Seedling	Apparently healthy	NH2U Boambee SF offset area
<i>Marsdenia longiloba</i>	1	ML-150	504721	6644544	1.8	Adult	Apparently healthy	NH2U Boambee SF offset area
<i>Marsdenia longiloba</i>	1	ML-151	504721	6644544	<0.1	Seedling	Apparently healthy	NH2U Boambee SF offset area
<i>Marsdenia longiloba</i>	1	ML-152	504721	6644544	1.4	Adult	Apparently healthy	NH2U Boambee SF offset area
<i>Marsdenia longiloba</i>	1	ML-153	504722	6644535	2	Adult	Apparently healthy	NH2U Boambee SF offset area
<i>Marsdenia longiloba</i>	1	ML-142	504724	6644525	0.2	Adult	Apparently healthy	NH2U Boambee SF offset area
<i>Marsdenia longiloba</i>	1	ML-157	504725	6644526	0.7	Adult	Apparently healthy	NH2U Boambee SF offset area
<i>Marsdenia longiloba</i>	1	ML-146	504726	6644537	2	Adult	Apparently healthy	NH2U Boambee SF offset area
<i>Marsdenia longiloba</i>	1	ML-154	504729	6644529	0.5	Adult	Apparently healthy	NH2U Boambee SF offset area
<i>Marsdenia longiloba</i>	1	ML-156	504730	6644520	0.6	Adult	Apparently healthy	NH2U Boambee SF offset area
<i>Marsdenia longiloba</i>	1	ML-158	504735	6644537	<0.1	Seedling	Apparently healthy	NH2U Boambee SF offset area
<i>Marsdenia longiloba</i>	1	ML-159	504738	6644521	1.8	Adult	Apparently healthy	NH2U Boambee SF offset area
<i>Marsdenia longiloba</i>	1	ML-155	504750	6644523	<0.1	Seedling	Apparently healthy	NH2U Boambee SF offset area
Total in NH2U Boambee SF offset area	120							
<i>Marsdenia longiloba</i>	1	ML_B39	502380	6643927	0.05	Seedling	Apparently healthy	WC2NH offset area
<i>Marsdenia longiloba</i>	6	ML-13	502575	6644035	0.5 x 4, 0.6, 1	Adult	Apparently healthy	WC2NH offset area

Species	Stems	Sample ID	Eastings	Northings	Height (m)	Age class	Health	Offset area
<i>Marsdenia longiloba</i>	2	ML_B62	502638	6644211	0.3, 1.5	Adult	Apparently healthy	WC2NH offset area
<i>Marsdenia longiloba</i>	1	M_C2	502713.8	6644160	150	Adult	Apparently healthy	WC2NH offset area
<i>Marsdenia longiloba</i>	2	ML_16	502761	6644068	2, 0.8	Adult	Apparently healthy	WC2NH offset area
<i>Marsdenia longiloba</i>	1	ML-3	502832	6644180	0.1	Seedling	Apparently healthy	WC2NH offset area
<i>Marsdenia longiloba</i>	1	ML_B7	502858	6644161	0.5	Adult	Apparently healthy	WC2NH offset area
<i>Marsdenia longiloba</i>	1	ML-4	502866	6644150	0.2	Adult	Apparently healthy	WC2NH offset area
<i>Marsdenia longiloba</i>	3	ML-5	502940	6644115	0.3, 0.3, 0.7	Adult	Apparently healthy	WC2NH offset area
<i>Marsdenia longiloba</i>	3	ML-213	502943	6644136	<0.1x3	Seedling	Apparently healthy	WC2NH offset area
<i>Marsdenia longiloba</i>	2	ML-6	502981	6644125	0.2, 0.4	Adult	Apparently healthy	WC2NH offset area
<i>Marsdenia longiloba</i>	3	ML-8	502981	6644129	0.5 x 3	Adult	Apparently healthy	WC2NH offset area
<i>Marsdenia longiloba</i>	4	ML-7	502981	6644141	0.3 x 4, 0.6	Adult	Apparently healthy	WC2NH offset area
<i>Marsdenia longiloba</i>	5	ML_B48	502989	6644064	5x 0.05	Seedling	Apparently healthy	WC2NH offset area
<i>Marsdenia longiloba</i>	1	ML-212	502994	6644229	0.2	Adult	Apparently healthy	WC2NH offset area
<i>Marsdenia longiloba</i>	3	ML_B49	502995	6644063	3x0.05	Adult	Apparently healthy	WC2NH offset area
<i>Marsdenia longiloba</i>	1	ML_B50	503013	6644065	1.5	Adult	Apparently healthy	WC2NH offset area
<i>Marsdenia longiloba</i>	1	ML_B51	503030	6644069	0.4	Adult	Apparently healthy	WC2NH offset area
<i>Marsdenia longiloba</i>	4	ML_B46	503120	6644013	0.25, 3x 0.05	3 x seedlings, 1 adult	Apparently healthy	WC2NH offset area
<i>Marsdenia longiloba</i>	1	ML_B40	503126	6644035	20.5	Adult	Apparently healthy	WC2NH offset area
<i>Marsdenia longiloba</i>	2	ML_B38	503128	6644104	0.3, 0.5	Adult	Apparently healthy	WC2NH offset area
<i>Marsdenia longiloba</i>	1	MLb_45	503160	6643967	0.4	Adult	Apparently healthy	WC2NH offset area
<i>Marsdenia longiloba</i>	1	ML_B52	503202	6644014	0.8	Adult	Apparently healthy	WC2NH offset area
<i>Marsdenia longiloba</i>	4	ML_B62	503214	6643848	0.6, 0.3, 0.20, 1.5	Adult	Apparently healthy	WC2NH offset area
<i>Marsdenia longiloba</i>	2	ML_B37	503215	6644097	0.4, 0.7	Adult	Apparently healthy	WC2NH offset area
<i>Marsdenia longiloba</i>	3	ML_B53	503258	6644004	0.3, 0.3, 0.7	Adult	Apparently healthy	WC2NH offset area
<i>Marsdenia longiloba</i>	2	ML_B23	503290	6644220	0.4, 1.5	Adult	Apparently healthy	WC2NH offset area

Species	Stems	Sample ID	Eastings	Northings	Height (m)	Age class	Health	Offset area
<i>Marsdenia longiloba</i>	4	ML_B43	503357	6644127	0.1, 0.3, 0.1, 2	3x juveniles, 1 x adult	Apparently healthy	WC2NH offset area
<i>Marsdenia longiloba</i>	2	ML_B33	503395	6644193	0.1, 0.15	Seedling	Apparently healthy	WC2NH offset area
<i>Marsdenia longiloba</i>	2	ML_B54	503410	6644101	0.4, 0.15	Adult	Apparently healthy	WC2NH offset area
<i>Marsdenia longiloba</i>	5	ML_B55	503413	6644107	0.3, 0.3, 0.5, 0.05, 0.3	Adult	Apparently healthy	WC2NH offset area
<i>Marsdenia longiloba</i>	1	ML_B32	503414	6644198	10.1	Adult	Apparently healthy	WC2NH offset area
<i>Marsdenia longiloba</i>	5	ML_B58	503421	6644030	120, 20, 5, 10, 0.4	Adult	Apparently healthy	WC2NH offset area
<i>Marsdenia longiloba</i>	1	ML_B57	503487	6644116	0.3	Adult	Apparently healthy	WC2NH offset area
<i>Marsdenia longiloba</i>	5	ML_B56	503497	6644150	0.05, 0.02, 0.5, 0.25, 0.20	2 x juveniles, 3 x adults	Apparently healthy	WC2NH offset area
<i>Marsdenia longiloba</i>	1	MLB6	502849.2	6644131	1	Adult	Apparently healthy	WC2NH offset area
<i>Marsdenia longiloba</i>	1	MLB10	502753.8	6644137	0.5	Adult	Apparently healthy	WC2NH offset area
<i>Marsdenia longiloba</i>	1	MLB18	503006.6	6644141	0.5	Adult	Apparently healthy	WC2NH offset area
<i>Marsdenia longiloba</i>	1	MLB5	502796.5	6644203	1	Adult	Apparently healthy	WC2NH offset area
Total in Boambee SF offset site	210							

<i>Tylophora woolsii</i>	1	TW-194	503746	6644816	0.8	Adult	Apparently healthy	NH2U Boambee SF offset area
<i>Tylophora woolsii</i>	1	TW-195	503746	6644816	<0.1	Seedling	Apparently healthy	NH2U Boambee SF offset area
<i>Tylophora woolsii</i>	1	TW-196	503746	6644816	<0.1	Seedling	Apparently healthy	NH2U Boambee SF offset area
<i>Tylophora woolsii</i>	1	TW-197	503746	6644816	<0.1	Seedling	Apparently healthy	NH2U Boambee SF offset area
<i>Tylophora woolsii</i>	1	TW-168	503779	6644797	0.5	Adult	Apparently healthy	NH2U Boambee SF offset area
<i>Tylophora woolsii</i>	1	TW-169	503779	6644797	0.4	Adult	Apparently healthy	NH2U Boambee SF offset area

Species	Stems	Sample ID	Eastings	Northings	Height (m)	Age class	Health	Offset area
<i>Tylophora woolsii</i>	1	TW-170	503779	6644797	<0.1	Seedling	Apparently healthy	NH2U Boambee SF offset area
<i>Tylophora woolsii</i>	1	TW-171	503779	6644797	0.2	Adult	Apparently healthy	NH2U Boambee SF offset area
<i>Tylophora woolsii</i>	1	TW-117	503825	6644656	2.2	Adult	Apparently healthy	NH2U Boambee SF offset area
<i>Tylophora woolsii</i>	4	TW-116	503858	6644649	1.1, 0.7, <0.1 x3	2 x adults, 2 x seedlings	Apparently healthy. 1.1m adult with seed pod.	NH2U Boambee SF offset area
<i>Tylophora woolsii</i>	1	ML-126	503938	6644449	1.2	Adult	Apparently healthy	NH2U Boambee SF offset area
<i>Tylophora woolsii</i>	1	TW-166	504192	6644801	1	Adult	Apparently healthy	NH2U Boambee SF offset area
<i>Tylophora woolsii</i>	1	TW-167	504194	6644799	1.2	Adult	Apparently healthy	NH2U Boambee SF offset area
<i>Tylophora woolsii</i>	1	TW-163	504200	6644799	0.6	Adult	Apparently healthy	NH2U Boambee SF offset area
<i>Tylophora woolsii</i>	2	TW-164	504200	6644799	0.8	Adult	Apparently healthy	NH2U Boambee SF offset area
<i>Tylophora woolsii</i>	3	TW-165	504200	6644799	1	Adult	Apparently healthy	NH2U Boambee SF offset area
<i>Tylophora woolsii</i>	1	745	504205	6644788	0.7	Adult	Apparently healthy	NH2U Boambee SF offset area
<i>Tylophora woolsii</i>	1	TW-162	504752	6644466	2	Adult	Apparently healthy	NH2U Boambee SF offset area
<i>Tylophora woolsii</i>	1	TW-161	504776	6644464	1	Adult	Apparently healthy	NH2U Boambee SF offset area
Total in NH2U Boambee SF offset area	25							
<i>Tylophora woolsii</i>	1	Tsp-9	502575	6644054	0.2	Adult	Apparently healthy	WC2NH offset area
<i>Tylophora woolsii</i>	1	TW_B13	502643	6644059	1.20, 0.6	Adult	Apparently healthy	WC2NH offset area

