ROADS AND MARITIME SERVICES

Princes Highway Upgrade - Foxground and Berry Bypass Project

BIODIVERSITY OFFSET PACKAGE

OCTOBER 2016

WSP | PARSONS BRINCKERHOFF

Princes Highway Upgrade - Foxground and Berry Bypass Project

BIODIVERSITY OFFSET PACKAGE

Roads and Maritime Services

Date: October 2016

REV	DATE	DETAILS
A	12/09/2016	Draft
B	7/10/2016	Update addressing review comments
C	12/10/2016	Final
D	14/10/2016	Revised final

AUTHOR, REVIEWER AND APPROVER DETAILS

Prepared by:	Tanya Bangel, Mark Stables	Date: 7/10/2016	Signature:	
Reviewed by:	Selga Harrington	Date 14/10/2016	Signature:	
Approved by:	Alex Cockerill	Date: 14/10/2016	Signature:	

WSP | Parsons Brinckerhoff
Level 3, 51-55 Bolton St
Newcastle NSW 2300
PO Box 1162
Newcastle NSW 2300

Tel: +61 2 4929 8300
Fax: +61 2 4929 8382

www.wsp-pb.com

Filename: 2267315A-ECO-REP-001 RevD

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS

BBAM	BioBanking Assessment Methodology 2014
BOP	Biodiversity Offset Package
BOS	Biodiversity Offset Strategy
CMA	Catchment Management Area
CoA	Conditions of Approval
DGRs	Director General's Requirements
DP&E	Department of Planning and Environment
DPI	Department of Primary Industries
EP&A Act	*Environmental Protection and Assessment Act 1979*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
FBA	Framework for Biodiversity Assessment
LGA	Local Government Area
Roads and Maritime	Roads and Maritime Services
The project	Princes Highway Upgrade – Foxground and Berry Bypass Project
TSC Act	*Threatened Species Conservation Act 1995*

1 INTRODUCTION

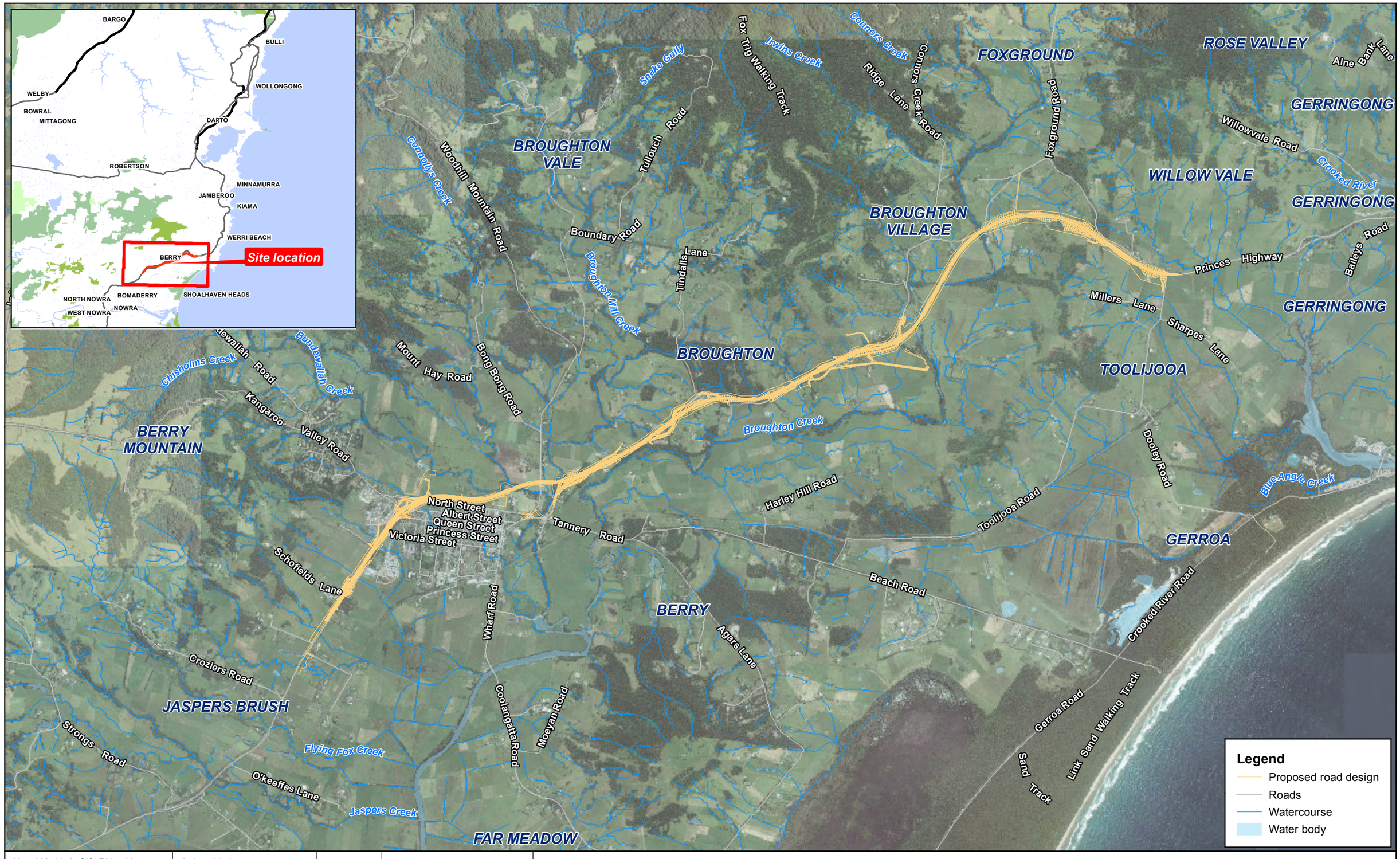
1.1 Project background

Roads and Maritime Services (Roads and Maritime) are currently upgrading 11.6 km of the Princes Highway between Toolijooa Road north of Foxground, to Schofields Land south of Berry (the project). The project is located within the Kiama and Shoalhaven Local Government Areas (LGAs). The resulting upgrade will be a four lane divided highway (two lanes in each direction) with median separation. The project includes bypasses of Foxground and Berry localities.

Terrestrial and aquatic biodiversity assessments (Biosis Research, 2012, Cardno Ecology Lab, 2012) which formed part of the project's Environmental Assessment (AECOM, 2012) were prepared in accordance with the Director General's Requirements (DGRs) to seek approval for the project under the now-superseded Part 3A of the (NSW) *Environmental Planning and Assessment Act 1979* (EP&A Act), as a transitional project. The reports examined the terrestrial and aquatic flora and fauna assemblages and their habitats within the study area and determined the worst case biological impacts of the construction and operation of the project. Additionally, they proposed mitigation measures and conducted assessments of significance required under the EP&A Act, *Threatened Species Conservation act 1995* (TSC Act), *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and the projects DGRs.

The biodiversity assessments (Biosis Research, 2012, Cardno Ecology Lab, 2012) identified that the project's study area mainly consisted of cleared areas and grazed paddocks that contained limited native vegetation generally occurring as remnants along creek lines and as small areas surrounded by cleared paddocks. The reports identified that the project would require the clearing of 30.4 hectares of vegetation, of which 28.2 hectares is comprised of native vegetation and 2.2 hectares is comprised of non-native vegetation (closed grassland / sedgeland). Of the native vegetation to be removed, approximately 25.3 hectares was considered non-threatened native vegetation that requires a 2:1 offset ratio. Approximately 2.9 hectares has been considered to form part of the threatened ecological community of River-flat Eucalypt Forest which is listed as Endangered under the TSC Act and required a 4:1 ratio offset.

Approval for the project was granted on 22 July 2013, under Part 3A of the EP&A Act with Conditions of Approval (CoA).



Map: 2267315A_GIS_F017_A2	Author: A Labruyere		0 500 1,000 m 1:40,000 Coordinate system: GDA 1994 MGA Zone 56 Scale ratio correct when printed at A3
Date: 30/08/2016	Approved by: M Stables		
Data source: © Land and Property Information 2015			

WSP | PARSONS BRINCKERHOFF

Foxground to Berry
Figure 1.1
Project locality

1.2 Foxground and Berry Bypass Project CoA

To satisfy the then Minster for Planning and Infrastructure's (now Department of Planning and Environment (DP&E)) CoA B7, Roads and Maritime was required to develop a revised Biodiversity Offset Strategy (BOS) to compensate for the removal of native vegetation. A revised BOS was prepared by Parsons Brinckerhoff (2014c), on behalf of Roads and Maritime which described the biodiversity offsets required to compensate for the identified residual impacts and in the medium to long term, improve ecological outcomes.

CoA B8 requires Roads and Maritime to develop and submit a Biodiversity Offset Package (BOP) for approval by the Director General within two years of the BOS date of approval (27 October 2014). A summary of Condition B8 and where in this report it has been address in outlined in Table 1.1.

Table 1.1 Condition B8 – Requirement for a biodiversity offset package

CONDITIONS OF APPROVAL (B8)	SECTION ADDRESSING CONDITION WITHIN BOP REPORT
Within two years of the date of approval of the Biodiversity Offset Strategy, unless otherwise agreed by the Director General, the Proponent shall prepare and submit a Biodiversity Offset Package for the approval of the Director General.	Section 6.1
The Package shall be developed in consultation with the OEH and DPI (Fishing and Aquaculture).	Section 4.2
Details of the final suite of the biodiversity offset measures to be implemented for the project demonstrating how it achieves the requirements of the Biodiversity Offset Strategy (including specified offset ratios).	Section 2.1, Section 2.2 and Section 4
The final selected means of securing the biodiversity values of the Package in perpetuity, including ongoing management, maintenance and monitoring requirements.	Section 4.5
Timing and responsibilities for the implementation of the provisions of the Package over time.	Section 4.5

Condition B7 specifies offset ratios dependent on the conservation status of the impacted habitat type. Specifically, Condition B7 details that:

> *'offsets shall be provided on a like-for-like basis and at a minimum ratio of 4:1 for areas of high conservation value (including EEC, salt marsh and poorly conserved vegetation communities identified as being more than 75% cleared in the catchment management authority area) and 2:1 for the remainder of native vegetation areas (including threatened species habitat, mangroves, seagrass and non-ECC riparian vegetation)*'.

The prescribed offset ratios in the CoA generally fall within the range that would be required for other offsetting policies such as the DPI policy and Roads and Maritime offset policy.

The BOS was quantified in accordance with CoA B7 which specified ratios for offsetting. Determining offsets by using BioBanking, NSW Biodiversity Offsets Policy for Major Projects and/or Framework for Biodiversity Assessment (FBA) was not required.

As the offsetting requirements have been set by the CoA and BOS, no detailed BioBanking Assessment Methodology (BBAM) calculations have been undertaken to quantify the project's impacts or offset requirements. BBAM calculations are not considered to be required given that offset ratios have been prescribed. This consideration has been confirmed during consultation with OEH for this project.

Notwithstanding, all offset sites will be fully funded and managed through the establishment of BioBanking agreements and as such BBAM and credit calculations have been completed for all offset sites.

1.3 Biodiversity offset policy and guidelines

The project was assessed under the now-superseded Part 3A major projects planning framework. The policy landscape that has guided the biodiversity offset identification process has changed multiple times since the projects assessment as outlined in Table 1.2. The policies relevant to the BOS and BOP are confirmed below.

In order to address the project's CoA, this BOP has been developed with reference to (refer to Table 1.2 for more details):

- The NSW OEH *Principles for the use of biodiversity offsets in NSW* (Department of Environment and Climate Change, 2008)
- Project's CoA (B7) which identify specific ratios required for offsetting impacted vegetation on a like-for-like basis
- The *Princes Highway Upgrade – Foxground and Berry Bypass Project – Biodiversity Offsets Strategy* (Parsons Brinckerhoff, 2014c).
- Although not required, the BOP has also been developed in consideration of:
  - *The BioBanking Assessment Methodology (BBAM)* (Office of Environment and Heritage, 2014a)
  - *Framework for Biodiversity (FBA)* (Office of Environment and Heritage, 2014b)
  - The NSW OEH *Biodiversity Offsets Policy for Major Projects* (Office of Environment and Heritage, 2014b)
  - DPI *Policy and guidelines for fish habitat conservation and management* (Department of Primary Industries, 2013)
  - Roads and Maritime Guidelines for Biodiversity Offsets (Roads and Maritime, 2011).