Species	Stems	Sample ID	Eastings	Northings	Height (m)	Age class	Health	Offset area
<i>Tylophora woolsii</i>	1	TW_B14	502664	6644065	0.2	Adult	Apparently healthy	WC2NH offset area
<i>Tylophora woolsii</i>	2	TW_15	502713	6644062	0.1, 0.5	Adult	Apparently healthy	WC2NH offset area
<i>Tylophora woolsii</i>	1	Tsp-1	502742	6644177	0.2	Adult	Apparently healthy	WC2NH offset area
<i>Tylophora woolsii</i>	1	Tsp-2	502770	6644187	0.2	Adult	Apparently healthy	WC2NH offset area
<i>Tylophora woolsii</i>	1	TW_9	502774	6644129	0.15	Adult	Apparently healthy	WC2NH offset area
<i>Tylophora woolsii</i>	2	TW_B8	502820	6644161	0.5, 0.1	Adult	Apparently healthy	WC2NH offset area
<i>Tylophora woolsii</i>	1	TW-214	502953	6644132	1.2	Adult	Apparently healthy	WC2NH offset area
<i>Tylophora woolsii</i>	1	TW-215	502959	6644132	0.5	Adult	Apparently healthy	WC2NH offset area
<i>Tylophora woolsii</i>	1	TW-216	502959	6644132	1	Adult	Apparently healthy	WC2NH offset area
<i>Tylophora woolsii</i>	1	775	502962	6644151	1	Adult	Apparently healthy	WC2NH offset area
<i>Tylophora woolsii</i>	1	TW-219	502972	6644199	0.5	Adult	Apparently healthy	WC2NH offset area
<i>Tylophora woolsii</i>	2	B1	502980	6644133	1.5, 0.20	Adult	Apparently healthy	WC2NH offset area
<i>Tylophora woolsii</i>	1	b2	502980	6644133	0.3	Adult	Apparently healthy	WC2NH offset area
<i>Tylophora woolsii</i>	1	TW-218	502985	6644133	0.5	Adult	Apparently healthy	WC2NH offset area
<i>Tylophora woolsii</i>	1	TW-217	502987	6644132	0.5	Adult	Apparently healthy	WC2NH offset area
<i>Tylophora woolsii</i>	1	b3	502994	6644141	1	Adult	Apparently healthy	WC2NH offset area
<i>Tylophora woolsii</i>	1	b4	503002	6644153	0.1	Seedling	Apparently healthy	WC2NH offset area
<i>Tylophora woolsii</i>	3	TW_B22	503056	6644219	2x0.1, 0.15	Seedling	Apparently healthy	WC2NH offset area
<i>Tylophora woolsii</i>	5	TW_B20	503065	6644257	4x0.1, 0.20	4 x seedlings, 1 x adult	Apparently healthy	WC2NH offset area
<i>Tylophora woolsii</i>	1	TW_B21	503069	6644240	0.1	Seedling	Apparently healthy	WC2NH offset area
<i>Tylophora woolsii</i>	2	TW_B19	503124	6644262	0.20, 0.6	Adult	Apparently healthy	WC2NH offset area
<i>Tylophora woolsii</i>	4	TW_B36	503217	6644100	2x0.05, 1.5, 2.2	2 x seedlings, 2 adults	Apparently healthy	WC2NH offset area
<i>Tylophora woolsii</i>	2	TW_B35	503226	6644107	0.05, 0.05	Seedling	Apparently healthy	WC2NH offset area
<i>Tylophora woolsii</i>	1	TW_b42	503255	6644027	2	Adult	Apparently healthy	WC2NH offset area
<i>Tylophora woolsii</i>	1	TW_C4	503314.9	6644263	0.3	Adult	Apparently healthy	WC2NH offset area
<i>Tylophora woolsii</i>	1	TW_B24	503344	6644254	0.05	Seedling	Apparently healthy	WC2NH offset area

Species	Stems	Sample ID	Eastings	Northings	Height (m)	Age class	Health	Offset area
<i>Tylophora woolsii</i>	1	TW-177	503344	6644292	1.3	Adult	Apparently healthy	WC2NH offset area
<i>Tylophora woolsii</i>	1	TW-178	503344	6644292	0.3	Adult	Apparently healthy	WC2NH offset area
<i>Tylophora woolsii</i>	1	TW-179	503344	6644292	0.3	Adult	Apparently healthy	WC2NH offset area
<i>Tylophora woolsii</i>	1	TW-180	503344	6644292	0.3	Adult	Apparently healthy	WC2NH offset area
<i>Tylophora woolsii</i>	1	TW-181	503344	6644292	0.3	Adult	Apparently healthy	WC2NH offset area
<i>Tylophora woolsii</i>	1	TW-182	503344	6644292	0.3	Adult	Apparently healthy	WC2NH offset area
<i>Tylophora woolsii</i>	1	TW-183	503349	6644289	0.3	Adult	Apparently healthy	WC2NH offset area
<i>Tylophora woolsii</i>	2	TW_C5	503353.4	6644276	0.3	Adult	Apparently healthy	WC2NH offset area
<i>Tylophora woolsii</i>	1	TW_B44	503360	6644136	1.4, 1	Adult	Apparently healthy	WC2NH offset area
<i>Tylophora woolsii</i>	1	TW-184	503360	6644300	0.2	Adult	Apparently healthy	WC2NH offset area
<i>Tylophora woolsii</i>	1	TWB_25	503373	6644266	0.20,	Adult	Apparently healthy	WC2NH offset area
<i>Tylophora woolsii</i>	1	TWB41	503228.1	6644007	1	Adult	Apparently healthy	WC2NH offset area
<i>Tylophora woolsii</i>	1	TWB12	502617	6644071	0.2	Adult	Apparently healthy	WC2NH offset area
<i>Tylophora woolsii</i>	1	MLB18	503006.5	6644141	0.15	Adult	Apparently healthy	WC2NH offset area
<i>Tylophora woolsii</i>	1	T_C3	502854.7	6644289	1.6	Adult	Very vigorous.	
Total in Boambee SF offset site	83							

Appendix A Table 2 Plant species recorded in plot/transects

Scientific Name	Common Name	Exotic	NSW Status	EPBC Status	Plot/transect (cover abundance)				
					1	2	3	4	5
<i>Acmena smithii</i>	Lilly Pilly						1	2	
<i>Acronychia oblongifolia</i>	White Aspen				2				
<i>Adiantum formosum</i>	Giant Maidenhair		P		1	3			
<i>Adiantum hispidulum</i>	Rough Maidenhair		P		1	1			1
<i>Allocasuarina torulosa</i>	Forest Oak				2				3
<i>Alocasia brisbanensis</i>	Cunjevoi						2		
<i>Alpinia caerulea</i>	Native Ginger				2	1	1	2	2
<i>Aneilema acuminatum</i>							2		
<i>Angophora costata</i>	Sydney Red Gum					3			2
<i>Arachniodes aristata</i>	Prickly Shield Fern							2	
<i>Archirhodomyrtus beckleri</i>	Rose Myrtle					1			2
<i>Archontophoenix cunninghamiana</i>	Bangalow Palm		P				3	6	
<i>Arthropteris tenella</i>									1
<i>Asplenium australasicum</i>	Bird's Nest Fern		P						1
<i>Blechnum cartilagineum</i>	Gristle Fern				7		2	1	3
<i>Boerhavia coccinea</i>	Tarvine							2	
<i>Breynia oblongifolia</i>	Coffee Bush				2	1			
<i>Calamus muelleri</i>	Southern Lawyer Cane		P				2	2	
<i>Calochlaena dubia</i>	Rainbow Fern					4			
<i>Carex</i> sp.								2	
<i>Cayratia clematidea</i>	Native Grape								1
<i>Celastrus subspicata</i>	Large-leaved Staff Vine					1			
<i>Cephalalaria cephalobotrys</i>	Climbing Panax						1	2	
<i>Christella dentata</i>	Binung						1		
<i>Cissus hypoglauca</i>	Giant Water Vine					1	3	2	2
<i>Clerodendrum floribundum</i> var. <i>floribundum</i>					1				

Scientific Name	Common Name	Exotic	NSW Status	EPBC Status	Plot/transect (cover abundance)				
					1	2	3	4	5
<i>Cordyline petiolaris</i>	Broad-leaved Palm Lily							2	
<i>Cordyline stricta</i>	Narrow-leaved Palm Lily		P		2	1	1		
<i>Corymbia intermedia</i>	Pink Bloodwood							2	
<i>Cryptocarya glaucescens</i>	Jackwood						2		
<i>Cryptocarya microneura</i>	Murrogun				2		1	1	
<i>Cryptocarya rigida</i>	Forest Maple				2				3
<i>Cyathea australis</i>	Rough Treefern		P		1			1	2
<i>Cyathea cooperi</i>	Straw Treefern		P				1		
<i>Cyathea leichhardtiana</i>	Prickly Treefern		P				2		
<i>Cyclosorus interruptus</i>								2	
<i>Cyperus filipes</i>								2	
<i>Daphnandra apatela</i>							2		
<i>Davallia solida</i> var. <i>pyxidata</i>	Hare's Foot Fern								1
<i>Derris involuta</i>						2			
<i>Dianella caerulea</i>	Blue Flax-lily				2	1			
<i>Dioscorea transversa</i>	Native Yam				2	2	1		2
<i>Diploglottis australis</i>	Native Tamarind						2		
<i>Doodia aspera</i>	Prickly Rasp Fern				1	3		2	3
<i>Dysoxylum mollissimum</i> subsp. <i>molle</i>	Red Bean						2	2	
<i>Endiandra muelleri</i> subsp. <i>muelleri</i>							2	2	
<i>Endiandra sieberi</i>	Hard Corkwood				2				
<i>Endiandra virens</i>	White Apple				4	2			
<i>Entolasia marginata</i>	Bordered Panic						2		
<i>Eucalyptus grandis</i>	Flooded Gum						4	4	
<i>Eucalyptus microcarpa</i>	Western Grey Box							3	
<i>Eucalyptus microcorys</i>	Tallowwood								2
<i>Eucalyptus pilularis</i>	Blackbutt				6	3			5