Table 1.2 Legislative and policy landscape changes

NSW POLICY REQUIREMENT	DATE OF ISSUE	QUALITATIVE OR QUANTITATIVE APPROACH?	GENERAL APPROACH OF POLICY	APPLICATION TO PROJECT
Principles for the use of biodiversity offsets in NSW	2008	Qualitative / BioBanking only considered by regulators on case by case to quantify project offset requirements.	Subjective assessment of a project's offsets against broad principles. Endorsed by both OEH and DPI.	Identified in CoA as the offsets policy to be addressed for the project
NSW Offset Principles for Major Projects	Draft 2011, 2013	Quantitative approach to impacts, BioBanking preferred by regulators. Provides flexibility to SSI projects including potential for discounting.	Use of BioBanking to quantify project offset requirements. Subjective assessment potential discounting of offset requirements for SSI projects against variation criteria. Minimum ration set at 2:1. The draft policy was only endorsed by OEH but mandatorily adopted by the DPI.	Not required as not specified in CoA. However, these principles have been referred to when developing the criteria for ranking preferred offsets.
Roads and Maritime Guideline for Biodiversity Offsets	November 2011	Qualitative / BioBanking as required.	Internal Roads and Maritime policy that outlines steps to determine when offsets are required and then outlines approach to take when offsets are required.	Requirements generally considered in the BOS.
DPI Policy and guidelines for fish habitat conservation and management	Update 2013	Qualitative and quantitative	No net loss. Minimum 2:1 generally, 10:1 for SEPP 14 impacts.	Requirements generally considered in the BOS.
NSW Biodiversity Offsets Policy for Major Projects	March 2014 (Draft), September 2014 (Final)	Quantitative, mandatory use for BioBanking to quantify offset requirements.	Provides for the discounting of offset requirements, under strict exemptions. Policy is endorsed by all NSW government departments. Provides greater flexibility to purchasing land offsets including providing for increased consideration of supplementary measures (indirect offsets) and the ability to pay funds onto new NSW Biodiversity Offsets Fund for Major Projects (the fund).	Not required as not specified in the CoA. However, relevant aspects generally considered in BOS.

1.4 Biodiversity offset package objectives

This report details the final biodiversity offset package for the project. This BOP builds on and importantly improves on the conservation outcomes of the proposed offset options by:

- Addressing the CoA relevant to the BOP (CoA B8)
- Providing for the acquisition of a substantial area of biodiversity offsets within proximity to the project (i.e. Kiama and Shoalhaven LGAs)
- Targeting the preservation of the specific endemic communities of the area (including River-flat Eucalypt Forest threatened ecological community).

The overall objective of this BOP is to detail the ecological values that will result from the project and how these impacts will be offset. Specifically, this BOP aims to:

- prepare a BOP in accordance with the project's CoA Condition B8, the approved BOS and in consideration of relevant NSW policies and guidelines
- compare the project and BioBanking sites to demonstrate that the BioBanking sites are appropriate to offset impacts of the project, including reference to the Principles for the use of biodiversity offsets in NSW (Department of Environment and Climate Change, 2008)
- provide a net gain in local conservation of important vegetation in consultation with the local community and relevant government regulators
- apply BioBanking Assessment Methodology (BBAM) to each selected offset site to enable BioBanking agreements to be established
- determine the management and monitoring requirements for biodiversity offset measures proposed to ensure outcomes of the package are achieved
- propose a timeframe for securing the required credits in perpetuity and their retirement.

2 FOXGROUND AND BERRY BYPASS PROJECT OFFSET REQUIREMENTS

The project's biodiversity assessments (Biosis Research, 2012, Cardno Ecology Lab, 2012) outline the ecological impacts associated within the project. The BOS (Parsons Brinckerhoff, 2014c) provides the details of the required offsets for the project in accordance with the CoA. This section provides a summary of the offset requirements required by the project.

2.1 Vegetation community types required to be offset

As outlined earlier in Section 1.2, the project's CoA specifically prescribe offset ratios based on the type of vegetation that is being impacted. Impacts to vegetation of high conservation value (including threatened ecological communities and poorly conserved vegetation communities identified as being more than 75% cleared in the catchment management area) be offset at a ratio of 4:1, whilst impacts to the remaining native vegetation types are to be provided at a ratio of 2:1.

A summary of the extent of each vegetation community to be impacted upon by the project and the subsequent offsets required are provided in Table 2.1.

Table 2.1 Summary of vegetation to be impacted and BBAM ecosystem credits required to offset impacts

VEGETATION COMMUNITY – FROM BIODIVERSITY ASSESSMENT	THREATENED ECOLOGICAL COMMUNITY	CLOSEST PCT/BIOMETRIC CODE, OVER 75% CLEARED IN SOUTHERN RIVERS CMA?	OFFSET RATIO	AREA TO BE IMPACTED	REQUIRED OFFSET AREA (ha)
Closed grassland / sedgeland	-	-	2:1	2.2	4.4
Constructed wetland	-	PCT781 / BVT SR536, no	2:1	0.4	0.8
Disturbed riparian open woodland	-	PCT 694 / BVT SR516, no	2:1	2.6	5.2
Illawarra gully wet forest	-	PCT 694 / BVT SR516, no	2:1	15.4	30.8
Riverbank forest	River- Flat Eucalypt Forest (Endangered under TSC Act)	PCT 1105 / BVT SR606, no	4:1	2.9	11.6
Warm temperate layered forest	-	PCT 1245 / BVT SR652 no	2:1	6.9	13.8
Total			**-**	**30.4**	**66.6**

As detailed in the BOS, the disturbed vegetation 'Closed Grassland' identified by Biosis Research (2012) was confirmed to not be a native plant community in consultation with OEH and therefore does not require offsetting. Therefore this community has not been included in this BOP. In addition, the 'Currumbene-Batemans lowland forest' which was recorded within the development impact areas was not included in the BOS as Biosis Research indicated that only 0.0002 ha was likely to be impacted upon, a negligible figure (Parsons Brinckerhoff, 2014c).

2.2 Threatened species considerations

Nine threatened fauna species were recorded for the project (Biosis Research, 2012) all of which are highly mobile species of bats and birds that would be expected in a highly modified landscape. The threatened species recorded included:

- Yellow-bellied Sheathtail Bat
- Eastern Freetail Bat
- Grey-headed Flying-fox
- Eastern Bentwing-bat
- Eastern False Pipistrelle
- Southern Myotis
- Greater Broad-nosed Bat
- Gang-Gang Cockatoo
- Powerful Owl.

Impact mitigation and habitat supplementation measures of relevance to these species, such as installation of nest boxes, is currently being implemented following the *Nest Box Management Plan* (Parsons Brinckerhoff, 2014a) and monitored as part of the project's Ecological Monitoring Program.

As part of preparing this BOP the process of identifying and selecting adequate offsets parcels considered the vegetation type requirements of these and other species identified as having potential to be impacted by the project. It is considered that the preservation of the required vegetation types would be sufficient for the relevant threatened species affected by the project.

3 IDENTIFICATION OF BIODIVERSITY OFFSETS

3.1 Biodiversity offset strategy

The BOS was developed in consultation with the OEH, DPI, local government authorities, landcare groups and the broader community. Based on consultation with OEH the following project specific offset strategies were initially assessed:

- land acquisition and dedication to local council and/or inclusions in the national reserve estates
- BioBanking – purchase of biodiversity credits
- monetary contribution to land management for conservation
- restoration of local riparian restoration by Roads and Maritime.

The BOS was submitted and approved in 2014 detailing the preferred biodiversity offset options as being the purchase of biodiversity credits as part of the BioBanking Scheme. Another suitable mechanisms identified was land acquisition and dedication to local council and/or inclusion in the national reserve estates.

Both these options are discussed in more detail below.

3.2 Land acquisition and dedication to local council and/or inclusions in the national reserve estates

As part of the overall project, Roads and Maritime have undertaken a number of land acquisitions for construction purpose. A number of these properties contain areas of remnant native vegetation. All properties acquired for the project have been considered in terms of potential biodiversity offset options although none directly adjoin Council conservation reserves or national reserve estates and as such dedication of the land is not considered a viable offset option. Given this, properties that are considered to exhibit suitable biodiversity attributes, that are compatible with the BOS, have been included within the option of establishment and purchase of biodiversity credits under the NSW BioBanking Scheme.

3.3 Establishment and purchase of biodiversity credits under the NSW BioBanking scheme

The BioBanking Scheme enables a proponent to offset the biodiversity impacts of a proposed development by buying and retiring biodiversity credits. The Principles for the use of Biodiversity Offsets in NSW, project's CoA and other offsetting policies require offsets to be located appropriately i.e. include the same vegetation type or formation and to occur within the same catchment management area (CMA).

To allow the conversion of offset ratios, the BioBanking characteristics of the study area were determined and are summarised below in Table 3.1.

Table 3.1 Criteria of the study area relevant to BioBanking

CRITERIA	LOCATION
Council	Kiama Municipal Council and Shoalhaven City Council
Bioregion	Sydney Basin
Catchment Management Authority	Southern Rivers

CRITERIA	LOCATION
Vegetation community (and formation) to be cleared	PCT 781 / BVT SR536 Coastal freshwater wetland (Constructed wetland)
	PCT 694 / BVT SR516 - Blackbutt - Turpentine – Bangalay moist open forest on sheltered slopes and gullies, southern Sydney Basin Bioregion (Disturbed riparian open woodland)
	PCT 694 / BVT SR516 - Blackbutt - Turpentine – Bangalay moist open forest on sheltered slopes and gullies, southern Sydney Basin Bioregion (Illawarra gully wet forest)
	PCT 1105 / BVT SR606 – River Oak open forest of major streams, Sydney Basin Bioregion and South East Corner Bioregion (Riverbank forest)
	PCT 1245 / BVT SR652 - Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion (Warm temperate layered forest)

3.3.1 Identification of existing BioBank sites

OEH maintains a public register of existing BioBank sites as well as a list of expressions of interest (EOI) for the development of BioBank sites, on the BioBanking public register. At the time of preparing the BOS the EOI contained:

- one BioBank site in Shoalhaven LGA and no BioBank sites in Kiama LGA
- two EOI's in Shoalhaven LGA and no EOI's in Kiama LGA.

These sites were identified as being potential offsets to be considered as part of the BOP.

3.3.2 Identification of additional potential BioBanking offset sites

As detailed in the BOS, desk based and rapid field assessments were undertaken in accordance with the BioBanking principles to identify the preferred BioBanking sites for inclusion into the BOP. The assessment process is detailed below.

An initial desk based assessment of potential sites for offsetting were identified by:

- reviewing the BioBank and EOI registers to identify existing BioBank sites currently on the offset market
- reviewing land acquired by Roads and Maritime for the project
- advertising for Expressions of Interest (EOI) for rural landowners within 50 kilometres of the Foxground and Berry bypass project interested in protecting areas of their property under a biodiversity offsets program through a local newspaper advertisement (Figure 3.1)
- meeting with local landcare groups (11 February, 2016) including representatives from Landcare Illawarra, Shoalhaven Landcare, Berry Landcare, a Foxground Landcare, Berry Public School Plant Propagation Unit, Local Land Services and Bush Connect (National Parks Association)
- providing local councils (Shoalhaven and Kiama) opportunities to identify lands within their portfolios. This included a meeting with Shoalhaven Council on 11 February, 2016 and phone discussions with Kiama Council).

The response to the EOI and review of existing Roads and Maritime lands identified 47 properties for further investigation (Figure 3.1). The suitability of the 47 properties were ranked through further desktop based criteria outlined within the BOS which included a review of:

- existing broadscale vegetation mapping to identify presence of the vegetation communities requiring offsets
- distance of the sites from the project area
- size and shape of remnants and hence their likely viability as habitat, particularly for threatened species
- suitability of the land use zoning and potential for conflicts between sites and adjacent current and future uses
- vulnerability of the lands to loss of biodiversity value without protection as an offset
- connectivity with other areas of habitat.

SUTTON FOREST
ILLAWARRA HIGHWAY
WINGECARRIBEE LGA
BURRAWANG
ROBERTSON
PEARSONS LANE
NOWRA ROAD
AVOCA
EXETER
FITZROY FALLS
MYRA VALE ROAD
ALBION PARK
BLACKBUTT
FLINDERS
SHELLHARBOUR LGA
CROOM
SHELL COVE
36
SHELLHARBOUR LGA
KIAMA DOWNS
JAMBEROO MOUNTAIN ROAD
JAMBEROO
JAMBEROO ROAD
BOMBO
KIAMA
KIAMA LGA
16
15
9
18
11
13
21
BARRENGARRY
KANGAROO VALLEY
26
WERRI BEACH
HIGHWAY
BROUGHTON VALE
GERRINGONG
47
45
PRINCES
GOULBURN MULWAREE LGA
7
TOOLIJOOA
46
GERROA
BERRY
33
30
43
SHOALHAVEN LGA
CAMBEWARRA VILLAGE
TAPITALLEE
44
SHOALHAVEN HEADS
BOMADERRY
BOLONG ROAD
NORTH NOWRA
TERARA
BURRIER
29
NOWRA
WEST NOWRA
BRUNDEE
GREENWELL POINT
PYREE
ORIENT POINT
SOUTH NOWRA
CROOKHAVEN
CULBURRA
CULBURRA BEACH
KINGHORNE

BATHURST
LITHGOW
PENRITH
PARRAMATTA
LIVERPOOL
SYDNEY
CAMDEN
CAMPBELLTOWN
WOLLONGONG
GOULBURN

Legend

- Proposed road design
- Major road
- Property boundaries
- LGA

Distance from road upgrade

- 0-5km
- 5-10km
- 10-20km
- 20-50km

Map: 2267315A_GIS_F003_A3	Author: A Labruyere
Date: 8/09/2016	Approved by: M Stables

Data source: © Land and Property Information 2015

0 2 4 Kilometers

1:200,000

Coordinate system: GDA 1994 MGA Zone 56

Scale ratio correct when printed at A3

Foxground to Berry
Figure 3.1
Expression of interest properties for biodiversity offsetting

WSP | PARSONS BRINCKERHOFF

- records of threatened species and suitability of mapped vegetation as potential habitat
- current condition and potential for improvement.