Scientific Name	Common Name	Exotic	NSW Status	EPBC Status	Plot/transect (cover abundance)				
					1	2	3	4	5
<i>Eupomatia bennettii</i>	Small Bolwarra								2
<i>Eupomatia laurina</i>	Bolwarra				2	2			
<i>Euroschinus falcatus</i> var. <i>falcatus</i>	Ribbonwood				1				
<i>Eustrephus latifolius</i>	Wombat Berry					1			
<i>Ficus coronata</i>	Creek Sandpaper Fig						2	2	1
<i>Flagellaria indica</i>	Whip Vine						1		
<i>Gahnia melanocarpa</i>	Black Fruit Saw-sedge				1				
<i>Geitonoplesium cymosum</i>	Scrambling Lily				1				
<i>Glochidion ferdinandi</i>	Cheese Tree				1			2	
<i>Glycine</i> sp.							1		
<i>Glycine</i> sp. <i>Coffs Harbour</i>	A glycine								1
<i>Guioa semiglauca</i>	Guioa				3			2	
<i>Hibbertia dentata</i>	Twining Guinea Flower								1
<i>Homalanthus populifolius</i>								1	
<i>Hybanthus</i> sp.	(blank)								1
<i>Hybanthus stellarioides</i>					1				
<i>Hydrocotyle pedicellosa</i>								2	
<i>Hypolepis rugosula</i>	Ruddy Ground Fern						2		3
<i>Imperata cylindrica</i>	Blady Grass					2			
<i>Jagera pseudorhus</i> var. <i>pseudorhus</i>	Foambark Tree				2		2		
<i>Lastreopsis decomposita</i>	Trim Shield Fern				3	2			
<i>Lepidozamia peroffskyana</i>			P						4
<i>Lobelia trigonocaulis</i>	Forest Lobelia					1		2	
<i>Lomandra longifolia</i>	Spiny-headed Mat-rush				1				2
<i>Lomandra spicata</i>							2		
<i>Lophostemon confertus</i>	Brush Box				3	4	2	2	1
<i>Mallotus philippensis</i>	Red Kamala					1			

Scientific Name	Common Name	Exotic	NSW Status	EPBC Status	Plot/transect (cover abundance)				
					1	2	3	4	5
<i>Marsdenia longiloba</i>	Slender Marsdenia		E1,P	V	2				
<i>Marsdenia rostrata</i>	Milk Vine				1				
<i>Melicope elleryana</i>	Pink-flowered Doughwood							1	
<i>Morinda jasminoides</i>	Sweet Morinda						1	2	
<i>Neolitsea dealbata</i>	Hairy-leaved Bolly Gum						1		
<i>Niemeyera whitei</i>	Rusty Plum, Plum Boxwood		V,P				1		
<i>Oplismenus imbecillis</i>						2			2
<i>Ottochloa gracillima</i>						2		2	
<i>Pandorea pandorana</i>	Wonga Wonga Vine								1
<i>Parsonsia straminea</i>	Common Silkpod								1
<i>Passiflora aurantia</i> var. <i>aurantia</i>	Blunt-leaved Passionfruit				1				
<i>Phyllanthus gunnii</i>					2	2			2
<i>Pilidiostigma glabrum</i>					1				
<i>Piper hederaceum</i> var. <i>hederaceum</i>	Giant Pepper Vine					1	2	2	
<i>Pittosporum multiflorum</i>	Orange Thorn				1				
<i>Pittosporum revolutum</i>	Rough Fruit Pittosporum				1	1			
<i>Platynerium bifurcatum</i>	Elkhorn Fern		P			1		1	
<i>Plectranthus parviflorus</i>									2
<i>Poa sieberiana</i>	Snowgrass								1
<i>Poranthera microphylla</i>	Small Poranthera								2
<i>Pseuderanthemum variabile</i>	Pastel Flower				2	2		2	2
<i>Pyrrosia rupestris</i>	Rock Felt Fern					1		2	1
<i>Quintinia verdonii</i>	Grey Possumwood						1		
<i>Rhodamnia rubescens</i>	Scrub Turpentine								1
<i>Ripogonum elseyanum</i>	Hairy Supplejack						2	3	
<i>Ripogonum fawcettianum</i>	Small Supplejack				3				2
<i>Rubus moluccanus</i>	Molucca Bramble							1	

Scientific Name	Common Name	Exotic	NSW Status	EPBC Status	Plot/transect (cover abundance)				
					1	2	3	4	5
<i>Rubus nebulosus</i>	Green-leaved Bramble						2		
<i>Rubus parvifolius</i>	Native Raspberry					1			
<i>Sigesbeckia orientalis</i> subsp. <i>orientalis</i>	Indian Weed					1			
<i>Sloanea australis</i>	Maiden's Blush							2	
<i>Smilax australis</i>	Lawyer Vine					2			2
<i>Stephania japonica</i>	Snake vine				2	2			2
<i>Syncarpia glomulifera</i>	Turpentine				3	1			2
<i>Synoum glandulosum</i> subsp. <i>glandulosum</i>	Scentless Rosewood				2			1	2
<i>Tabernaemontana pandacaqui</i>	Banana Bush							1	
<i>Tetrastigma nitens</i>						1			
<i>Trema tomentosa</i> var. <i>aspera</i>	Native Peach							1	
<i>Tripladenia cunninghamii</i>					2	2			2
<i>Viola hederacea</i>	Ivy-leaved Violet				1	2			3
<i>Wilkiea huegeliana</i>	Veiny Wilkiea				2		2	2	
<i>Xanthorrhoea malacophylla</i>			P			2			2

Notes: NSW Status: P = protected species under the *NPW Act 1974*; E1 = endangered species under the TSC Act

EPBC Act Status: V = vulnerable species.

Cover abundance rankings within plot /transects: 1 - Foliage sparsely or very sparsely present, cover less than 5%; 2 - 1-5% Plentiful, foliage cover 1-5 %; 3 - 5-25% foliage cover; 4 - 26-50% foliage cover; 5 - 51-75% foliage cover; 6 - 76-100% foliage cover.

Appendix A Table 3 Plot/transect data

Veg. Type ID ¹	Plot ID	Native plant species richness	Native over-storey cover	Native mid-storey cover	Native ground cover (grasses)	Native ground cover (shrubs)	Native ground cover (other)	Exotic plant cover	Number of trees with hollows	Over storey regeneration	Total length of fallen logs	Easting	Northing	Zone
NR120	Benchmark	40	15-100	25-100	0-90	0-25	10-50	0	1	1	> = 10			
	1	44	56	34	2	16	40	10	0	1	51	504705	6644542	56
	2	40	51.5	10.2	4	4	74	10	0	1	222	504176	6644800	56
	5	44	38.5	30	4	24	36	8	0	1	120	503686	6644732	56
NR159	Benchmark	40	15-100	25-100	0-90	0-25	10-50	0	1	1	> = 10			
	3	37	28.5	59.5	10	6	48	4	0	0	65	504493	6644492	56
	4	42	34	55	4	16	14	23	0	0	129	504067	6644387	56

Notes: 1) closest matching NSW (Biometric) vegetation type (OEH, 2014a) 2) Benchmark values (i.e. values in an undisturbed example of the NSW vegetation type) according to the Vegetation Benchmarks Database (OEH, 2014b)

Appendix B – Weed Management Plan

Appendix B Table 1 Weed management plan

Management zone/s	Weed/s	Method of weed control	Frequency
All Zones	All weeds	<p>Herbicide usage</p> <p>At all times during weed control:</p> <ul style="list-style-type: none"> • Herbicide spraying is not to be performed outside of the 'Treat moderate weed infestation' and 'Treat severe Lantana infestation' areas shown on Figure 5. • Off-label usage of any herbicide is only to be undertaken in accordance with a permit issued by the Australian Pesticide and Veterinary Medicine Authority (APVMA). • Mixing or decanting of herbicides shall not be undertaken within 20m of any natural or built drainage line or wetland. • Herbicide usage to only be undertaken where there is no risk to any waterway or the immediate environment. Accumulation of translocated residual herbicides into waterways during wet periods is to be considered in this context. • All herbicide usage, including storage and transport, to be in accordance with WorkCover NSW (2006) and all relevant legislation, including NSW Pesticides Act 1999. • Any bush regenerator undertaking herbicide spray applications must hold a current chemicals application training certification to AQF Level 3. • Any bush regenerator undertaking herbicide spray applications must be highly competent in native and exotic plant identification. • Contractors are to limit, to the best of their ability, off-target damage to emerging or mature native plant species to occur as a result of targeted spraying of exotic/weed species. <p>Should a herbicide spill occur, incident and spill management procedures shall be immediately implemented.</p>	All works

Management zone/s	Weed/s	Method of weed control	Frequency
		<p>Primary weed removal / Avoidance of over-clearing</p> <p>At all times during primary weed control, over-clearing of dense weed patches is to be avoided such that:</p> <ul style="list-style-type: none"> • exposure of soil substrate does not require subsequent additional stabilisation intervention (unless specified). • existing native fauna species habitat is not directly impacted upon. • suitable alternate native fauna species habitat is considered to be available within the surrounding area. • the rate of weed removal is commensurate with the rate of native species regeneration. • the rate of weed removal is commensurate with the resources available to properly maintain the cleared areas. • the rate of weed removal is commensurate with the resources available to satisfactorily manage remaining remnant native vegetation throughout the site. <p>Secondary and Maintenance weed control</p> <p>All secondary and maintenance weed control is to be achieved via a combination of techniques depending upon the area within which works are being undertaken:</p> <ul style="list-style-type: none"> • Native vegetation areas with dense/diverse native understorey cover: predominately manual removal, cut/scrape and painting as required. • Exotic scrub as above, plus careful spot spraying preceded by preparatory hand weeding around native plants / patches where required. • Within areas of dense native grass / fern cover and growth that require weed maintenance, brush-cutting may be utilised as a vegetation removal method in order to prevent weed seed set, provide better spot-spraying access to target weeds and initiating new weed species growth for more efficacious herbicide spray control. • Secondary weed control should aim to establish conditions favourable to native species regeneration, rather than complete control and suppression of all weed 	

Management zone/s	Weed/s	Method of weed control	Frequency
		<p>species.</p> <ul style="list-style-type: none"> In general, use of herbicides should be minimised at all times. Maintenance weed control works are to be undertaken during regular sweeps of the site. At all times priority is to be given to the consolidation and expansion of native species patches and minimisation of weed seed set. <p>Soil borne pathogen control</p> <ul style="list-style-type: none"> All contractors are to follow hygiene protocols specified within the Sydney Botanic Gardens Trust Best Practice Management Guidelines for Phytophthora cinnamomi within the Sydney Metropolitan Catchment Management Authority Area (2008). No foreign soil should be imported into bushland within the site. <p>Green waste disposal</p> <ul style="list-style-type: none"> All removed propagative weed material should be bagged, removed from site and disposed of at a registered green waste facility. Non-propagative removed weed material may be piled within bushland areas provided that piles: <ul style="list-style-type: none"> are discrete (no bigger than 2m²). Do not smother areas of diverse native bushland understorey or areas of potentially high native species resilience. Wherever possible, weed piles should be established within areas that are scheduled to be burnt. <p>Performance targets</p>	

Management zone/s	Weed/s	Method of weed control	Frequency
		Bush regeneration contractor has scheduled appropriately resourced site visits for the duration of the contract period, complied with all specified methods and protocols, and undertaken all works as specified.	
'Treat severe Lantana infestation' (see Figure 5)	Lantana (20-50%) cover	<p>Primary weed control</p> <ul style="list-style-type: none"> To be achieved via a combination of splatter gun application and cut and painting with neat Glyphosate. Herbicide spray application to be applied during spring/summer growth period. Lantana regrowth to be re-treated by foliar spray application of Glyphosate. At all times priority to be given to prevention of seed set. <p>Secondary weed control</p> <ul style="list-style-type: none"> Lantana regrowth to be re-treated by foliar spray application of Glyphosate. Herbicide spray application to be applied during spring/summer growth period. At all times priority to be given to prevention of seed set. <p>Performance targets</p> <ul style="list-style-type: none"> Lantana populations and cover being reduced at all times. Lantana cover reduced to less than 10% cover in mapped infestation areas by the end of year 2. No dense infestations (>20% cover in an area greater than 50 metres squared) in perpetuity. Removed Lantana cover is being replaced by regenerating native plants species derived from the surrounding local vegetation communities, including recruitment of a range of understorey, mid-storey and canopy species. Removed Lantana cover is not being replaced by other noxious or environmental weed species. 	<p>Year 1 (primary – high-volume spray): 1 session / yr</p> <p>Year 2 (secondary – follow up spraying): 1 session / yr</p> <p>Year 3-20 (secondary, only if required): 1 session / yr</p>

Management zone/s	Weed/s	Method of weed control	Frequency
'Treat moderate weed infestation' (see Figure 5)	Lantana (10-20% cover) <i>Cinnamomum camphora</i> <i>Ageratina adenophora</i> <i>Passiflora</i> species <i>Paspalum mandiocanum</i> <i>Solanum mauritianum</i> <i>Cestrum nocturnum</i> (5-40% cover)	<p>Primary weed control</p> <p>Primary weed control is to prioritise the control of mature and seeding woody weeds and exotic vine species:</p> <ul style="list-style-type: none"> Initially, any exotic vines are to be skirted from mid-storey and canopy, clumped on the ground and sprayed with an appropriate herbicide. Primary woody weed control is to be achieved principally via a cut/scrape and painting with herbicide. <p>Secondary weed control</p> <ul style="list-style-type: none"> Priority to be given to the control of exotic vine species and any other noxious or major environmental weed species with the potential to rapidly establish a dominant cover. Remaining woody weeds are also to be progressively reduced, with priority given to maturing individuals in order to prevent further weed seed set. Treatment via a combination of cut/scrape and painting, careful spot spraying, manual removal and, where applicable, brush-cutting, as required. As far as practicable, any emerging annual weed infestations are to be controlled via brush-cutting and/or manual removal, rather than via chemical controls. As native species regeneration establishes a dominant cover within previously areas of weed infestation, use of spot spraying is to be reduced, with maintenance works being achieved principally via manual removal, cut/scrape and painting and brush-cutting. <p>Performance targets</p> <p>Following completion of primary weed control:</p> <ul style="list-style-type: none"> No mature or seeding woody weed species present. No exotic vines to be encroaching into native or exotic species mid-storey or canopy. <p>Following completion of secondary weed control:</p> <ul style="list-style-type: none"> No mature or seeding exotic vines present and no exotic vines encroaching into native 	<p>Year 1 (primary – high-volume spray): 1 session / yr</p> <p>Year 2 (secondary – slashing and follow up spraying): 1 session / yr</p> <p>Year 3-20 (secondary): 1 session / yr</p>

Management zone/s	Weed/s	Method of weed control	Frequency
		<p>or exotic species mid-storey or canopy.</p> <ul style="list-style-type: none"> Woody weed presence reduced to emerging individuals, below 1m in height and no mature or seeding woody weed species present. No dense infestations (>20% cover in an area greater than 50 metres squared) of any weed species present. Removed weed cover is being replaced by regenerating native plants species derived from the surrounding local vegetation communities, including recruitment of a range of understorey, mid-storey and canopy species, such that long-term target cover values for all strata will be achieved upon maturation of regeneration species (see Appendix A for benchmark strata cover targets). Removed weed cover is not being replaced by other noxious or environmental weed species. <p>Ongoing maintenance weed control:</p> <ul style="list-style-type: none"> Establishment / maintenance of canopy cover to long-term target cover values within each management zone (see Appendix A). Establishment of native under- and mid-storey species cover to long-term target cover values within each management zone (see Appendix A). Maintenance of all weed species to long-term target cover values within each management zone. No new weed infestations establishing throughout the weed zone. 	
Threatened plant habitat (see Figure 4)	<p>Lantana (0-20% cover)</p> <p><i>Cinnamomum camphora</i> <i>Ageratina adenophora</i> <i>Passiflora</i></p>	<p>Weed control</p> <ul style="list-style-type: none"> Targeted treatment of noxious and environmental weeds in the immediate vicinity (2 m radius) of identified stems of <i>Marsdenia longiloba</i> and <i>Tylophora woolfsii</i>. This activity will be coordinated with the monitoring program outlined in Section 4.3. Priority to be given to the control of exotic vine species and any other noxious or major environmental weed species with the potential to rapidly establish a dominant cover. 	Year 1-5: 1 session / yr

Management zone/s	Weed/s	Method of weed control	Frequency
	species <i>Paspalum mandiocanum</i> <i>Solanum mauritianum</i> <i>Cestrum nocturnum</i> (0-20% cover)	<ul style="list-style-type: none"> Remaining noxious and environmental weeds are to be progressively reduced, with priority given to maturing individuals in order to prevent further weed seed set. Treatment via a combination of cut/scrape and painting and manual removal. <p>Performance targets Following completion of primary weed control:</p> <ul style="list-style-type: none"> No mature or seeding woody weed species present. No exotic vines to be encroaching into native or exotic species mid-storey or canopy. No weeds to be touching or overshadowing threatened plants. Removed weed cover is not being replaced by other noxious or environmental weed species. 	
Native vegetation (all areas outside mapped weed infestations on Figure 5)	Environmental & noxious weeds (0-10% cover)	<p>Weed control</p> <ul style="list-style-type: none"> Maintenance weed control to be achieved primarily via manual removal during weed sweeps, as well as cut/scrape and painting as required. Spot-spraying is to be avoided throughout the weed zone as it contains high condition bushland. <p>Performance targets All weed species to be maintained to <10% cover.</p>	Year 1-20: 1 session / yr

Appendix C – Baseline photo monitoring point results

NH2U Boambee SF offset area photo monitoring points

Photo point 1	
Easting	504705
Northing	6644542
Bearing	90°
Monitoring round / date of photo	Baseline / 28.04.2015
Vegetation type	Hinterland and Escarpment Tallowwood - Blackbutt - Blue Gum Wet Ferny Forest
NSW Veg Type ID	NR120
Survey effort	Plot/transect 1
Conservation significance	Native vegetation. Not listed as a TEC. Occupied threatened plant habitat. <i>Marsdenia longiloba</i> stems within plot.
Condition	Moderate/good. Remnant or regrowth native vegetation with high species richness and an intact over storey within benchmark values. Mid storey and groundcover attributes were within benchmark values. Large amounts of woody debris were present. No hollow-bearing trees were observed.
Extent of weed infestation	Localised, moderate Lantana infestation. 10% cover along the transect sampled, comprising: occasional patches of Lantana; and Broad-leaved Paspalum (<i>Paspalum mandiocaunum</i>) along the edges of the access track.
Evidence of other management issues (e.g. erosion, dieback, pest fauna)	None observed in majority of plot. Healthy, near-intact native vegetation.
Observed changes since last monitoring round	N/a – baseline monitoring round.



Photo point 2	
Easting	504176
Northing	6644800
Bearing	90°
Monitoring round / date of photo	Baseline / 28.04.2015
Vegetation type	Northern Escarpment Blackbutt - Apple Wet Ferny Forest
NSW Veg Type ID	NR120
Survey effort	Plot/transect 2
Conservation significance	Native vegetation. Not listed as a TEC. Occupied threatened plant habitat. <i>Tylophora woollsii</i> within the plot.
Condition	Moderate/good. Remnant or regrowth native vegetation with moderate over storey cover. Native mid storey was below benchmark values as was native species richness. Native groundcover (shrubs) was below benchmark values. No hollows were observed. Large amounts of fallen timber was recorded with the total length of fallen logs well above benchmark values. The majority of canopy species were observed regenerating.
Extent of weed infestation	Localised, moderate Lantana and Passion Flower (<i>Passiflora</i> species) infestation. 10% exotic plant cover along the transect sampled. Weed management should specifically target Passion Flower vines in the vicinity of <i>Tylophora woollsii</i> stems.
Evidence of other management issues (e.g. erosion, dieback, pest fauna)	None observed. Healthy, near-intact native vegetation.
Observed changes since last monitoring round	N/a – baseline monitoring round.



Photo point 3	
Easting	504493
Northing	6644492
Bearing	270°
Monitoring round / date of photo	Baseline / 28.04.2015
Vegetation type	Coast and Hinterland Riparian Flooded Gum Bangalow Wet Forest
NSW Veg Type ID	NR159
Survey effort	Plot/transect 3
Conservation significance	Native vegetation. Not listed as a TEC. Occupied threatened plant habitat. <i>Marsdenia longiloba</i> recorded in vicinity of the plot.
Condition	Moderate/good. Remnant or regrowth native vegetation with moderate over storey cover. Species richness was below benchmark values as was native ground cover (shrubs). All other native groundcover attributes were within benchmark values. Exotic cover was sparse and low. There was a moderate density of woody debris with the total length of fallen logs above benchmark value.
Extent of weed infestation	Localised, slight Lantana infestation. 4% cover along the transect sampled.
Evidence of other management issues (e.g. erosion, dieback, pest fauna)	None observed. Healthy, near-intact native vegetation.
Observed changes since last monitoring round	N/a – baseline monitoring round.



Photo point 4


Easting	504067	
Northing	6644387	
Bearing	90°	
Monitoring round / date of photo	Baseline / 28.04.2015	
Vegetation type	Coast and Hinterland Riparian Flooded Gum Bangalow Wet Forest	
NSW Veg Type ID	NR159	
Survey effort	Plot/transect 4	
Conservation significance	Native vegetation. Not listed as a TEC. Poorer quality / potential threatened plant habitat.	
Condition	Moderate/good - poor	
Extent of weed infestation	Severe infestation with Lantana, Crofton Weed (<i>Ageratina adenophora</i>) and Broadleaf Paspalum (<i>Paspalum mandiocanum</i>)	
Evidence of other management issues (e.g. erosion, dieback, pest fauna)	None observed.	
Observed changes since last monitoring round	N/a – baseline monitoring round.	

Photo point 5	
Easting	503687
Northing	6644732
Bearing	270 degrees
Monitoring round / date of photo	Baseline / 29.04.2015
Vegetation type	Northern Escarpment Blackbutt - Apple Wet Ferny Forest
NSW Veg Type ID	NR120
Survey effort	Plot/transect 5
Conservation significance	Native vegetation. Not listed as a TEC. Occupied threatened plant habitat. <i>Marsdenia longiloba</i> recorded in the vicinity of the plot.
Condition	Moderate/good. Remnant or regrowth native vegetation with a moderate over storey cover. Species richness was just below benchmark values. Native mid storey and all ground over attributes were within benchmark values. Exotic plant over was low (predominantly Lantana) fallen logs were higher than benchmark. No hollow-bearing trees were observed.
Extent of weed infestation	Localised, low Lantana and Crofton Weed (<i>Ageratina adenophora</i>) infestation. 8% cover along the transect sampled
Evidence of other management issues (e.g. erosion, dieback, pest fauna)	None observed. Healthy, near-intact native vegetation.
Observed changes since last monitoring round	N/a – baseline monitoring round.