Each of the attributes above were ranked based on a scoring system as detailed section 3.4.3 below. The score of each property allowed for the prioritisation of sites which lead to a shortlist of preferred sites.

3.3.3 Ranking methodology for expression of interest properties for BioBanking offset sites

3.3.3.1 VEGETATION COMMUNITIES

The CoA for the project specifically prescribe offset ratios based on the type of vegetation that is being impacted. Table 2.1 outlines the likely offset requirements for the direct impacts upon each of the vegetation types that were identified in the Terrestrial Flora and Fauna Technical Paper (Biosis 2012).

The likely presence of these vegetation communities was initially identified through analysis of existing vegetation mapping. Ground-truthing of vegetation will be required prior to the finalisation of the offset package.

Given that the preference is to offset on a 'like for like' basis and the likely availability of properties with the target vegetation communities, any properties without (or with less than 5 ha) of these target communities mapped were eliminated from further assessment.

To ensure areas for each target community were met scoring for vegetation communities was undertaken as outlined in Table 3.2.

Table 3.2 Scoring for vegetation communities

VEGETATION CHARACTERISTIC	SCORE
Presence of each of the target communities within the property	1 per target community
Presence of Illawarra Gully Wet Forest	+1
Greater than half of the target area for a community was provided by the property	+1 per target community
Greater than the target area for a community was provided by the property	+1 per target community

3.3.3.2 DISTANCE FROM THE PROJECT

Biodiversity offsets should be located appropriately. Ideally, offset habitat areas should be located within the local area or if not available, the region of the Project.

Choosing offsets within the locality or region of the Project is consistent with the need to provide compensatory habitat of similar type and quality to that being removed. The integrity of the habitat network and biodiversity values of the locality are retained and habitat is secured and existing corridors consolidated for local flora and fauna populations.

Scoring used for distance from the project is outlined in Table 3.3.

Table 3.3 Scoring for distance from project

DISTANCE FROM PROJECT (KM)	SCORE
<5km	4
5-10km	3
10-20km	2
20-50km	1

3.3.3.3 SIZE AND SHAPE OF REMNANTS

The size and shape of remnants contributes significantly to their long-term viability as native vegetation communities and habitat. Smaller vegetation remnants and remnants with a high edge to area ratio are more susceptible to threatening processes such as weed invasion, the introduction of pathogens and altered environmental characterises such sunlight penetration, wind, soil moisture and nutrient levels. Native animals in these remnants are likely to be at higher risk of threats such as predation and competition with introduced animals and overly abundant native animals which are typically associated the interface between native vegetation and adjacent cleared areas.

Smaller patches may not be of sufficient size to support viable populations of some animal species that require large home ranges. The small populations supported by such remnants are likely to be more susceptible to local extinction due to reduced breeding success and disturbance events such as fires and disease epidemics.

Scoring used for size of vegetation is outlined in Table 3.4.

Table 3.4 Scoring for size of remnants

SIZE OF REMNANTS (HA)	SCORE
>50	3
20-50	2
10-19	1
Less than 10	0

Scoring used for size of vegetation is outlined in Table 3.5.

Table 3.5 Scoring for shape of remnants

SHAPE OF REMNANTS	SCORE
Vegetation with low edge to area ratio e.g. Consolidated area of vegetation	1
Vegetation with high edge to area ratio. Includes patchy/ fragmented vegetation or long-narrow remnants.	0

3.3.3.4 CONNECTIVITY

Connectivity of habitats is essential to the long-term survival of many species because it facilitates movement on a local scale, for foraging and sheltering, as well as on a regional or even national scale as a wildlife corridor for dispersal and migration. Remnants with habitat linkages are more likely to maintain their biodiversity in the long-term and connectivity of habitats creates larger remnants that are likely to be of higher quality and support higher biodiversity.

Offsets are likely to be of greater biodiversity value where they are located adjacent to remnant vegetation creating a larger remnant or where they provide linkages within otherwise fragmented landscapes. Compensatory habitat should act to consolidate existing corridors or, occur adjacent to existing areas of native vegetation in order to maintain or increase their habitat quality and long-term viability.

Scoring for connectivity is outlined in Table 3.6.

Table 3.6 Scoring for connectivity

CONNECTIVITY	SCORE
Adjacent to conservation reserve	2
Adjacent to remnant vegetation	1
Occurs within an identified wildlife corridor	+1

3.3.3.5 SUITABILITY OF THE LAND USE ZONING AND POTENTIAL FOR MANAGEMENT CONFLICTS

The zoning of potential offset sites may affect their suitability. If sites are located in areas identified in strategic regional planning as future locations of significant infrastructure, residential or industrial development, they are unlikely to be available as offset sites. Similarly properties with mining exploration leases may not be appropriate for offsets.

Land use zoning and mining exploration leases and titles were examined and properties excluded where potential management conflicts were identified.

3.3.3.6 ZONING: VULNERABILITY OF THE LANDS TO LOSS OF BIODIVERSITY VALUE WITHOUT PROTECTION

If the offsets are to be effective and genuine it is also important that they are not currently effectively protected from a loss of biodiversity values through development controls, binding conservation arrangements and/or management for conservation purposes.

An effective offset needs to be an area that, in the absence of the protection and management provided by its use as an offset, would be likely to see a reduction in biodiversity values and/or a failure to recover values. The current land use zoning was used to assess this.

The zoning of the property where there was native vegetation was scored. In most cases, this consisted of a single zoning, however, where multiple zonings occurred with native vegetation, the dominant zoning was scored. Scoring used for zoning and vulnerability of loss of biodiversity value is outlined in Table 3.7.

Table 3.7 Scoring for zoning and vulnerability of loss of biodiversity value

ZONING	SCORE
Non- environmental zoning	4
Environmental zoning	3
Public reserve	2
Crown land	1

3.3.3.7 RECORDS OF THREATENED SPECIES

Mapping of threatened species was examined. However, the absence of records on a potential offset site does not, in the absence of very intensive survey effort, necessarily indicate that the species is absent. Records of threatened species on potential offset sites were therefore noted, however were not included in the ranking process.

3.3.3.8 CURRENT CONDITION AND POTENTIAL FOR IMPROVEMENT

Habitat condition gives an indication of its quality for flora and fauna habitat and long-term viability. Where the condition of habitats can be improved through changes in management (for example cessation of grazing, weed control), this improvement in condition can be used to offset a development.

The scope for improvements to the condition of offset sites and proposed methods of restoration and enhancement were not considered as part of the ranking methodology. This criteria was considered more critical in terms of shortlisted offset site review and was considered as part of the rapid site inspection phase.

3.3.4 Shortlisted BioBanking offset sites

Following the desktop assessment eight preferred offset sites were shortlisted for consideration (7, 21, 26, 29, 30, 43, 44 and 45). Although property 47 had a lower ranking score, it was also assessed due to the presence of Riverbank Forest which was otherwise only identified within property 29. Given the interest shown by private property owners and Council, and the number of properties with the target communities, it was considered likely that a combination of three or four properties could be secured that would achieve the offsets required for the three targeted communities i.e. Warm Temperate Layered Forest, Illawarra Gully Wet Forest and Riverbank Forest.

Rapid ground-truthing surveys were undertaken on all shortlisted sites to confirm the desktop assessment and determine the suitability of each property in contributing to the final BOP for the best conservation outcome.

4 FINAL PROPOSED BIODIVERSITY OFFSET PACKAGE

4.1 Overview

Roads and Maritime are committed to developing a robust offset package to compensate for identified impacts of the project that cannot be avoided or mitigated and in the medium to long term, to improve ecological outcomes. This biodiversity offset package has been developed and quantified through the application of prescribed offset ratios detailed in the BOS, the Director General's CoA, and OEH and DPI offsetting requirements for the project. The proposed offsets will provide ongoing conservation of land in perpetuity, management to maintain and improve biodiversity values on the offset sites, and protection of habitat for threatened species.

The final proposed BOP represents a substantial improvement on the BOS as it will also protect threatened biodiversity that is not being impacted by the project, namely:

- two additional threatened plant populations (*Daphnandra johnsonii* and *Zieria granulata*)
- two additional threatened ecological communities (Illawarra Subtropical Rainforest and Swamp Sclerophyll Forest on Coastal Floodplain).

All proposed BioBanking offset sites occur within close proximity to the project, addressing the requirements of the principles for the use of Biodiversity Offsets in NSW and other offsetting policy requirements. The final BOP is illustrated in Figure 4.1 and the specific offset properties are detailed in Table 4.1.

Table 4.1 Final selected properties for establishment of BioBanking agreements under the BOP

SITE ID	LOT & DP	ADDRESS	OWNERSHIP	BIOBANKING SITE AREA
7	Part of L81 DP1188079	A371 Princes Highway, Broughton	Private	30.45 ha
30	Part of L401 DP1176501	83 Agars Lane, Berry	Private	23.0
45	Part of LA DP377518	37 Princes Highway, Broughton Village	RMS	11.2 ha
47[1]	Part of L4 DP778833 Part of L79 DP1186383 Part of L414DP1186383 Part of L416 DP1186383	161 & 199 Princes Highway, Broughton Village	RMS	7.0
Total offset area				**71.65**

(1) Prior to the final approval of BioBanking agreements all lots will be consolidated into one single lot

In the event that one or both of the private properties withdraws from the BOP and subsequent BioBanking agreement, additional shortlisted properties have been earmarked to fulfil the required vegetation type offsets. These properties include two Council managed reserves being Moeyan Hill (Site 43) and Coolangatta Mountain (Site 44) along with a privately owned land parcel on Woodhill Mountain Road, Woodhill (Site 25). Whilst this risk is deemed low, alternative options have been established to ensure the BOP remains able to fully achieve the CoA and BOS requirements.

4.2 Consultation

To fulfil the project's CoA and build on the offsets identified in the BOS, ongoing consultation was undertaken with OEH and DPI as well as local government authorities, Landcare groups and the broader community.

A summary of the main consultation includes:

- 8 February 2016 – Correspondence with Kiama Municipal Council on the preparation of the BOP.
- 11 February 2016 – Consultation with community groups on the preparation of the BOP.
- 11 February 2016 – Meeting with Shoalhaven City Council on the preparation of the BOP.
- 14 March 2016 – OEH and community working group meeting on the shortlisting of potential offset properties.
- 7 June 2016 – Correspondence with OEH to discuss final selection of offset properties.
- 17 June 2016 – Meeting with OEH and Illawarra Landcare to discuss final selection of offset properties.
- 11 August 2016 – Correspondence with OEH regarding riparian buffer widths for Riverbank Forest offset on Site 47.
- 9 August 2016 – Correspondence with DPI regarding riparian buffer widths for Riverbank Forest offset on Site 47.

Due to overwhelming community interest in the delivery and composition of the BOP, a community meeting was held in Berry on 11 February 2016 at project inception to listen to and understand community expectations from the offset package. Present at the meeting were representatives from Local Land Services, National Parks Association, Landcare Illawarra, Foxground Landcare, Berry Landcare, Shoalhaven Landcare and interested community members. The primary purpose of the meeting was to gather information about private land holders' interest and why certain areas may be important from a community perspective in delivering biodiversity offsets for this project.

Through initial community consultation, it became evident that an offset package should attempt to be complimentary to the extensive conservation projects that local Landcare groups have been undertaking in the local area. Of particular focus was the opportunity to contribute to the 'Escarpment to Sea' Berry corridor project that has for a number of years engaged with landholders in the restoration and creation of vegetation corridors in the area.

In addition to the community consultation, phone discussions were held with Mr Byron Robertson of Kiama Municipal Council and a meeting was also held with Shoalhaven City Council to discuss potential offset options and the overall goals of the BOP.

Advertisements were placed in local newspapers for Expressions of Interest (EOI) for rural landowners within 50 kilometres of the Foxground and Berry bypass project interested in protecting areas of their property under a biodiversity offsets program. Following the receipt of EOI properties for potential offsetting, a working group was established to discuss the findings of the property ranking scores and potential offset options available. The working group comprised of representatives from OEH, National Parks Association, Landcare Illawarra, Berry Landcare and Shoalhaven Landcare. Based on the desktop assessment in consultation with the working group, it become apparent that the majority of offsets could be achieved from a number of property combinations, delivering sound biodiversity outcomes complimentary to local conservation projects. The only shortfall in offset options was for Riverbank Forest vegetation type that lead to further consideration of potential options.

Ongoing negotiations over suitable options were held with OEH and local Landcare representatives. Following this, the final site selections were identified that included supplementary offset vegetation types in the form of additional lands with threatened ecological communities and included the protection and ongoing management of two endangered flora populations within Site 45.

In terms of the final site selection for the bulk of the Riverbank Forest offset (Site 47), consultation over suitable riparian buffer widths was held with both OEH and DPI where it was clearly recommended that a minimum 40 metre buffer should apply to ensure the integrity of conserved patches. This recommendation was incorporated into the final site configuration of the Site 47 BioBanking agreement area.

Overall, the final properties for the offset package were chosen through ongoing agency and community consultation to ensure the package is consistent with CoA (B8) and the BOS.

Map: 2267315A_GIS_F015_A3	Author: LabruyereA		0 360 720 m 1:25,000 Coordinate system: GDA 1994 MGA Zone 56 Scale ratio correct when printed at A3
Date: 5/10/2016	Approved by: -		

WSP | PARSONS BRINCKERHOFF

Foxground to Berry

Figure 4.1
Final selected biodiversity offset properties

4.3 BioBanking offset sites

4.3.1 BioBanking Site 7

BioBanking Site 7 includes part of Lot 81 DP 1188079 and is located immediately north of the Princes Highway and east of Tindalls Lane in Broughton, NSW (Figure 4.1). This site is situated within the Shoalhaven LGA and is a privately owned property that immediately adjoins the project area. A vegetated portion of the property totalling 30.4 hectares is currently being established with a BioBanking agreement under the NSW BioBanking Scheme. Roads and Maritime has funded detailed surveys, assessment and costs associated with the establishment of the BioBanking agreement.

This property was chosen based on meeting the following biodiversity offset ranking criteria and score summarised in Table 4.2. The score of 15 was the third highest score of the properties identified, with 17 being the highest score. This score was the second highest for a property with Illawarra Gully Wet Forest and the second highest for a property with Warm Temperate Layered Forest.

Table 4.2 Biodiversity offset ranking for Site 7

RANKING CRITERIA	SITE CHARACTERISTIC	SCORE
Required vegetation communities	Illawarra Gully Wet Forest – PCT 694 / BVT SR516 Warm Temperate Layered Forest – PCT 1245 / BVT SR652	3
Distance from the Project	<5km	4
Size of remnant	20-50 ha	2
Shape of remnant	Vegetation with low edge to area ratio e.g. Consolidated area of vegetation, despite some areas of low condition	1
Connectivity	Occurs within an identified wildlife corridor	1
Vulnerability of the lands to loss of biodiversity value without protection	Non-environmental zoning (Rural Production)	4
Total score		**15**

Detailed BBAM surveys have been undertaken to assess landscape features, native vegetation, threatened species and populations to determine the BioBanking values of the site. These values have been incorporated into a BioBanking assessment report and credit calculations.

To ensure the biodiversity offset achieves an improved outcome, Roads and Maritime have committed to the purchase and retirement of the following ecosystem credits on the final establishment of a BioBanking agreement on Site 7 as outlined in Table 4.3 and Figure 4.2.

Table 4.3 Ecosystem credits generated within BioBanking Site 7

REQUIRED VEGETATION TYPE FOR PROJECT OFFSET	NSW PLANT COMMUNITY TYPE & CONDITION CLASS IDENTIFIED WITHIN THE SITE	THREATENED ECOLOGICAL COMMUNITY	TOTAL AREA AVAILABLE (HA)	TOTAL BIOBANKING ECOSYSTEM CREDITS
Illawarra Gully Wet Forest	PCT 694 / BVT SR516 – Blackbutt – Turpentine – Bangalay moist open forest on sheltered slopes and gullies, southern Sydney basin Bioregion (moderate – good) high quality	No	16.50	131
	PCT 694 / BVT SR516 – Blackbutt – Turpentine – Bangalay moist open forest on sheltered slopes and gullies, southern Sydney basin Bioregion (moderate – good) medium quality	No	3.60	31

REQUIRED VEGETATION TYPE FOR PROJECT OFFSET	NSW PLANT COMMUNITY TYPE & CONDITION CLASS IDENTIFIED WITHIN THE SITE	THREATENED ECOLOGICAL COMMUNITY	TOTAL AREA AVAILABLE (HA)	TOTAL BIOBANKING ECOSYSTEM CREDITS
	PCT 694 / BVT SR516 – Blackbutt – Turpentine – Bangalay moist open forest on sheltered slopes and gullies, southern Sydney basin Bioregion (moderate – good) poor quality	No	3.50	27
Sub-total			**23.60**	**189**
Warm Temperate Layered Forest	PCT 1245 / BVT SR652 – Sydney Blue Gum x Bangalay – Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion Moderate – good) high quality	No	5.50	49
	PCT 1245 / BVT SR652 – Sydney Blue Gum x Bangalay – Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion Moderate – good) medium quality	No	1.31	10
Sub-total			**6.81**	**59**
Constructed wetland	Miscellaneous ecosystem - water body (dam)	No	0.04	-
Total area and BioBanking ecosystems credits generated			**30.45**	**248**

PCT 694 / BVT SR516 – Blackbutt – Turpentine – Bangalay moist open forest on sheltered slopes and gullies, southern Sydney basin Bioregion (moderate – good) high quality

PCT 1245 / BVT SR652 – Sydney Blue Gum x Bangalay – Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion Moderate – good) high quality

The ecosystem credits generated for this site are considered to provide potential habitat for a range of threatened fauna species as outlined in Table 4.4. The BioBanking site vegetation zones and proposed management zones are shown in Figure 4.2 and Figure 4.3.

Table 4.4 Threatened fauna species reliably predicted to utilise the site based on BioBanking credit calculator output

SCIENTIFIC NAME	COMMON NAME	TSC ACT[1]	EPBC ACT[2]	PCT/BVT
Birds				
Callocephalon fimbriatum	Gang-gang Cockatoo	V	-	PCT694 / BVT SR516 PCT 1245/ BVT SR652
Calyptorhynchus lathami	Glossy Black-cockatoo	V	-	PCT694 / BVT SR516
Hieraaetus morphnoides	Little Eagle	V	-	PCT694 / BVT SR516 PCT 1245 / BVT SR652
Glossopsitta pusilla	Little Lorikeet	V	-	PCT694 / BV TSR516
Tyto novaehollandiae	Masked Owl	V	-	PCT694 / BVT SR516 PCT 1245 / BVT SR652
Ninox strenua	Powerful Owl	V	-	PCT694 / BVT SR516 PCT 1245 / BVT SR652
Lophoictinia isura	Square-tailed Kite	V	-	PCT694 / BVT SR516 PCT 1245 / BVT SR652
Calyptorhynchus lathami	Varied Sittella	V	-	PCT694 / BVTSR516 PCT 1245 / BVT SR652
Bats				
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	-	PCT694 / BVT SR516 PCT 1245 / BVT SR652
Mormopterus norfolkensis	Eastern Freetail-bat	V	-	PCT694 / BVT SR516 PCT 1245 / BVT SR652
Kerivoula papuensis	Golden-tipped Bat	V	-	PCT694 / BVT SR516 PCT 1245 / BVT SR652
Scoteanax rueppellii	Greater Broad-nosed Bat	V	-	PCT694 / BVT SR516 PCT 1245 / BVT SR652
Saccolaimus flaviventris	Yellow-bellied Sheathtail Bat	V	-	PCT694 / BVT SR516 PCT 1245 / BVT SR652
Mammals				
Dasyurus maculatus	Spotted-tailed Quoll	V	E	PCT694 / BVT SR516 PCT 1245 / BVT SR652
Petaurus australis	Yellow-bellied Glider	V	-	PCT694 / BVT SR516 PCT 1245 / BVT SR652

(1) V – Vulnerable species listing under the TSC Act
(2) E – Endangered species listing under the EPBC Act

Overall, the selection of Site 7 delivers like for like vegetation offsets for both Illawarra Gully Wet Forest (PCT694) and Warm Temperate Layered Forest (PCT1245) and provides suitable habitat for many of the threatened fauna species identified as being potentially subject to project impacts. The site is located within the Berry Corridor 'Escarpment to Sea' and is consistent with Landcare initiatives in the local area.

In addition, the southern boundary of the Site 7 directly adjoins the project footprint and is complementary to a number of fauna connectivity structures that form part of the overall project biodiversity mitigation measures. These fauna connectivity structures include a dual use underpass, two rope bridges over road structures and a dedicated fauna underpass. Given this, the inclusion of Site 7 within the BOP is considered to lead to an overall enhancement of these project specific biodiversity mitigation measures over the longer term.

Q7
Q8
Q3
Q4
Q1
Q9
Q6
Q10
Q5
Q11
Q2
PRINCES HIGHWAY

ROBERTSON
MINNAMURRA
JAMBEROO
KIAMA
WERRI BEACH
GERRINGONG
BERRY
SHOALHAVEN HEADS
BOMADERRY
NORTH NOWRA
NOWRA
SOUTH NOWRA
ORIENT POINT
WEST NOWRA
GREENWELL POINT

Legend

- Biobanking plot
- Track
- Watercourse
- Proposed biobank site
- PCT 694 / BVT SR516 - Blackbutt - Turpentine - Bangalay moist open forest on sheltered slopes and gullies, southern Sydney Basin Bioregion (moderate - good) - High quality
- PCT 694 / BVT SR516 - Blackbutt - Turpentine - Bangalay moist open forest on sheltered slopes and gullies, southern Sydney Basin Bioregion (moderate - good) - Medium quality
- PCT 694 / BVT SR516 - Blackbutt - Turpentine - Bangalay moist open forest on sheltered slopes and gullies, southern Sydney Basin Bioregion (moderate - good) - Poor quality
- PCT 1245 / BVT SR652 - Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion (moderate - good) - High quality
- PCT 1245 / BVT SR652 - Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion (moderate - good) - Medium quality
- Miscellaneous ecosystem - water body (dam)

Map: 2267315A_GIS_F046_A1	Author: A Labruyere
Date: 29/08/2016	Approved by: M Stables

Data source: © Land and Property Information 2015

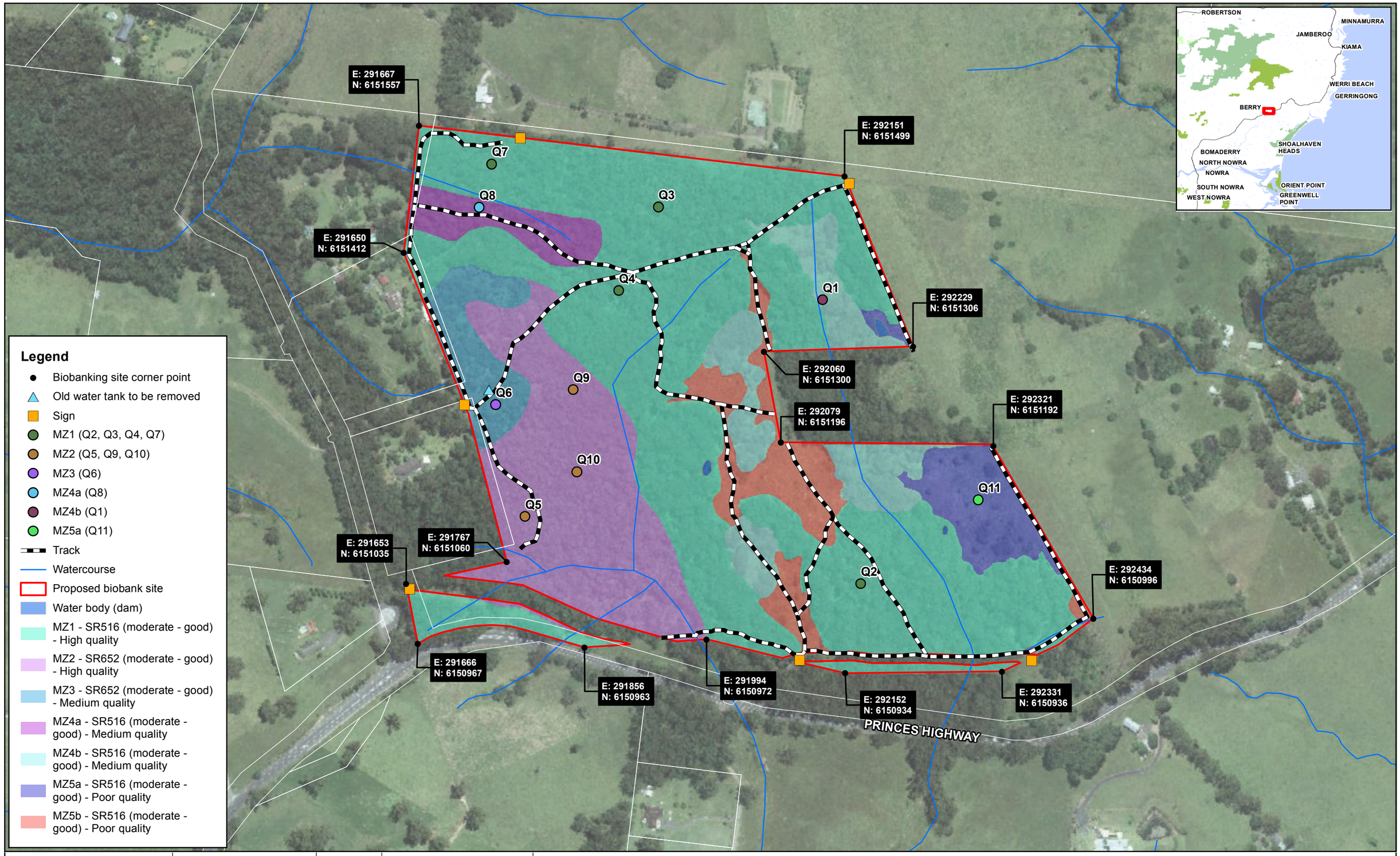
0 50 100 m

1:3,000

Coordinate system: GDA 1994 MGA Zone 56

Scale ratio correct when printed at A3

Foxground to Berry
Figure 4.2
BioBanking Site 7 – Vegetation Zones



Map: 2267315A_GIS_F049_A1	Author: A Labruyere
Date: 8/09/2016	Approved by: M Stables

Data source: © Land and Property Information 2015

0 60 120 m

1:4,000

Coordinate system: GDA 1994 MGA Zone 56

Scale ratio correct when printed at A3

Foxground to Berry
Figure 4.3
BioBanking Site 7 – Management Zones

4.3.2 BioBanking site 30

BioBanking Site 30 includes part of L401 DP1176501 83 Agars Lane, Berry NSW (Figure 4.1). The site is situated within the Shoalhaven LGA and is a privately owned property approximately 1.5 km south east of the project area. This site is currently being established as a BioBanking site under the NSW BioBanking Scheme. Roads and Maritime has funded the detailed surveys, assessment and costs associated with the establishment of the BioBanking site.