Appendix D – Response to the Department’s Document Review / Comments

Document Review / Comments

Proponent:	Roads and Maritime Services
Project:	Pacific Highway Upgrade (Nambucca Heads to Urunga)
Documents:	Threatened Flora Offset Strategy Threatened Flora Offset Management Plan
EPBC conditions:	EPBC 2013/6963: Conditions 18 and 19.
Document full title	Roads and Maritime Services, Pacific Highway Upgrade, Nambucca Heads to Urunga, Threatened Flora Offset Strategy, October 2015. Roads and Maritime Services, Pacific Highway Upgrade, Nambucca Heads to Urunga, Threatened Flora Offset Management Plan, October 2015.
Date documents received	2 October 2015
Drafting officer	Kahli Beissner
Reviewing officer	Peter Blackwell

Condition Number	Condition	Has the condition been met?	Comments (Gaps in information, improvements, adequacy of technical/ scientific information and assumption/justifications, etc.)	Relevant Sections (provided by GHD)	Response by Proponent to comments/issues
	General Comments		Please provide the reports by Dr Benwell from 2013 and 2014 that have been referenced throughout the Plan.		Agreed
	General Comments		The term 'would' is used numerous times throughout the plan. Please replace all instances with 'will'.		Agreed
Condition 18	<p>With reference to the Department's offset policy, the person taking the action must provide for the Minister's approval a Threatened Flora Offset Strategy (TFOS) for the Clear Milkvine and Cryptic Forest Twiner, within one year from the date of this approval. The Minister will only approve the TFOS if it demonstrates how a threatened flora offset meeting no less than 90% of the direct offset requirements (as determined by the Department in accordance with the offset user guide) will be legally secured in perpetuity within two years of the date of this approval.</p> <p>Note: At the time the offset required by condition 18 is submitted for approval, the person taking the action may ask the Minister to consider that the salvage and translocation program required by condition 15, meet 10% of the offset requirements for the Clear Milkvine and Cryptic Forest Twiner</p>	Partial	<p>The revised Threatened Flora Offset Strategy (TFOS) mentions candidate properties that have the potential to satisfy direct offset requirements for the Clear Milkvine and Cryptic Forest Twiner.</p> <p>Roads and Maritime Services (RMS) is in the process of obtaining an in-principle agreement from Forestry Corporation of NSW (FCNSW) that the site can be legally secured in perpetuity as a Flora Reserve (Section 4.1).</p> <p>Clear Milkvine and Cryptic Forest Twiner exist within the same habitat so the offset requirements have been determined based on the species with the highest conservation status (Cryptic Forest Twiner is endangered).</p> <p>This Plan was submitted 2 October 2015 and it was due on 30 June 2015. The letter dated 2 October 2015 states that an extension to timeframe was requested on 30 June 2015 asking for the timeframe to be extended to 30 September 2015. The Department is currently looking in to this.</p>		
Condition	The person taking the action must provide a plan for the management		The impact assessment for Clear Milkvine and Cryptic Forest Twiner		The impact assessment considered impact on areas of occupied habitat

Condition Number	Condition	Has the condition been met?	Comments (Gaps in information, improvements, adequacy of technical/ scientific information and assumption/justifications, etc.)	Relevant Sections (provided by GHD)	Response by Proponent to comments/issues
19	and delivery of the offset requirements of the threatened flora offset to the Minister for approval no later than 30 June 2015. The Threatened Flora Offset Management Plan (TFOMP) must include, but need not be limited to:		habitat only considered impact on areas with “sheltered slopes” (southerly, or in gullies that are sheltered by an opposite slope) and also only in mature successional stage moist forest, that has not been recently logged or burnt and that is not too heavily infested by Lantana or other weeds” (similar also mentioned in Section 5.2.2). To remain consistent with this approach the area to be offset should be calculated the same way.		for the threatened plants, as confirmed by targeted surveys. The environmental characteristics mentioned apply to the occupied habitat, but they were not used to define the area for impact calculations. The same approach was applied at the offset site: targeted surveys to confirm the extent of occupied habitat and a description of the environmental factors associated with that habitat. Dr Andrew Benwell was involved with both surveys and both sets of calculations and applied the same methodologies and criteria each time.
			ACTION: Please recalculate the Clear Milkvine and Cryptic Forest Twiner habitat in the offset area using the same methodologies and criteria used to determine the impact.		The same approach has been applied at the impact and offset sites: targeted surveys to confirm the extent of occupied habitat and a description of the environmental factors associated with that habitat. Dr Andrew Benwell was involved with both surveys and both sets of calculations and applied the same methodologies and criteria each time.
	map(s) and shapefiles that clearly define the location and boundaries of the offset;	No	Maps and shapefiles of the offset area have been provided to the Department.		
			It is proposed that 49 ha of Clear Milkvine and Cryptic Forest Twiner habitat will be offset within Boambee State Forest. This may need to be adjusted to be consistent with the approach used to calculate the impact on the species		As described above, the same approach has been applied at the impact and offset sites. Dr Andrew Benwell was involved with both surveys and both sets of calculations and applied the same methodologies and criteria each time. The occupied habitat at NH2U Boambee SF offset area will not be re-mapped or re-

Condition Number	Condition	Has the condition been met?	Comments (Gaps in information, improvements, adequacy of technical/ scientific information and assumption/justifications, etc.)	Relevant Sections (provided by GHD)	Response by Proponent to comments/issues
					calculated.
			ACTION: Sections 1.5 and Table 2 state the offset area as 49.35 ha whereas Section 1.1 states it as 49 ha.		49.35 hectares was the total area of the offset area at the time of publication. The figure of 49 hectares has been rounded to the nearest whole number from 49.35 hectares as is standard for introductory text or general discussion.
			Section 3.4 states that "This area includes 46.5 hectares of occupied habitat for Marsdenia longiloba and Tylophora woollsii", and that the remaining 2.85 ha is not included in the proposed offset but will be managed accordingly. Section 3.4 says this quality habitat is 2.86 ha. Please clarify which is correct and update the plan.		There are 46.5 hectares of occupied habitat in the offset area that was included in the offset assessment guide calculations. There are 2.85 ha of poorer quality habitat in the offset area that was not included in the offset calculations. The reference to 2.86 ha was a typo and has been corrected.
			Please clarify if access tracks and firebreaks have been subtracted from the offset amount being provided.		There are no fire breaks in the NH2U Boambee SF offset area. Fire trails have not been subtracted from the area of habitat because they are a small gap (<4m across) with continuous native vegetation over and around them. They comprise a negligible proportion of the assessment area and have not been clipped out as is standard practice for GIS-based assessments. Please also note that similar features were not clipped out of the project impact area.
	details on the quality of the offset;	No	Quality of the Clear Milkvine and Cryptic Forest Twiner habitat within the offset area is mentioned in Sections 5.3 and 5.6. More detail is required, particularly in relation to justification of scores entered into the offsets assessment guide.		

Condition Number	Condition	Has the condition been met?	Comments (Gaps in information, improvements, adequacy of technical/ scientific information and assumption/justifications, etc.)	Relevant Sections (provided by GHD)	Response by Proponent to comments/issues
			<p>ACTION:</p> <p>Section 3.2 states that “There is evidence of edge effects around the perimeter of the Boambee SF offset site where it adjoins disturbed, cleared land as well as along tracks”. Figure 2 shows that the border of the offset area is adjacent to cleared land on the north and some on the south. As the area impacted from edge effect is of noticeably reduced quality compared to the remainder of the offset, this should be taken into consideration (i.e. it might be necessary to offset more to compensate for providing low quality habitat).</p>		<p>The ‘Boambee SF offset site’ described in Section is distinct from the ‘NH2U Boambee SF offset area’ described in sections 5.3 and 5.6 (i.e. the area of occupied habitat included in offset calculations). Only a small proportion of the NH2U Boambee SF offset area along the northern boundary adjoins cleared land and a negligible proportion of the area of habitat included in offset calculations would be edge affected. No ‘low quality’ habitat has been included in the offset calculations. The edge effects in question are reflected in moderate weed infestation in places but this is not sufficient to significantly degrade the quality of the habitat, as supported by the presence of threatened plants.</p>
			<p>Please clarify “...stems were observed with around 20 metres of the boundary of the offset site...”. Should that read “within 20m from the boundary”?</p>		<p>Typo has been amended.</p>
			<p>Section 4.2.2 mentions that the offset area contains remnant and regrowth native vegetation. Please justify applying the same habitat quality score to both</p>		<p>All of the vegetation in the offset area is structurally mature with a well-developed canopy, sheltered, humid microclimate and rainforest elements in the mid and understorey. Some of it is ‘regrowth’ in that it does not contain pre-European aged trees. Since the threatened plants do not rely on any habitat resources that take centuries to develop the distinction between remnant and regrowth does not affect the quality of habitat.</p>
			<p>More detailed justification for scores</p>		<p>As stated clearly in section 3.4 ‘The</p>

Condition Number	Condition	Has the condition been met?	Comments (Gaps in information, improvements, adequacy of technical/ scientific information and assumption/justifications, etc.)	Relevant Sections (provided by GHD)	Response by Proponent to comments/issues
			entered into the offsets assessment guide is required (Section 5.3). Are the scores provided representative of findings produced during the BioBanking assessments?		<p>baseline condition of occupied habitat in the NH2U Boambee SF offset area was assessed using BioBanking plot/transects and compared with benchmark data from matching NSW vegetation types. Benchmarks are a quantitative measure of vegetation condition where there is relatively little evidence of modification by humans (DECC 2008) and provide a reliable measure of the relative condition of vegetation sampled by plot/transects. The plot/transect data confirmed that the vegetation associated with occupied habitat is in good condition with benchmark values for the majority of attributes in the majority of plot/transects that were sampled.’ And “ Based on the above assessment of habitat quality, the site condition component of the current habitat quality of the NH2U Boambee SF offset area was scored as 7/10 in the offset assessment guide calculations (see Section 5.3.3)’.</p> <p>A cross reference has been added to Section 5.3.3 to make this clearer.</p>
			Figure 6- Please ensure that the purple shaded area is identified in the Legend. It is unclear where grazing is permitted.		This figure comprises a Raster of FCNSW GIS layers and cannot be edited. This figure has been removed from the final TFOMP to avoid confusion.
			Potential/poorer quality threatened plant habitat is shown in Figure 6 and in other maps included in the Plan. Was the lower quality of this habitat taken into account when calculating the impact area?		As clearly stated in Section 3.4 “Additional areas of ‘potential / poorer quality threatened plant habitat’ were mapped that contained less suitable aspects or vegetation structure, more recent disturbance or more severe and/or extensive weed

Condition Number	Condition	Has the condition been met?	Comments (Gaps in information, improvements, adequacy of technical/ scientific information and assumption/justifications, etc.)	Relevant Sections (provided by GHD)	Response by Proponent to comments/issues
					infestation (see Figure 4). Areas of potential/poorer quality habitat in the NH2U Boambee SF offset area have not been included in offset assessment guide calculations but would still be managed as part of the offset site.”
			Please justify the 95% confidence in result as entered into the offsets assessment guide. The Department suggests that 90% would be more realistic.		Noted. Additional justification has been added to Table 6. The Department has accepted a 95% confidence in result (averted loss) for offset areas on recent project approvals we have delivered for offset sites protected under secure conservation covenants. This confidence reflects the legislation, systems, policies and governance connected to biobank sites and Flora Reserves.
			Please consider increasing the ‘Risk of loss with offset’ to around 10% as the offset is still contained within State Forest and there is the possibility of management activities adverse to these species occurring, and a risk of threatened plants reducing in abundance and distribution. As a conservation covenant is different to a flora reserve, please consider rewording this section.		We disagree. The NH2U Boambee SF offset area will be protected and managed in perpetuity as a Flora Reserve. The Flora Reserve will be delimited by hard boundaries such as roads, drainage lines, fences and the State forest boundary and as such will be readily identified and avoided in the planning and harvesting processes. FCNSW files include no records of a Flora Reserve being breached by any harvesting operations or management activities. The NSW OEH recognises that as a conservation mechanism, Flora Reserves offer a similar level of security and protection to biodiversity as National Parks and Nature Reserves (OEH, 2011). Additional detail regarding the