This property was chosen based on meeting the following biodiversity offset ranking criteria and score summarised in Table 4.5. The score of 13 was the fifth highest score of the properties identified, with 17 being the highest score, and the highest score for a property with Illawarra Gully Wet Forest.

Table 4.5 Biodiversity offset ranking for Site 30

RANKING CRITERIA	SITE CHARACTERISTIC	SCORE
Required vegetation communities	Illawarra Gully Wet Forest – PCT 694 / BVT SR516 Warm Temperate Layered Forest – PCT 1245 / BVT SR652	2
Distance from the Project	<5km	4
Size of remnant	20-50 ha	2
Shape of remnant	Vegetation with low edge to area ratio e.g. Consolidated area of vegetation	1
Connectivity	Occurs within an identified wildlife corridor	1
Vulnerability of the lands to loss of biodiversity value without protection	Environmental zoning	3
Total score		**13**

Detailed BBAM surveys were undertaken to assess landscape features, native vegetation, threatened species and populations to determine the BioBanking values of the site. These values have been incorporated into a BioBanking Assessment report and credit calculations.

To ensure the biodiversity offset achieves and improved outcome, Roads and Maritime have committed to the purchase and retirement of the following ecosystem credits on the final establishment of a BioBanking agreement on Site 30 as outlined in Table 4.6. The BioBanking site vegetation zones and proposed management zones are shown in Figure 4.4 and Figure 4.5.

Table 4.6 Ecosystem credits generated within BioBanking Site 30

REQUIRED VEGETATION TYPE FOR PROJECT OFFSET	NSW PLANT COMMUNITY TYPE & CONDITION CLASS IDENTIFIED WITHIN THE SITE	THREATENED ECOLOGICAL COMMUNITY	TOTAL AREA AVAILABLE (HA)	TOTAL BIOBANKING ECOSYSTEM CREDITS
Illawarra Gully Wet Forest	PCT 694 / BVT SR516 – Blackbutt – Turpentine – Bangalay moist open forest on sheltered slopes and gullies, southern Sydney basin Bioregion (moderate – good) medium quality	No	13.5	109
	PCT 694 / BVT SR516 – Blackbutt – Turpentine – Bangalay moist open forest on sheltered slopes and gullies, southern Sydney basin Bioregion (moderate – good) poor quality	No	3.60	25
Sub-total			**17.10**	**134**

REQUIRED VEGETATION TYPE FOR PROJECT OFFSET	NSW PLANT COMMUNITY TYPE & CONDITION CLASS IDENTIFIED WITHIN THE SITE	THREATENED ECOLOGICAL COMMUNITY	TOTAL AREA AVAILABLE (HA)	TOTAL BIOBANKING ECOSYSTEM CREDITS
Warm Temperate Layered Forest	PCT 1245 / BVT SR652 – Sydney Blue Gum x Bangalay – Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion Moderate – good) medium quality	No	3.30	26
Sub-total			**3.30**	**26**
-	PCT1231 / BVT SR648 Swamp Mahogany swamp sclerophyll forest on coastal lowlands of the Sydney Basin Bioregion and South East Corner Bioregion	Yes – Swamp Sclerophyll Forest on Coastal Floodplain	2.60	21
Sub-total			**2.60**	**21**
Total area and BioBanking ecosystems credits generated			**23.00**	**181**

PCT 1245 / BVT SR652 – Sydney Blue Gum x Bangalay – Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion Moderate – good) medium quality

PCT1231 / BVT SR648 Swamp Mahogany swamp sclerophyll forest on coastal lowlands of the Sydney Basin Bioregion and South East Corner Bioregion (moderate – good) medium quality

The BioBanking calculator considers that the ecosystem credits generated on this site would provide potential habitat for a range of threatened fauna species as outlined in Table 4.7.

Table 4.7 Threatened fauna species reliably predicted to utilise Site 30 based on BioBanking credit calculator output

SCIENTIFIC NAME	COMMON NAME	TSC ACT1	EPBC ACT2	PCT/BVT
Birds				
Callocephalon fimbriatum	Gang-gang Cockatoo	V	-	PCT694 / BVT SR516 PCT 1245 / BVT SR652 PCT 1231 / BVT 648
Calyptorhynchus lathami	Glossy Black-cockatoo	V	-	PCT694 / BVT SR516 PCT 1245 / BVT SR652 PCT 1231 / BVT 648

SCIENTIFIC NAME	COMMON NAME	TSC ACT1	EPBC ACT2	PCT/BVT
Hieraaetus morphnoides	Little Eagle	V	-	PCT694 / BVT SR516 PCT 1245 / BVT SR652 PCT 1231 / BVT 648
Glossopsitta pusilla	Little Lorikeet	V	-	PCT694 / BVT SR516 PCT 1231 / BVT 648
Tyto novaehollandiae	Masked Owl	V	-	PCT694 / BVT SR516 PCT 1245 / BVT SR652 PCT 1231 / BVT 648
Ninox connivens	Barking Owl	V		PCT 1231 / BVT 648
Ninox strenua	Powerful Owl	V	-	PCT694 / BVT SR516 PCT 1245 / BVT SR652 PCT 1231 / BVT 648
Lophoictinia isura	Square-tailed Kite	V	-	PCT694 / BVT SR516 PCT 1245 / BVT SR652 PCT 1231 / BVT 648
Lathamus discolor	Swift Parrot	E	CE	PCT 1231 / BVT 648
Daphoenositta chrysoptera	Varied Sittella	V	-	PCT694 / BVT SR516 PCT 1245 / BVT SR652 PCT 1231 / BVT 648
Bats				
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	-	PCT694 / BVT SR516 PCT 1245 / BVT SR652 PCT 1231 / BVT 648
Mormopterus norfolkensis	Eastern Freetail-bat	V	-	PCT694 / BVT SR516 PCT 1245 / BVT SR652 PCT 1231 / BVT 648
Kerivoula papuensis	Golden-tipped Bat	V	-	PCT694 / BVT SR516 PCT 1245 / BVT SR652
Scoteanax rueppellii	Greater Broad-nosed Bat	V	-	PCT694 / BVT SR516 PCT 1245 / BVT SR652 PCT 1231 / BVT 648
Saccolaimus flaviventris	Yellow-bellied Sheathtail Bat	V	-	PCT694 / BVT SR516 PCT 1245 / BVT SR652 PCT 1231 / BVT 648

SCIENTIFIC NAME	COMMON NAME	TSC ACT1	EPBC ACT2	PCT/BVT
Mammals				
Pseudomys novaehollandiae	New Holland Mouse	-	V	PCT 1231 / BVT 648
Potorous tridactylus	Long-nosed Potoroo	V	V	PCT 1231 / BVT 648
Dasyurus maculatus	Spotted-tailed Quoll	V	E	PCT694 / BVT SR516 PCT 1245 / BVT SR652 PCT 1231 / BVT 648
Petaurus australis	Yellow-bellied Glider	V	-	PCT694 / BVT SR516 PCT 1231 / BVT 648

(1) V – Vulnerable species listing under the TSC Act
(2) CE – Critically endangered, E – Endangered species listing under the EPBC Act

The inclusion of this site provides a supplementary biodiversity gain of 2.6 hectares of the Swamp Sclerophyll Forest on Coastal Floodplain endangered ecological community.

Site 30 provides suitable habitat for a number of the threatened fauna species identified as being potentially subject to the project impacts. The site is also located within the Berry Corridor 'Escarpment to Sea' and is consistent with Landcare initiatives in the local area.

Legend

- Biobanking plot
- Track
- Watercourse
- Proposed biobank site
- PCT 694 / BVT SR516 - Blackbutt - Turpentine - Bangalay moist open forest on sheltered slopes and gullies, southern Sydney Basin Bioregion (moderate - good) - Medium quality
- PCT 694 / BVT SR516 - Blackbutt - Turpentine - Bangalay moist open forest on sheltered slopes and gullies, southern Sydney Basin Bioregion (moderate - good) - Poor quality
- PCT 1231 / BVT SR648 - Swamp Mahogany swamp sclerophyll forest on coastal lowlands of the Sydney Basin Bioregion and South East Corner Bioregion (moderate - good) - Medium quality
- PCT 1245 / BVT SR652 - Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion (moderate - good) - Medium quality

Map: 2267315A_GIS_F045_A1	Author: A Labruyere
Date: 30/08/2016	Approved by: M Stables

Data source: © Land and Property Information 2015

0 50 100 m

1:3,000

Coordinate system: GDA 1994 MGA Zone 56

Scale ratio correct when printed at A3

WSP | PARSONS BRINCKERHOFF

Foxground to Berry
Figure 4.4
BioBanking Site 30 – Vegetation Zones

E: 292186
N: 6148751

E: 292142
N: 6148743

E: 291876
N: 6149014

E: 291774
N: 6148820

E: 291624
N: 6148698

E: 292136
N: 6148347

E: 292036
N: 6148358

E: 291967
N: 6148268

Q1
Q2
Q3
Q4
Q5
Q6
Q7
Q8
Q9

AGARS LANE

ROBERTSON
MINNAMURRA
JAMBEROO
KIAMA
WERRI BEACH
GERRINGONG
BERRY
SHOALHAVEN HEADS
BOMADERRY
NORTH NOWRA
NOWRA
SOUTH NOWRA
WEST NOWRA
ORIENT POINT
GREENWELL POINT

Legend

- Biobanking site corner point
- Old water tank to be removed
- Sign
- Biobanking plot
- Track
- Watercourse
- Proposed biobank site
- MZ1a - SR516 (moderate - good) - Medium quality
- MZ1b - SR516 (moderate - good) - Medium quality
- MZ2 - SR652 (moderate - good) - Medium quality
- MZ3 - SR648 (moderate - good) - Medium quality
- MZ4 - SR516 (moderate - good) - Poor quality

Map: 2267315A_GIS_F050_A1	Author: A Labruyere
Date: 30/08/2016	Approved by: M Stables

Data source: © Land and Property Information 2015

0 30 60 m

1:2,500

Coordinate system: GDA 1994 MGA Zone 56

Scale ratio correct when printed at A3

WSP | PARSONS BRINCKERHOFF

Foxground to Berry
Figure 4.5
BioBanking Site 30 – Management Zones

4.3.3 BioBanking Site 45

BioBanking Site 45 is located on part of Lot A DP377518 37 Princes Highway, Broughton Village, NSW (Figure 4.1). This site is situated within the Kiama LGA and is on land owned by Roads and Maritime approximately 500 m from the project area. The total area of the proposed BioBanking site is approximately 11.2 hectares.

Based on suitability methodology and scoring, Site 45 ranked relatively lower with an overall score of 9 (Table 4.8). The lower ranking score generally resulted from a lack of required vegetation communities along with the size and shape of the remnant. However, the site does contain low condition Riverbank Forest suitable for rehabilitation and was only one of three suitable properties identified that provides potential offsets for this community.

Notwithstanding the relatively low ranking score, this site contains biodiversity of high conservation value and was chosen as a compensatory offset due to the limited options for Riverbank Forest vegetation. This approach was deemed appropriate during consultation with OEH (see section 4.2).

The selection of this site as a supplementary offset has been based on the presence of:

- two endangered flora populations (*Daphnandra johnsonii* and *Zieria granulata*)
- vegetation consistent with a listed threatened ecological community under the TSC Act (Illawarra Subtropical Rainforest).

Table 4.8 Biodiversity offset ranking for Site 45

RANKING CRITERIA	SITE CHARACTERISTIC	SCORE
Required vegetation communities	Non target vegetation types	0
Distance from the Project	<5km	4
Size of remnant	10-19 ha	1
Shape of remnant	Vegetation with high edge to area ratio. Includes patchy/ fragmented vegetation or long-narrow remnants	0
Connectivity	Occurs within an identified wildlife corridor	1
Vulnerability of the lands to loss of biodiversity value without protection	Environmental zoning	3
Total score		**9**

Detailed BBAM surveys have been undertaken to assess landscape features, native vegetation, threatened species and populations to determine the BioBanking values of the site. These values have been incorporated into a BioBanking Assessment report and credit calculations.

To ensure the biodiversity offset achieves and improved outcome, Roads and Maritime have committed to the purchase and retirement of the following ecosystem and species credits on the final establishment of a BioBanking agreement as outlined in Table 4.9 and Table 4.10.

Table 4.9 Ecosystem credits generated within BioBanking Site 45

REQUIRED VEGETATION TYPE FOR PROJECT OFFSET	NSW PLANT COMMUNITY TYPE & CONDITION CLASS IDENTIFIED WITHIN THE SITE	THREATENED ECOLOGICAL COMMUNITY	TOTAL AREA AVAILABLE (HA)	NUMBER OF ECOSYSTEM CREDITS GENERATED
-	PCT 906 / BVT SR568 – Lilly Pilly – Sassafras – Stinging Tree subtropical/warm temperate rainforest on moist fertile lowlands, southern Sydney Basin Bioregion (moderate – good) high quality	Yes – Illawarra Subtropical Rainforest	4.6	44
	PCT 906 / BVT SR568 – Lilly Pilly – Sassafras – Stinging Tree subtropical/warm temperate rainforest on moist fertile lowlands, southern Sydney Basin Bioregion (moderate – good) poor quality	Yes – Illawarra Subtropical Rainforest	0.80	5
	PCT 906 / BVT SR568 – Lilly Pilly – Sassafras – Stinging Tree subtropical/warm temperate rainforest on moist fertile lowlands, southern Sydney Basin Bioregion (low)	Yes – Illawarra Subtropical Rainforest	1.7	10
Sub-total			**7.1**	**59**
-	PCT 1300 / BVT SR662 - Whalebone Tree - Native Quince dry subtropical rainforest on dry fertile slopes, southern Sydney Basin Bioregion (moderate – good) high quality	Yes – Illawarra Subtropical Rainforest	1.6	12
	PCT 1300 / BVT SR662 - Whalebone Tree - Native Quince dry subtropical rainforest on dry fertile slopes, southern Sydney Basin Bioregion (moderate – good) poor quality	Yes – Illawarra Subtropical Rainforest	1.7	9
Sub-total			**3.3**	**21**
-	PCT 1105 / BVT SR606 - River Oak open forest of major streams, Sydney Basin Bioregion and South East Corner Bioregion (low)	Yes – River-flat Eucalypt Forest on Coastal Floodplains	0.4	4
Sub-total			**0.4**	**4**
	Miscellaneous ecosystem – major rock outcrop (lichen, moss mats, rock fern, cockspur flower and Illawarra Zieria) (NOTE: The BioBanking calculator has substituted SR697 for this miscellaneous ecosystem).	-	0.4	3
Sub-total			**0.4**	**3**
Total area and BioBanking ecosystems credits generated			**11.2**	**87**

REQUIRED VEGETATION TYPE FOR PROJECT OFFSET	NSW PLANT COMMUNITY TYPE & CONDITION CLASS IDENTIFIED WITHIN THE SITE	THREATENED ECOLOGICAL COMMUNITY	TOTAL AREA AVAILABLE (HA)	NUMBER OF ECOSYSTEM CREDITS GENERATED
 **PCT 906 / BVT SR5688 – Lilly Pilly – Sassafras – Stinging Tree subtropical/warm temperate rainforest on moist fertile lowlands, southern Sydney Basin Bioregion (moderate – good) high quality**	 **PCT 1300 / BVT SR662 – Whalebone Tree – Native Quince dry subtropical rainforest on dry fertile slopes, southern Sydney Basin Bioregion (moderate – good) high quality**			

BioBanking Site 45 contains two vegetation communities (consistent with Illawarra subtropical rainforest in the Sydney Basin Bioregion listed as Endangered under the TSC Act) and two threatened flora populations (*Daphnandra johnsonii* and *Zieria granulata* both listed under the TSC Act and EPBC Act) which generate ecosystem and species credits not required by the project. Although credits for this community and threatened species are not required by the project the conservation of these will provide an improved outcome for the BOP in alignment with the Principles for the use of Biodiversity Offsets in NSW. An overview of the species credits generated for *Daphnandra johnsonii* and *Zieria granulata* are outlined in Table 4.10.

Table 4.10 Species credits generated within BioBanking Site 45

COMMON NAME	SCIENTIFIC NAME	NUMBER INDIVIDUALS	NUMBER OF SPECIES CREDITS CREATED
Illawarra Socketwood	*Daphnandra johnsonii*	205	1,456
Illawarra Zieria	*Zieria granulata*	39	277

The BioBanking calculator has estimated that the ecosystem credits generated on this site are considered to provide potential habitat for a range of threatened fauna species as outlined in Table 4.11. The BioBanking site vegetation zones and proposed management zones are shown in Figure 4.6 and Figure 4.7.

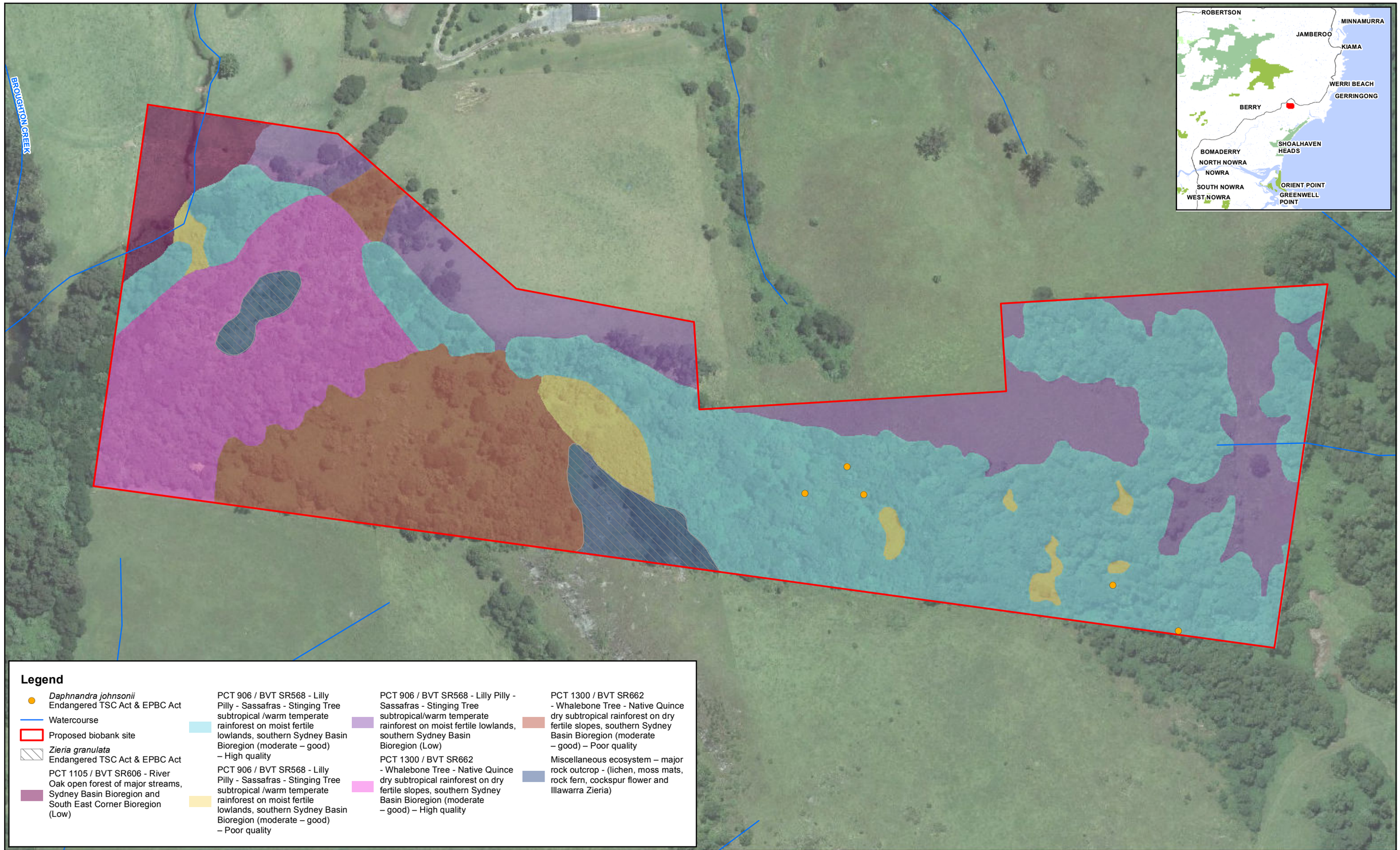
Table 4.11 Threatened fauna species reliably predicted to utilise Site 45 based on BioBanking credit calculator output

SCIENTIFIC NAME	COMMON NAME	TSC ACT[1]	EPBC ACT[2]	PCT/BVT
Birds				
Callocephalon fimbriatum	Gang-gang Cockatoo	V	-	PCT 1300 / BVT SR662 PCT 906/ BVT SR568
Hieraaetus morphnoides	Little Eagle	V		PCT N/A / BVT SR697

SCIENTIFIC NAME	COMMON NAME	TSC ACT[1]	EPBC ACT[2]	PCT/BVT
Tyto novaehollandiae	Masked Owl	V	-	PCT 1300 / BVT SR662 PCT 906/ BVT SR568
Ptilinopus regina	Rose-crowned Fruit-dove	V	-	PCT 1300 / BVT SR662 PCT 906/ BVT SR568
Ptilinopus superbus	Superb Fruit-dove	V	-	PCT 1300 / BVT SR662 PCT 906/ BVT SR568
Bats				
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	-	PCT 906/ BVT SR568
Mormopterus norfolkensis	Eastern Freetail Bat			PCT N/A / BVT SR697
Kerivoula papuensis	Golden-tipped Bat	V	-	PCT 1300 / BVT SR662 PCT 906/ BVT SR568
Scoteanax rueppellii	Greater Broad-nosed Bat	V	-	PCT 1300 / BVT SR662 PCT 906/ BVT SR568 PCT N/A / BVT SR697
Saccolaimus flaviventris	Yellow-bellied Sheathtail Bat	V	-	PCT 1300 / BVT SR662 PCT 906/ BVT SR568
Mammals				
Potorous tridactylus	Long-nosed Potoroo	V	V	PCT 1300 / BVT SR662 PCT 906/ BVT SR568
Dasyurus maculatus	Spotted-tailed Quoll	V	E	PCT 1300 / BVT SR662 PCT 906/ BVT SR568 PCT N/A / BVT SR697

(1) V – Vulnerable species listing under the TSC Act
(2) E – Endangered species listing under the EPBC Act

Overall Site 45 is strategically positioned in the local landscape and provides connectivity from Broughton Creek to vegetated rainforest patches on volcanic ridge caps between Broughton Village and Toolijooa. Further, the location of the offset site is considered complimentary to ongoing and future Landcare conservation projects in the local area.



Legend

- *Daphnandra johnsonii* Endangered TSC Act & EPBC Act
- Watercourse
- Proposed biobank site
- *Zieria granulata* Endangered TSC Act & EPBC Act
- PCT 1105 / BVT SR606 - River Oak open forest of major streams, Sydney Basin Bioregion and South East Corner Bioregion (Low)
- PCT 906 / BVT SR568 - Lilly Pilly - Sassafras - Stinging Tree subtropical /warm temperate rainforest on moist fertile lowlands, southern Sydney Basin Bioregion (moderate – good) – High quality
- PCT 906 / BVT SR568 - Lilly Pilly - Sassafras - Stinging Tree subtropical /warm temperate rainforest on moist fertile lowlands, southern Sydney Basin Bioregion (moderate – good) – Poor quality
- PCT 906 / BVT SR568 - Lilly Pilly - Sassafras - Stinging Tree subtropical/warm temperate rainforest on moist fertile lowlands, southern Sydney Basin Bioregion (Low)
- PCT 1300 / BVT SR662 - Whalebone Tree - Native Quince dry subtropical rainforest on dry fertile slopes, southern Sydney Basin Bioregion (moderate – good) – High quality
- PCT 1300 / BVT SR662 - Whalebone Tree - Native Quince dry subtropical rainforest on dry fertile slopes, southern Sydney Basin Bioregion (moderate – good) – Poor quality
- Miscellaneous ecosystem – major rock outcrop - (lichen, moss mats, rock fern, cockspur flower and Illawarra Zieria)

Map: 2267315A_GIS_F047_A1	Author: A Labruyere
Date: 8/09/2016	Approved by: M Stables