Condition Number	Condition	Has the condition been met?	Comments (Gaps in information, improvements, adequacy of technical/ scientific information and assumption/justifications, etc.)	Relevant Sections (provided by GHD)	Response by Proponent to comments/issues
					security associated with a Flora Reserve as a type of conservation covenant has been added to Section 5.4.
			Please consider describing habitat and plant quality in terms of results summarised from habitat quality surveys (i.e., Appendix A, Table 3) and targeted threatened flora assessments. These baseline conditions should influence some of the measurable triggers and targets to be set.		Section 3.4 'Habitat quality' describes habitat quality in terms of the results of surveys.
			Please clarify the vegetation communities that are present within the offset area.		Vegetation communities in the offset area are summarised in Table 2 and mapped on Figure 3.
	information about Clear Milkvine and Cryptic Forest Twiner (in relation to ecology, biology and conservation status) to inform appropriate management actions;	No	Conservation status, distribution and habitat, life history traits, threats and recovery actions have been discussed for Clear milkvine (Section 2.2) and the Cryptic Forest Twiner (Section 2.3).		
			Potential threats and recovery actions have been considered in relation to relevant Commonwealth Conservation Advice (Sections 2.2.4 and 2.3.4).		
			ACTION: Phytophthora cinnamomi is noted to affect the Cryptic Forest Twiner. Does it also affect Clear Milkvine? Are there other diseases or pathogens that could have an impact on the species?		As stated in sections 2.2.4 and 2.3.4: -Phytophthora cinnamomi is listed as threat to the Cryptic Forest Twiner in the Department's conservation advice for the species. - This threat is not mentioned in the Department's conservation advice for Clear Milkvine. No other diseases have been identified as threats to these species in the conservation advices and other literature that was reviewed.

Condition Number	Condition	Has the condition been met?	Comments (Gaps in information, improvements, adequacy of technical/ scientific information and assumption/justifications, etc.)	Relevant Sections (provided by GHD)	Response by Proponent to comments/issues
			Please include, or justify not including, threats and recovery actions for feral animals and severe weather events in Sections 2.2.4 and 2.3.4.		Threats and recovery actions for feral animals are identified in Sections 2.2.4 and 2.3.4 despite not being mentioned in OEH or DoEE documents e.g. "Grazing, trampling and habitat degradation by feral herbivores would also be a threat to the species", "Managing feral herbivores would also benefit the recovery of the species". See also 'Pest fauna control' in Section 4. 'Severe weather events' are beyond the control of a land manager and cannot be realistically included in an adaptive management framework.
			Section 2.3 proposes "Investigating formal inclusion of crown land in reserve tenure if possible" as a recovery action for Clear Milkvine. However, Section 4.1 mentions that the offset area will remain in the State Forest estate. Please clarify.		A Flora Reserve within a State forest is reserve tenure. Flora Reserves are designed to meet the requirements of JANIS dedicated (formal) reserves in the National Forest Policy Statement and as such are equivalent to IUCN- Protected area categories I, II, III or IV. The NSW OEH recognises that as a conservation mechanism, Flora Reserves offer a similar level of security and protection to biodiversity as National Parks and Nature Reserves (see http://www.environment.nsw.gov.au/bioregions/BioregionsNswoutlineConservation.htm). Additional detail regarding the security associated with a Flora Reserve as a type of conservation covenant has been added to Section 5.4 to make this clearer.
	performance objectives and management actions that will enable	No	Table 3 contains proposed management strategies and their		

Condition Number	Condition	Has the condition been met?	Comments (Gaps in information, improvements, adequacy of technical/ scientific information and assumption/justifications, etc.)	Relevant Sections (provided by GHD)	Response by Proponent to comments/issues
	maintenance and enhancement of the Clear Milkvine and Cryptic Forest Twiner offset and habitat covered by the plan;		effect on species habitat and populations.		
			Management actions and their respective performance targets, corrective actions and timeframes have been discussed in Table 4.		
			ACTION: Section 4.1 mentions that the offset area will be secured as a flora reserve under the Forestry Act. Flora Reserves can be limited to prevent future mining practices. Please consider implementing this limitation to protect the offset in perpetuity and justify the averted risk score provided in the offsets guide calculation.		Noted. Specific exclusion of mining has been added to Section 5.4.
			Please clarify how long this will be effective for. Is it based on a specified timeframe or measurable outcomes?		The Flora Reserve will apply in perpetuity. As stated in table 6 "The NH2U Boambee SF offset area will be protected and managed in perpetuity as a Flora Reserve. 20 years is the maximum timeframe for averting loss in the guide".
			Please clarify if the working plan provided in Section 4.2 is the document that will be provided to the FCNSW to govern the conservation of the offset area. If so, please change "would" in the last sentence of the first paragraph (Section 4.2) to 'will'.		Noted.
			The third sentence of Section 4.1 is confusing. Please consider rewording to increase clarity.		Noted and reworded.
			Property maintenance (Section 4.2.2) Please consider erecting more signs, particularly in the north and south of		Noted and amended.

Condition Number	Condition	Has the condition been met?	Comments (Gaps in information, improvements, adequacy of technical/ scientific information and assumption/justifications, etc.)	Relevant Sections (provided by GHD)	Response by Proponent to comments/issues
			the "NH2U Boambee SF offset area".		
			Figure 5 shows a 4WD track going through the north-west of the offset area. What management measures are being implemented to ensure that this does not increase the edge effect or decrease habitat quality near the road? Is it possible to restrict use of the 4WD tracks through the offset area to reduce the risk of human disturbance (i.e., collecting firewood, dumping rubbish, spreading weeds, lighting fires, etc)?		The four-wheel drive track shown in the north west of the offset area will not be maintained and has been removed from Figure 5. It is not proposed to restrict public access to the Flora Reserve. Based on personal observations and discussions with FCNSW and neighbours to the site public visitation rates are very low. Funds have been set aside to monitor and manage potential impacts of human visitation such as rubbish dumping. Gates and fencing are unlikely to ever be 100% effective against illegal dumping or arson.
			Public access is permitted in the State Forest. As rubbish has been identified on the offset site, it is considered likely that public access will continue to reduce the value of the offset. The Department considers that a few signs noting restricted activities are unlikely to be effective. As the flora reserve is proposed as an offset area under different legislation, please set out whether restricted public access is appropriate or proposed.		As above, it is not proposed to restrict public access to the Flora Reserve. Based on personal observations and discussions with FCNSW and neighbours to the site, public visitation rates are very low. The dense vegetation and steep topography is likely to continue to limit access. Funds have been set aside to monitor and manage potential impacts of human visitation such as rubbish dumping. Gates and fencing are unlikely to ever be 100% effective against illegal dumping or arson.
			Under the 'Property Maintenance' subheading in Section 4.2.2, it is proposed that different management actions be required in the offset area and the remainder of the Boambee SF offset site. Please detail how it will be ensured that those implementing the different		As stated in Section 4.2.1 'Management actions have been identified based on the ecology of <i>Marsdenia longiloba</i> and <i>Tylophora woolfsii</i> , known threats to populations and habitat and the current site conditions at the NH2U Boambee SF offset area. These management

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			management practices in the adjoining areas do so effectively. For example, if invasive species management measures are less stringent (with lower performance indicators) in one area, this could have a negative impact on adjoining offset areas.		actions will be applied across the entire Boambee SF offset site once it is included in offset package(s) for other projects and would be coordinated with FCNSW management of adjoining State forests'. The performance indicators for common management actions, such as weed control, will be consistent between offset areas. The reference in Section 4.2.2 ('Other management activities that would occur in the Boambee SF offset site, but outside the NH2U Boambee SF offset area, would be included in separate offset packages and management plans linked to other projects') refers to management actions that do not apply to the threatened plants e.g. pest carnivore control, monitoring of threatened fauna populations etc.
			Please consider inspecting fences more frequently than annually, particularly along the section of the offset area to the south which appears to be adjacent to private agricultural land. Please change or justify not monitoring this fence line regularly.		This action has been modified to include routine inspection during other activities and additional inspection as required after bushfires, extreme weather, flooding etc. Annual dedicated monitoring is likely to be sufficient to ensure the integrity of fences.
			Conservation and improvement of habitat Section 4.2.2, mentions that treatment of Lantana will be required in the first 2 years. The spread of weeds is likely to continue after 2 years as it is proposed that the tracks (including 4WD and foot tracks) remain in use, and sections of the		The initial two years of treatment is proposed to manage the current mapped infestations of Lantana. Ongoing treatment of Lantana and other weeds will occur after year 2 under the management action 'Broad scale weed monitoring and bush regeneration'.

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			offset adjoin grazing pastures. Will treatment of Lantana be implemented after 2 years if required?		
			Weed management measures are proposed to “comprise targeted treatment of weeds in the immediate vicinity of identified stems”. Please clarify what constitutes the immediate vicinity and provide a specific distance or range. Will all weed species be subject to removal?		It means a 2m radius of identified stems of <i>Marsdenia longiloba</i> and <i>Tylophora woollsii</i> . This detail has been added to the TFOMP. All weeds species will be removed i.e. noxious and environmental weeds.
			The last paragraph under the ‘Conservation and improvement of habitat’ subheading mentions weed control occurring around locations of threatened plants shown in Figure 4 and in areas shown in Figure 5. If previously unmapped threatened plants are identified, will weed control occur around them too? Please revise this paragraph to include areas of weeds identified during broad-scale monitoring.		The paragraph in question says: “Weed control would be conducted with reference to the locations of weed infestations shown on the property action plan (see Figure 5). Weed control would also consider the locations of threatened plants shown on Figure 4 and/or the results of the monitoring program outlined in Section 4.3. “. Table 4 also states that the activity ‘Targeted threatened plant monitoring and bush regeneration of occupied habitat’ will be applied to ‘Occupied habitat in the vicinity of threatened plants shown on Figure 4 and any additional threatened plants identified during monitoring rounds’.
			Please define the vicinity around threatened plants in which weed spraying will not occur. Could targeted herbicide application affect Clear MilkVine or Cryptic Forest Twiner if implemented too close?		It means a 2m radius of identified stems of <i>Marsdenia longiloba</i> and <i>Tylophora woollsii</i> . This detail has been added to the TFOMP. Targeted herbicide application as proposed in the TFOMP (cut and paint, stem scrape etc.) would not affect Clear MilkVine or Cryptic Forest Twiner unless herbicide was applied directly