Data source: © Land and Property Information 2015

0 30 60 m

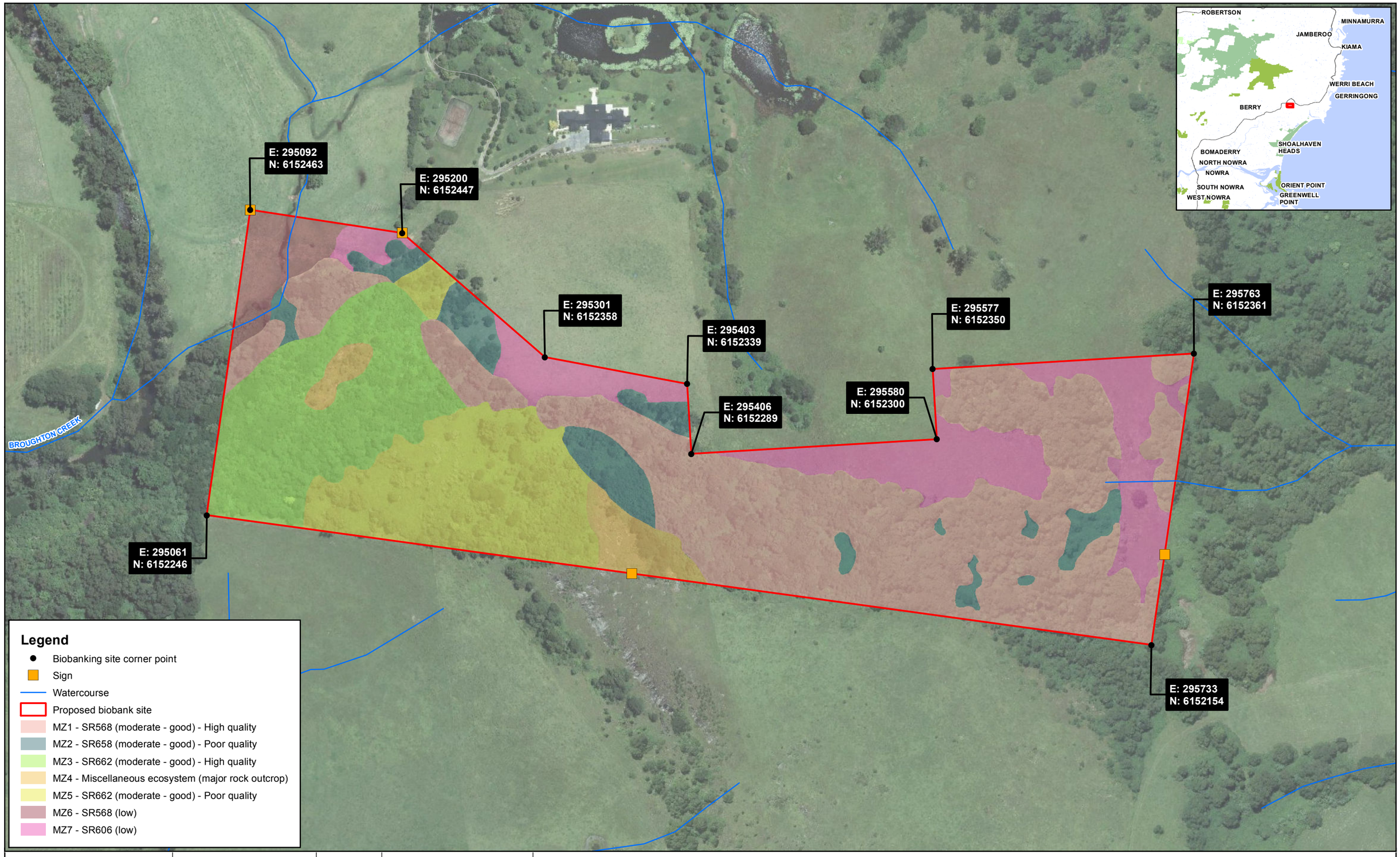
1:2,000

Coordinate system: GDA 1994 MGA Zone 56

Scale ratio correct when printed at A3

WSP | PARSONS BRINCKERHOFF

Foxground to Berry
Figure 4.6
BioBanking Site 45 – Vegetation Zones



Map: 2267315A_GIS_F051_A1	Author: A Labruyere
Date: 9/09/2016	Approved by: M Stables

Data source: © Land and Property Information 2015

0 30 60 m

1:2,500

Coordinate system: GDA 1994 MGA Zone 56

Scale ratio correct when printed at A3

WSP | PARSONS BRINCKERHOFF

Foxground to Berry
Figure 4.7
BioBanking Site 45 – Management Zones

4.3.4 BioBanking site 47

This BioBanking site is situated within the Kiama LGA and is wholly located on land owned by Roads and Maritime. Site 47 is located on part of L4 DP778833, L79 DP1186383, L414 DP1186383 & L416 DP1186383, being 161 & 199 Princes Highway, Broughton Village, NSW (Figure 4.1). These properties were acquired by Roads and Maritime to enable orderly construction of the Foxground and Berry Bypass project. The newly aligned Princes Highway bisects a number of these properties and at the completion of the project these properties will be reconfigured into a single land parcel and title.

The proposed BioBanking site is approximately 7 hectares in size and generally comprises of land within 40 metres of Broughton Creek, immediately adjacent to the project. Based on suitability methodology and scoring, Site 47 ranked relatively poorly with an overall score of 10 (Table 4.12). The lower ranking score generally resulted from the size and shape of the remnant. Although the highest score for a property was 17, the score of 10 was the second highest for a property with Riverbank Forest. Overall, this property was selected based on the most suitable Riverbank Forest vegetation offset option.

Table 4.12 Biodiversity offset ranking for Site 47

RANKING CRITERIA	SITE CHARACTERISTIC	SCORE
Required vegetation communities	Riverbank Forest – PCT 1105 / BVT SR606	1
Distance from the Project	<5km	4
Size of remnant	<10 ha	0
Shape of remnant	Vegetation with high edge to area ratio. Includes patchy/ fragmented vegetation or long-narrow remnants	0
Connectivity	Occurs within an identified wildlife corridor	1
Vulnerability of the lands to loss of biodiversity value without protection	Environmental zoning	3
Total score		**10**

Notwithstanding the lower ranking score, this site was selected based on being the most suitable Riverbank Forest vegetation offset option.

Detailed BBAM surveys have been undertaken to assess landscape features, native vegetation, threatened species and populations to determine the BioBanking values of the site. These values have been incorporated into a BioBanking Assessment report and credit calculations.

To ensure the biodiversity offset achieves and improves biodiversity outcomes, Roads and Maritime have committed to the purchase and retirement of the following ecosystem credits on the final establishment of a BioBanking agreement as outlined in Table 4.13.

Table 4.13 Ecosystem credits generated within BioBanking Site 47

REQUIRED VEGETATION TYPE FOR PROJECT OFFSET	NSW PLANT COMMUNITY TYPE & CONDITION CLASS IDENTIFIED WITHIN THE SITE	THREATENED ECOLOGICAL COMMUNITY	TOTAL AREA AVAILABLE (HA)	NUMBER OF ECOSYSTEM CREDITS GENERATED
Riverbank Forest	PCT 1105 / BVT SR606 – River Oak open forest of major streams, Sydney Basin Bioregion and South East Corner Bioregion in (moderate to good) – medium quality	Yes – River-flat Eucalypt Forest on Coastal Floodplains	0.23	2

REQUIRED VEGETATION TYPE FOR PROJECT OFFSET	NSW PLANT COMMUNITY TYPE & CONDITION CLASS IDENTIFIED WITHIN THE SITE	THREATENED ECOLOGICAL COMMUNITY	TOTAL AREA AVAILABLE (HA)	NUMBER OF ECOSYSTEM CREDITS GENERATED
Riverbank Forest	PCT 1105 / BVT SR606 – River Oak open forest of major streams, Sydney Basin Bioregion and South East Corner Bioregion in (moderate to good) – poor quality	Yes – River-flat Eucalypt Forest on Coastal Floodplains	2.37	22
	PCT 1105 / BVT SR606 – River Oak open forest of major streams, Sydney Basin Bioregion and South East Corner Bioregion in (low)	Yes – River-flat Eucalypt Forest on Coastal Floodplains	3.5	29
Total area and BioBanking ecosystems credits generated			**6.1**	**53**

PCT 1105 / BVT SR606 – River Oak open forest of major streams, Sydney Basin Bioregion and South East Corner Bioregion (moderate to good) – poor quality

PCT 1105 / BVT SR606 – River Oak open forest of major streams, Sydney Basin Bioregion and South East Corner Bioregion (low)

The BioBanking calculator has estimated that the ecosystem credits generated on this site are considered to provide potential habitat for a range of threatened fauna species as outlined in Table 4.14. The BioBanking site vegetation zones and proposed management zones are shown in Figure 4.8 and Figure 4.9.

Table 4.14 Threatened fauna species reliably predicted to utilise Site 47 based on BioBanking credit calculator output

SCIENTIFIC NAME	COMMON NAME	TSC ACT[1]	EPBC ACT[2]	PCT/BVT
Birds				
Burhinus grallarius	Bush Stone-curlew	E	-	PCT1105 / BVTSR5606
Callocephalon fimbriatum	Gang-gang Cockatoo	V	-	PCT1105 / BVTSR5606
Calyptorhynchus lathami	Glossy Black-cockatoo	V	-	PCT1105 / BVTSR5606
Hieraaetus morphnoides	Little Eagle	V	-	PCT1105 / BVTSR5606
Glossopsitta pusilla	Little Lorikeet	V	-	PCT1105 / BVTSR5606
Ninox connivens	Barking Owl	V	-	PCT1105 / BVTSR5606
Tyto novaehollandiae	Masked Owl	V	-	PCT1105 / BVTSR5606
Circus assimilis	Spotted Harrier	V	-	PCT1105 / BVTSR5606

SCIENTIFIC NAME	COMMON NAME	TSC ACT[1]	EPBC ACT[2]	PCT/BVT
Lophoictinia isura	Square-tailed Kite	V	-	PCT1105 / BVTSR5606
Stagonopleura guttata	Diamond Firetail	V	-	PCT1105 / BVTSR5606
Petroica phoenicea	Flame Robin	V	-	PCT1105 / BVTSR5606
Petroica boodang	Scarlet Robin	V	-	PCT1105 / BVTSR5606
Neophema pulchella	Turquoise Parrot	V	-	PCT1105 / BVTSR5606
Daphoenositta chrysoptera	Varied Sittella	V	-	PCT1105 / BVTSR5606
Bats				
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	-	PCT1105 / BVTSR5606
Mormopterus norfolkensis	Eastern Freetail-bat	V	-	PCT1105 / BVTSR5606
Scoteanax rueppellii	Greater Broad-nosed Bat	V	-	PCT1105 / BVTSR5606
Saccolaimus flaviventris	Yellow-bellied Sheathtail Bat	V	-	PCT1105 / BVTSR5606
Mammals				
Dasyurus maculatus	Spotted-tailed Quoll	V	E	PCT1105 / BVTSR5606

(1) V – Vulnerable species listing under the TSC Act
(2) E – Endangered species listing under the EPBC Act

Overall, the selection of Site 47 delivers like for like vegetation offsets for Riverbank Forest vegetation (PCT1105) and provides suitable habitat for many of the threatened fauna species identified as being potentially subject to the project impacts. The site is located within the 'Escarpment to Sea' Berry Corridor and is consistent with Landcare initiatives in the local area particular Foxground and Berry Landcare groups who have been working extensively within are around the Broughton Creek corridor.

In addition, Site 47 directly adjoins the project footprint at two bridge crossings of Broughton Creek where it is generally located on the western and northern side of the creek with a 40 m buffer from the top of the creek. The site also crosses over the creek where it connects to site 45 (Figure 4.8). The site is complementary to the fauna connectivity structures that form part of the overall project biodiversity mitigation measures. These fauna connectivity structures include a rope bridge over and under bridge structure in the western portion of the site and a rope bridge over road structure and a rope bridge over and under bridge structure. The strengthening of the existing riparian corridor along Broughton Creek within Site 47 is considered to lead to an overall enhancement of these project specific biodiversity mitigation measures over the longer term.

Map: 2267315A_GIS_F048_A3	Author: A Labruyere
Date: 7/10/2016	Approved by: M Stables

Data source: © Land and Property Information 2015

0 60 120 m

1:4,000

Coordinate system: GDA 1994 MGA Zone 56

Scale ratio correct when printed at A3

WSP | PARSONS BRINCKERHOFF

Foxground to Berry
Figure 4.8
BioBanking Site 47 – Vegetation Zones

THOMPSONS ROAD

PRINCES HIGHWAY

BROUGHTON CREEK

TOMLINS ROAD

Q1

Q2

Q3

Q4

Legend

- Biobanking plot
- Fauna rope bridge
- Proposed road design
- Watercourse
- Bridges
- Biodiversity site
- MZ1 - SR606 (moderate - good) - Poor quality
- MZ2 - SR606 (low)
- MZ3 - SR606 (moderate - good) - Medium quality

Map: 2267315A_GIS_F052_A2	Author: A Labruyere
Date: 7/10/2016	Approved by: M Stables

Data source: © Land and Property Information 2015

0 60 120 m

1:4,000

Coordinate system: GDA 1994 MGA Zone 56

Scale ratio correct when printed at A3

WSP | PARSONS BRINCKERHOFF

Foxground to Berry
Figure 4.9
BioBanking Site 47 – Management Zones

4.4 Summary of the biodiversity offset package

Overall the final selected BOP comprises four separate properties that will have four separate BioBanking agreements established over vegetated parts of each property. Collectively the four properties will provide a biodiversity offset of approximately 70.3 hectares of native vegetation.