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					to the threatened plants, which is not a risk with these application techniques.
			Pest fauna control Please clarify how often evaluation of feral animals will be undertaken to determine if pest fauna control is required.		As stated in the 'timeframe' column in Table 4 "Monitoring, followed by a pest fauna control round, at least once every two years or as required, for a minimum of 20 years." Also see 4.2.1 'management actions program' "Monitoring and pest fauna control rounds two-yearly or as required for a minimum of 20 years."
			Will group control programs be coordinated with adjoining properties?		Yes. See section 4.2.2.
			Table 4- Management Actions Specific and measureable triggers are required for all corrective actions, as well as quantifiable performance targets where possible.		
			Please consider the erection of more signs.		Noted and amended.
			Fence and sign maintenance will be ongoing as required. Please detail how long will it take to implement the corrective action once a problem is identified.		The performance targets that have been set are outcomes based, as is appropriate for an adaptive management framework. It is not appropriate to set specific, quantifiable targets in this context e.g. if a fence is broken the time taken to fix it will depend on the length of fence requiring repair, topography, magnitude of damage (which could range from a few metres of broken strands to an entire fence line being burnt out in a wildfire) etc. Repairs and other corrective actions will be undertaken as soon as is practicable to ensure

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					performance targets are met.
			Please consider undertaking fence line inspections more regularly (i.e., monthly or quarterly).		This action has been modified to include routine inspection during other activities and additional inspection as required after bushfires, extreme weather, flooding etc. Annual dedicated monitoring is likely to be sufficient to ensure the integrity of fences.
			Roads that are not required for management purposes will be closed. Will they be rehabilitated? Please indicate which roads will be closed.		The roads in question are poorly formed and defined snig tracks associated with previous timber harvesting at the site. There is no spatial data associated with these tracks and they are not visible on aerial photos. It is not practical to indicate their specific locations. These tracks already feature native regeneration. No additional, active rehabilitation is proposed.
			Will maintenance of access tracks occur more often than annually if required?		Yes, additional maintenance as required to achieve performance targets. The TFOMP has been updated accordingly.
			Please clarify what management measures will be implemented to prevent weeds returning to the offset site once eradicated, especially due to vehicles and in areas adjoining livestock pastures.		See 'Broad scale weed monitoring and bush regeneration' in Table 4.
			Table 4 refers to target threatened plant monitoring and bush regeneration of occupied habitat as shown in Figure 4. If threatened plants are identified at other locations, will these be mapped and managed in the same manner?		Section 4.2.2: "Weed control would be conducted with reference to the locations of weed infestations shown on the property action plan (see Figure 5). Weed control would also consider the locations of threatened plants shown on Figure 4 and/or the results of the monitoring program outlined in

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					<p>Section 4.3. “.</p> <p>Table 4 states that the activity ‘Targeted threatened plant monitoring and bush regeneration of occupied habitat’ will be applied to ‘Occupied habitat in the vicinity of threatened plants shown on Figure 4 and any additional threatened plants identified during monitoring rounds’.</p>
			<p>The activity details for this management action only specifies weed control measures. Please provide more information on bush regeneration activities and plant monitoring. What factors will be considered, especially in relation to plant health?</p>		<p>‘Bush regeneration’ is the application of weed control measures. No supplementary planting is proposed because the threatened plant habitat already contains mature native vegetation.</p> <p>Plant monitoring is described in Section 4.3.2. Additional detail has been added to this Table 4 and Section 4.3.2 as described in the responses to other comments below.</p> <p>Please note that there is limited potential for specific monitoring of plant health given:</p> <ul style="list-style-type: none"> - both species routinely die back to below ground tissue as part of their natural life cycle as described in section 2.2.3 and 2.2.4. - management intervention cannot possibly address the range of potential causal factors for an episodic decline in health in a wild population of threatened plants in a natural environment (e.g. climatic variation, natural herbivory etc). <p>The management and monitoring will</p>

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					focus on maintaining a resident population of the threatened plants, maintaining the overall area of occupied habitat and managing known threats such as weeds.
			Measurable and specific performance targets are required for all weed control measures, particularly when referring to suppression of weeds as a performance target. Please commit to weed control in either spring or autumn. When will the 2 control rounds for noxious weeds be undertaken?		Control rounds will occur in Spring. Additional detail comprising activity details, performance targets and corrective actions have been added to Table 4 and Section 4.2.2 and a weed management plan has been added as Appendix B.
			Please provide corrective actions to be implemented if plant health decreases or the overall abundance and distribution declines.		<p>Table 4 has been amended to include additional corrective actions. Please note that there is limited potential for specific, measureable performance targets or corrective actions for plant health and abundance given:</p> <ul style="list-style-type: none"> - both species routinely die back to below ground tissue as part of their natural life cycle as described in section 2.2.3 and 2.2.4. - management intervention cannot possibly address the range of potential causal factors for an episodic decline in health in a wild population of threatened plants in a natural environment (e.g. climatic variation, natural herbivory etc). <p>The management and monitoring will focus on maintaining a resident population of the threatened plants,</p>

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					maintaining the overall area of occupied habitat and managing known threats such as weeds.
			More detail is needed about the 5 monitoring/control rounds of occupied habitat. Is this once a year? Will it continue past 2020 if the outcomes of the plan have not been met?		As stated in Table 4 'Additional monitoring and control rounds as required to achieve performance targets.' Section 4.2.1 has been amended to make it clearer that monitoring is proposed for a minimum of five years because five years is the 'Offset calculator – Time horizon – Time until ecological benefit' value that was entered in the Offset assessment guide calculations and so this is the critical period after which it is necessary to confirm that the biodiversity offset has been delivered as planned. If the performance targets are not met after five years then the program will be extended. Section 5 has been expanded to make this clearer.
			Broad scale weed monitoring and bush regeneration does not mention bush regeneration activity details, performance targets or corrective actions.		Additional detail comprising activity details, performance targets and corrective actions have been added to Table 4 and Section 4.2.2 and a weed management plan has been added as Appendix B.
			Please provide methodologies for broad scale weed monitoring and control. Will areas of weeds be identified through transect surveys?		Additional detail comprising the methodology for bush regeneration activities has been added to Section 4.2.2 and a weed management plan has been added as Appendix B. Areas of weeds will be identified through systematic walked transects across the site and observations during all time spent on site completing treatment.
			Please consider increasing the		The frequency of feral animal

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			frequency of feral animal monitoring and control. Measurable and specific performance targets and triggers are required. What time of year will the pest fauna control and monitoring occur?		<p>monitoring and control has been determined in consultation with the Local Land Services control officer and designed to coordinate with their existing programs. It is not practical to set measurable and specific performance targets and triggers for populations of mobile, feral animals in an area of dense vegetation on steep terrain.</p> <p>Pest fauna control will be conducted as part of group control programs, coordinated with activities in the State forest estate and neighbouring private properties. As such, the time of year of pest fauna control will vary depending upon when other programs are proposed.</p>
			Corrective actions to be implemented if fire threatens or enters the occupied habitat are required. What will be done if it impacts on threatened plants?		<p>The fire management strategy is to exclude fire from occupied threatened plant habitat. Wildfire would only affect threatened plants if it occurred as a result of events outside of the control of FCNSW as land manager.</p> <p>There are no practical corrective actions that could be implemented after a threatened plant population has been affected by wildfire.</p>
			<p>A performance target and corrective action is required for natural regeneration and for if it does not progress as planned.</p> <p>Specific and measurable performance targets are required for general conservation, maintenance and monitoring activities. What are the performance targets for vegetation and habitat condition, and what corrective actions will be</p>		<p>Performance targets and corrective actions have been added to Table 4.</p>

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			implemented once a specific trigger has been reached?		
			Management actions are required for erosion and extreme weather events (i.e., drought, floods).		A management action has been added for erosion as a sub category within 'General conservation, maintenance and monitoring' in Table 4. 'Severe weather events' are beyond the control of a land manager and cannot be realistically included in an adaptive management framework.
			A corrective action to be implemented if the offset area is accidentally logged by Forestry (e.g., map misinterpreted) is required.		Noted and added.
	demonstration that any management actions to be undertaken will not adversely impact EPBC species (for example, this may apply to herbicide usage);	Partial	Section 4.2.1 demonstrates how weed management and the exclusion of logging and grazing is likely to increase habitat quality.		
			Proposed management actions are unlikely to have an adverse impact on Clear Milkvine or Cryptic Forest Twiner (Section 4.2.3). As mentioned in the comments above, more detail is required on what is meant by "in the vicinity of threatened flora species".		2m radius of stems as described above.
	a description of funding arrangements or agreements including work programs and responsible entities;	Yes	FCNSW will be funded to monitor and manage the offset site in accordance with the Threatened Flora Offset Management Plan once approved (Section 4.2.1).		
	an assessment of the baseline population and distribution for Clear Milkvine and Cryptic Forest Twiner within the offset, including: the number of plants protected and their location;	No	A comprehensive survey of the offset area was undertaken over 6 days in May 2015 (Sections 1.3.3, 3.4).		

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	plant and habitat condition; and		The offset area contains 120 Clear Milkvine stems and 24 Cryptic Forest Twiner stems (Section 3.5), with their locations depicted in Figure 4		
	age classes.		More information on plant condition and age classes is required.		Age class and health of observed stems has been added to Appendix A based on field survey notes.
			ACTION: Section 2.3.3 states that some previously translocated plants that were thought to be Clear Milkvine were later identified as Cryptic Forest Twiner once they flowered.		
			Cryptic Forest Twiner flowers January to April and the Clear Milkvine flowers in summer. As both species can be difficult to identify, is it possible that some individuals were not correctly classified due to the survey being undertaken outside of flowering season?		It is highly likely. It was not possible to conduct targeted surveys at the Boambee SF during the flowering period for both species because of the time it took to inspect candidate offset sites as part of the delivery of the TFOS. The surveys were undertaken by Dr Andrew Benwell and other specialist botanists and we collectively made our best attempt to discriminate between the two plant species based on vegetative characteristics. As clearly stated in Sections 2.2 and 2.3, throughout the TFOMP and in the SPRAT profiles for both species they very rarely flower or set fruit. Dr Andrew Benwell, a recognised expert on both species has seen <i>Marsdenia longiloba</i> flower in the wild on only a few occasions and has never seen <i>Tylophora woollsii</i> flower, despite several years of targeted monitoring. As also clearly stated in Sections 2.2 and 2.3 and throughout the TFOMP the species share the same habitat

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					requirements and one set of Offset assessment guide calculations was performed for both species based on the species with the higher conservation significance and based on areas of shared habitat.
			Table 2 attributes 1.52 ha of dry sclerophyll forest and 2.07 ha of rainforest towards the total habitat available for Clear Milkvine and Cryptic Forest Twiner. Impact on these species in the project area was restricted to only include areas within wet sclerophyll forests, on slightly sloping southerly aspects. Please justify including dry sclerophyll forest and rainforest as suitable habitat in this instance.		No - Table 2 lists the areas of vegetation types in the NH2U Boambee SF offset area (total area 49.35 ha) NOT the area of occupied habitat for Clear Milkvine and Cryptic Forest Twiner. Habitat for these species is discussed separately in Section 3.4. The area of habitat was confirmed through observation of stems of the threatened plants within the mapped area of occupied habitat (see Figure 4) combined with direct observation of the habitat in question, and confirmation of its suitability, by Dr Andrew Benwell. As discussed in responses to the DoEEs comments on the TFOS the area of loss of potential habitat for the affected threatened plants is also based on the area of occupied habitat observed by Dr Benwell during surveys of the impact area.
			Please consider providing a map as included in the Threatened Flora Offset Strategy (Figure 2b) highlighting suitable habitat within the offset area in terms of southerly aspects between 112 and 220 degrees and encompassing wet sclerophyll forest.		Not appropriate. The map included in the TFOS was the result of a broad GIS based approach to identifying potentially suitable habitat within a study area of hundreds of thousands of hectares (i.e. it shows modelled threatened plant habitat). Figure 4 in the TFOMP shows actual, occupied threatened plant habitat as confirmed through targeted field surveys and direct observation of the habitat in question by Dr Andrew Benwell.

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			The second sentence of the paragraph starting “Additional areas of ‘potential...’ (Section 3.4) does not make sense. Please consider rewording.		Reworded.
			Please justify the potential/poorer quality habitat being nominated as a buffer (Section 3.4) as it does not surround the offset area as depicted in Figure 4		The potential/poorer quality habitat in question was not purposefully created as a buffer, it was merely observed, and so it could not be tailored to fully surround the occupied habitat. Nonetheless where it occurs adjacent to occupied habitat it would act as a buffer between this habitat and cleared land or harmful activities. This section has been amended to make it clearer that only a portion of the occupied habitat would benefit from the buffer.
			Section 3.4 indicates that 4 of the 5 plots had 4% - 8% weed cover and one had 23% weed cover. However, the offset area was given an overall habitat quality score of 7/10. Please justify all habitat within the offset area being rated with the same start quality despite notable differences.		The start quality score was calculated based on assessment of ‘Site condition’, ‘Site context’ and ‘Species stocking rate’ in accordance with the EPBC act offset policy and associated guidance documents. The degree of weed infestation is just one input to one of these three factors (site condition) along with vegetation type, microclimate etc. The plots were stratified across the occupied habitat to sample the range of variation in attributes contributing to site condition. A 15% difference in weed cover as one of ten attributes sampled in plot/transects, which is in turn one of the various factors contributing to ‘site condition’, which in turn is one of three factors that make up the site quality score, does not warrant a separate set of offset calculations.

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			Section 3.5 refers to the offset assessment guide calculations in "Section 0". Is this meant to be Section 5.3.3?		Section 5.6
			Habitat condition has been mentioned but not plant condition specifically. Please provide information on the condition of identified Clear Milkvine and Cryptic Forest Twiner and approximate age classes.		Age class and health of observed stems has been added to Appendix A based on field survey notes.
	measures for regular monitoring of the status of individuals of Clear Milkvine and Cryptic Forest Twiner and their habitat as measured against the baseline population and distribution, including:	No	Fluctuations in population size and distribution will be monitored annually (Section 4.3.2).		
	fluctuations in population size and distribution;		The effectiveness of management measures will be assessed using photo point monitoring. Vegetation and habitat assessments will monitor habitat requirements (Section 4.3.3). More information is required as described below.		
			ACTION: Please propose ongoing monitoring sites to determine that the impact of edge effects does not increase and therefore reduce habitat quality. Do Plots 2 and 4 encompass the areas impacted by edge effect?		Plot/transect 1 traverses a fire trail and includes some edge affected vegetation (though the effect is minor and very localised). Plot/transect 2 includes some edge affected vegetation. Plot/transect 4 samples an area that is severely affected by Lantana infestation.
	response to disturbances and/or management actions.		Threatened flora populations will be monitored for at least 5 years. What will determine when the monitoring will stop? Please consider continuing monitoring after this period.		Additional detail has been included in Section 4.3.2. Five years is the 'Offset calculator – Time horizon – Time until ecological benefit' value that was entered in the Offset assessment guide calculations and so this is the critical period after

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					which it is necessary to confirm that the biodiversity offset has been delivered as planned. If the performance targets are not met after five years then the program will be extended by another year.
			Will evidence of feral animals be noted?		Yes, see section 4.3.
			To improve comparability and strengthen results, please commit to doing the threatened flora monitoring during a specific month each year, preferably during flowering of the listed species		As stated above and in sections 2.2.3 and 2.3.3, both species flower very infrequently in the wild. 'February' has been nominated as the survey month for consistency.
			Please specify how plant/stem health is assessed. How subjective is it?		By necessity, it is subjective and will need to be subjectively considered at the population scale. As clearly stated in Sections 2.2 and 2.3 and in the SPRAT profiles for both species they routinely die back to underground tissue as part of their natural life cycles.
			More information is required on photopoint monitoring. Will the photos be taken in north, south, east and west directions at each of the 5 locations?		Baseline photo point monitoring results have been added as Appendix B. Photos will be taken in a single direction, along the bearing of the transect. Bearings are listed in Appendix B.
	habitat requirements; and		Please provide a specific month of the year when vegetation and habitat monitoring will occur.		October has been nominated (see Section 4.2.1).
			To measure progress against the baseline conditions please employ similar survey methods. Please consider providing measurable and comparable data obtained through BioBanking surveys as initially undertaken to provide baseline conditions.		Re-sampling of plot/transects has been included in the proposed vegetation and habitat monitoring in Section 4.3.3

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			Please specify the time of year that pest fauna will be monitored and provide a map showing the locations of camera traps and other monitoring methods that will be implemented.		Pest fauna monitoring will be implement by experienced specialist sub-contractors in consultation with Local Land Services. Precise locations and techniques for monitoring pest fauna will be established by these specialists. Further, pest fauna are mobile, cryptic and irruptive and fixed monitoring points are unlikely to be an effective management measure.
	life-cycle patterns;		Please elaborate on how life-cycle patterns are being monitored.		As stated in Section 2.2.3 and 2.3.3 both of the threatened plant species: May die back to the rhizome and remain stem-less and dormant for at least two years. Very rarely flower or set seed. Appear to rely on vegetative reproduction for population persistence with flowering and seed dispersal playing a minor role. Consist of sub-populations which originate vegetatively from the same parent plant and spread over a considerable area. Given these features of the life history of the affected threatened plants it is not practical or achievable to monitor their life cycle patterns. As stated throughout the TFOMP the offset calculations are based around conserving and managing an area of occupied habitat.
	provisions to revise the approved TFOMP in response to the findings of research associated with condition 20 (h).	No	ACTION: Please specify where in Section 4.3 provisions to revise the Plan in response to findings have been detailed.		Added to Section 4.3.1.
			Section 3.5 refers to the offset		Section 5.6

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			assessment guide calculations in "Section 0". Is this meant to be Section 5.3.3?		
			Habitat condition has been mentioned but not plant condition specifically. Please provide information on the condition of identified Clear Milkvine and Cryptic Forest Twiner and approximate age classes.		Age class and health of observed stems has been added to Appendix A based on field survey notes.
	measures for regular monitoring of the status of individuals of Clear Milkvine and Cryptic Forest Twiner and their habitat as measured against the baseline population and distribution, including:	No	Fluctuations in population size and distribution will be monitored annually (Section 4.3.2).		
	fluctuations in population size and distribution;		The effectiveness of management measures will be assessed using photo point monitoring. Vegetation and habitat assessments will monitor habitat requirements (Section 4.3.3). More information is required as described below.		
			ACTION: Please propose ongoing monitoring sites to determine that the impact of edge effects does not increase and therefore reduce habitat quality. Do Plots 2 and 4 encompass the areas impacted by edge effect?		Plot/transect 1 traverses a fire trail and includes some edge affected vegetation (though the effect is minor and very localised). Plot/transect 2 includes some edge affected vegetation. Plot/transect 4 samples an area that is severely affected by Lantana infestation.
	response to disturbances and/or management actions.		Threatened flora populations will be monitored for at least 5 years. What will determine when the monitoring will stop? Please consider continuing monitoring after this period.		Additional detail has been included in Section 4.3.2. Five years is the 'Offset calculator – Time horizon – Time until ecological benefit' value that was entered in the Offset assessment guide calculations and so this is the critical period after which it is necessary to confirm that

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					the biodiversity offset has been delivered as planned. If the performance targets are not met after five years then the program will be extended by another year.
			Will evidence of feral animals be noted?		Yes.
			To improve comparability and strengthen results, please commit to doing the threatened flora monitoring during a specific month each year, preferably during flowering of the listed species		As stated above and in sections 2.2.3 and 2.3.3 both species flower very infrequently in the wild. 'February' has been nominated as the survey month for consistency.
			Please specify how plant/stem health is assessed. How subjective is it?		By necessity, it is subjective and will need to be subjectively considered at the population scale. As clearly stated in Sections 2.2 and 2.3 and in the SPRAT profiles for both species they routinely die back to underground tissue as part of their natural life cycles.
			More information is required on photopoint monitoring. Will the photos be taken in north, south, east and west directions at each of the 5 locations?		Baseline photo point monitoring results have been added as Appendix B. Photos will be taken in a single direction, along the bearing of the transect. Bearings are listed in Appendix B.
	habitat requirements; and		Please provide a specific month of the year when vegetation and habitat monitoring will occur.		October has been nominated (see Section 4.2.1).
			To measure progress against the baseline conditions please employ similar survey methods. Please consider providing measurable and comparable data obtained through BioBanking surveys as initially undertaken to provide baseline conditions.		Re-sampling of plot/transects has been included in the proposed vegetation and habitat monitoring in Section 4.3.3
			Please specify the time of year that		Pest fauna monitoring will be

Condition Number	Condition	Has the condition been met?	Comments (Gaps in information, improvements, adequacy of technical/ scientific information and assumption/justifications, etc.)	Relevant Sections (provided by GHD)	Response by Proponent to comments/issues
			pest fauna will be monitored and provide a map showing the locations of camera traps and other monitoring methods that will be implemented.		implement by experienced specialist sub-contractors in consultation with Local Land Services. Precise locations and techniques for monitoring pest fauna will be established by these specialists. Further, pest fauna are mobile, cryptic and irruptive and fixed monitoring points are unlikely to be an effective management measure.
	life-cycle patterns;		Please elaborate on how life-cycle patterns are being monitored.		<p>As stated in Section 2.2.3 and 2.3.3 both of the threatened plant species:</p> <ul style="list-style-type: none"> - May die back to the rhizome and remain stem-less and dormant for at least two years. - Very rarely flower or set seed. - Appear to rely on vegetative reproduction for population persistence with flowering and seed dispersal playing a minor role. - Consist of sub-populations which originate vegetatively from the same parent plant and spread over a considerable area. <p>Given these features of the life history of the affected threatened plants it is not practical or achievable to monitor their life cycle patterns. As stated throughout the TFOMP the offset calculations are based around conserving and managing an area of occupied habitat.</p>
	provisions to revise the approved TFOMP in response to the findings of research associated with condition 20 (h).	No	ACTION: Please specify where in Section 4.3 provisions to revise the Plan in response to findings have been		Added to Section 4.3.1.

Condition Number	Condition	Has the condition been met?	Comments (Gaps in information, improvements, adequacy of technical/ scientific information and assumption/justifications, etc.)	Relevant Sections (provided by GHD)	Response by Proponent to comments/issues
			detailed.		

GHD

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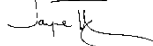
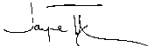

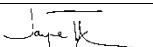
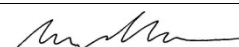
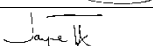
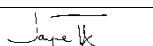
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2	B Harrington	J Tipping		B Harrington		6/10/16
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