A summary overview of the BOP against project impacts is provided in Table 4.15. Given a shortfall of approximately 5.1 hectares has been identified on a 'like for like basis', an additional 13 hectares of threatened ecological communities will be provided as part of the BOP (Table 4.16). This has been agreed with OEH.

Table 4.15 Summary of biodiversity offset package against project impacts and BOS offset requirements

VEGETATION IMPACTED BY PROJECT	CLOSEST ALIGNED PCT / BVT	TOTAL AREA IMPACTED	RATIO OFFEST REQUIRED	TOTAL OFFSET AREA REQUIRED	OFFSET PROVIDED PER BIOBANKING SITE				TOTAL OFFSET AREA PROVIDED	OFFSET SHORTFALL / EXCEEDANCE	NOTES
					7	30	45	47			
Constructed wetland	SR536	0.4	2:1	0.8	-	-	-	-	-	- 0.8	Site 7 contains three small farm dams that exhibit native aquatic vegetation. Given the small size and artificial construct these dams were not aligned to the PCTs. This shortfall will be made up by the conservation of additional areas of threatened ecological communities.
Illawarra Gully Wet Forest & Disturbed riparian open woodland	694 / SR516	18	2:1	36	23.6	17.1	-	-	40.7	+ 4.7	PCT 694 and 1245 are both Wet Sclerophyll Forests (Shrubby sub-formation) of the North Coast Wet Sclerophyll Forest class. Under BioBanking trading rules these PCTs are interchangeable and act as surrogates for offset purpose.
Warm temperate layered forest	1245 / SR652	6.9	2:1	13.8	6.8	3.3	-	-	10.1	- 3.7	As stated above, the shortfall for this vegetation type is offset by the exceedance of 4.7 ha of PCT 694 / SR516 based on BioBanking trading rules.

VEGETATION IMPACTED BY PROJECT	CLOSEST ALIGNED PCT / BVT	TOTAL AREA IMPACTED	RATIO OFFEST REQUIRED	TOTAL OFFSET AREA REQUIRED	OFFSET PROVIDED PER BIOBANKING SITE				TOTAL OFFSET AREA PROVIDED	OFFSET SHORTFALL / EXCEEDANCE	NOTES
					7	30	45	47			
Riverbank forest (considered to form part of the threatened ecological community – River-flat Eucalypt Forest on Coastal Floodplain)	1105 / SR606	2.9	4:1	11.6	-	-	0.4	6.1	6.5	- 5.1	The shortfall of 5.1 hectares has occurred based on the difficulty to secure suitable offset properties with large enough patches of this vegetation type. Site 29 at Bundanoon was inspected as part of the shortlisted property options however given the highly modified nature of the vegetation condition and distance to the project impact this property was not deemed a viable selection option. A surrogate option this offset requirement is the inclusion of Site 45 that contains threatened ecological community vegetation and endangered flora populations to supplement this short fall.
Total		**30.4**		**66.6**					**57.3**	**- 4.9**	**A total offset shortfall of 4.9 hectares is primarily due to the lack of viable Riverbank Forest offset options. This shortfall has been supplemented by the inclusion of an additional 13 hectares of threatened ecological community with additional summary details provided in** Table 4.16

Table 4.16 Supplementary offset attributes to cover the shortfall in project impacts and BOS offset requirements

BIODIVERSITY ATTRIBUTE	TSC ACT[1]	EPBC[2] ACT	OFFSET SITE	TOTAL AREA (HA)	SPECIES COUNT	NOTES
PCT1231 / BVT SR648 Swamp Mahogany swamp sclerophyll forest on coastal lowlands of the Sydney Basin Bioregion and South East Corner Bioregion	E4 – Swamp Sclerophyll Forest on Coastal Floodplain	-	30	2.6	-	This offset provides 2.6 hectares of threatened ecological community to partially supplement the 5.1 hectare shortfall of Riverbank Forest.

BIODIVERSITY ATTRIBUTE	TSC ACT[1]	EPBC[2] ACT	OFFSET SITE	TOTAL AREA (HA)	SPECIES COUNT	NOTES
PCT 906 / BVT SR5688 – Lilly Pilly – Sassafras – Stinging Tree subtropical/warm temperate rainforest on moist fertile lowlands, southern Sydney Basin Bioregion	E4 – Illawarra Subtropical Rainforest	-	45	7.1	-	This offset provides 7.1 hectares of threatened ecological community to supplement the 5.1 hectare shortfall of Riverbank Forest.
PCT 1300 / BVT SR662 – Whalebone Tree – Native Quince dry subtropical rainforest on dry fertile slopes, southern Sydney Basin Bioregion	E4 – Illawarra Subtropical Rainforest	-	45	3.3	-	This offset provides 3.3 hectares of threatened ecological community to supplement the 5.1 hectare shortfall of Riverbank Forest.
Daphnandra johnsonii (Illawarra Socketwood)	E1	E	45	-	205	Additional biodiversity offset value through the long-term protection and management of an endangered flora population.
Zieria granulata (Illawarra Zieria)	E1	E	45	-	39	Additional biodiversity offset value through the long-term protection and management of an endangered flora population.
TOTAL				**13**		

(1) E1 – Endangered species, E4 – Endangered ecological community under the TSC Act
(2) E – Endangered species under the EPBC Act

Table 4.17 Overall compliance of BOP with CoA (B7) and BOS offset ratio of 2:1 for non-threatened vegetation

NON-THREATENED VEGETATION TYPE	TOTAL AREA IMPACTED (HA)	TOTAL AREA REQUIRED FOR OFFSET (HA)	TOTAL AREA PROVIDED UNDER THE BOP (HA)	OFFSET SHORTFALL / EXCEEDANCE
Constructed wetland	0.4	0.8	-	- 0.8
Illawarra Gully Wet Forest & Disturbed riparian open woodland	18	36	40.7	+4.7
Warm temperate layered forest	6.9	13.8	10.1	- 3.7
Total	**25.3**	**50.6**	**50.8**	**+ 0.2**

Table 4.18 Overall compliance of BOP with CoA (B7) and BOS offset ratio of 4:1 for threatened vegetation

THREATENED VEGETATION TYPE	TOTAL AREA IMPACTED	TOTAL AREA REQUIRED FOR OFFSET	TOTAL AREA PROVIDED UNDER THE BOP (HA)	
River-flat Eucalypt Forest on Coastal Floodplain	2.9	11.6	6.5	- 5.1
Swamp Sclerophyll Forest on Coastal Floodplain	-	-	2.6	+ 2.6
Illawarra Subtropical Rainforest	-	-	10.4	+ 10.4
Total	**2.9**	**11.6**	**19.5**	**+ 7.9**

Overall the BOP exceeds the required vegetation offset area of 66.6 hectares (this figure includes 4.4 hectares of non-native vegetation) as outlined in the BOS by 3.7 hectares, with the delivery of 70.3 hectares of native vegetation in total. The BOP delivers 50.8 hectares of vegetation exceeding the required non-threatened vegetation offset of 50.6 hectares by 0.2 (Table 4.17). In respect to the required 11.6 hectares of threatened vegetation, the BOP greatly exceeds this with the delivery of 19.5 hectares that provides and exceedance of 7.9 hectares (Table 4.18).

4.5 Security of offset sites and monitoring

4.5.1 Overview

Roads and Maritime are committed to establishing a biodiversity offset package that will provide ongoing conservation of land in perpetuity for the benefit of future generations. Offsets therefore must be enduring and must offset the impact of the development for the period that the impact occurs. The security of land tenure and ongoing management of offset sites is critical to the long-term viability of offsets and has been carefully considered.

To ensure the conservation of lands in-perpetuity, the offset package will secure offsets the establishment of BioBanking agreements on all offset properties and are committed to the full purchase and retirement of all ecosystem and species credits generated. BioBanking agreements are currently being finalised with private land owners and on the both Roads and Maritime properties (Sites 45 & 47).

BioBanking agreements will ensure the offset sites will be adequately monitored for positive conservation outcomes in perpetuity.

4.5.2 Management and monitoring requirements

Condition B8 of the projects CoA's requires management, maintenance and monitoring requirements to ensure that outcomes of the package are achieved.

The responsibility for management, maintenance and monitoring of the offset sites are prescribed under the individual BioBanking agreements and lies with the land owners of the agreements. These prescribed management, maintenance and monitoring requirements are guaranteed commitments for those properties. The BioBanking agreements can be referred to for full detail, however a summary of the management measures included in the BioBanking agreements and associated management plans for each BioBanking site is provided below.

4.5.2.1 STANDARD MANAGEMENT ACTIONS

Standard management actions are required on all BioBank sites to improve vegetation condition when entering into a BioBanking agreement.

The standard management actions for all BioBank sites are:

- elimination of grazing
- weed control
- elimination of fire where possible
- management of human disturbance (e.g. limiting use and creation of informal tracks)
- retention of regrowth and remnant native vegetation
- replanting or supplementary planting where natural regeneration will not be sufficient/possible
- retention of dead timber
- erosion control
- retention of bush rock.

Management plans are attached to the BioBanking agreements to prescribe how the above actions will be implemented.

Specific management and monitoring plans also apply to the offset sites, which outline monitoring, reporting and record keeping requirements. These apply on an annual basis and are to include photographic points at monitoring sites, a monitoring schedule, annual reporting requirements and record-keeping procedures. Monitoring and associated reporting to OEH is the responsibility of the landholder and is outlined in detail in the Management Actions plan for each property developed as part of the BioBanking agreement.

4.5.3 Remedial actions

Remedial actions will required to be undertaken where the monitoring and OEH determine that biodiversity outcomes are not being achieved. The process for this is outlined in the BioBanking agreements and includes the following statement:

> *The landowner must notify the Chief Executive* [of the Office of Environment and Heritage] *in writing as soon as practicable after becoming aware of any failure to comply with this agreement or any other incident at the Biobank site (or surrounds) which results or may result in a sudden or significant decline of biodiversity values at the Biobank site. In particular, the landowner must notify the Chief Executive of:*
>
> - *the nature, location and time of the incident*
> - *the impact of the incident on biodiversity values*
> - *the measures that have been taken or will be taken in response to the incident*
> - *any provision of this agreement which may have been breached*
> - *the extent of any damage caused or permitted by the incident*
> - *the measures which have been taken or will be taken to prevent a recurrence of the incident.*

It is expected that such measures will ensure that appropriate remedial actions are taken as required, including supervision and sign off by OEH.

5 COMPLIANCE WITH NSW OFFSETTING PRINCIPLES

The overriding policy that applies to determine offsets for this project is the '*Principles for the use of Biodiversity Offsets in NSW*' (Department of Environment and Climate Change, 2008). These were provided by the OEH as guidelines for developing biodiversity offsets to achieve conservation outcomes, particularly for projects where there will be an unavoidable loss of biodiversity. Although not a defined requirement under legislation, these guidelines provide a list of 13 principles to be followed when developing biodiversity offsets. The 13 principles are addressed below in relation to the biodiversity impacts of the project and the proposed BOP.

1. Impacts must be avoided first by using prevention and mitigation measures

Given the location and nature of the project and its context with regard to existing road infrastructure, there is limited scope for using alternative locations to entirely avoid impacts on biodiversity.

Reduction of impacts on areas of high ecological value were considered in the analysis and evaluation of design options for the project by Roads and Maritime. In addition substantial mitigation measures for the project were implemented as part of the Flora and Fauna Management Plan (Roads and Maritime Services, 2014), Ecological Monitoring Program (Parsons Brinckerhoff, 2014b), and Environmental Impact Assessment (AECOM, 2012).

2. All regulatory requirement must be met

This BOP forms part of the CoA (Condition B8) for the project. A summary of where the package addresses the specific requirements of Condition B8 is provided in Table 1.1.

This BOP outlines the offset measures and the strategy proposed to offset any impacts of the actions on matters of state and national environmental significance.

3. Offsets must never reward ongoing poor performance

Roads and Maritime are committed to providing biodiversity offsets for residual impacts to native vegetation and has procedures and policies in place to ensure appropriate management of land under their control.

4. Offsets will complement other government programs

This BOP incorporates offsets under the NSW BioBanking Scheme. It will also provide offsets that are considered complementary to the NSW Saving Our Species programs for the endangered *Daphnandra johnsonii* (Illawarra Socketwood) and *Zieria granulata* (Illawarra Zieria).

The proposed offsets are complementary to Berry Corridor 'Escarpment to Sea' project that is identified in the South Coast Regional Conservation Plan and the Southern Rivers Catchment Action Plan. The Berry Corridor is also reflected in the South Coast Regional Strategy and links with the Great Eastern Ranges Corridor.

The BOP has also been prepared in consultation with Landcare groups and has attempted to ensure that final selected properties play a complementary role in the ongoing conservation projects being implemented in the local area.

5. Offsets must be underpinned by sound ecological principles

The selection of the final proposed offset properties has been guided by the approved BOS and underpinned by detailed field survey carried out in accordance with BioBanking assessment methodology.

The proposed offsets have been determined with direct reference to the likely impacts of the project and where slight variations have occurred, improve or maintain outcomes has been achieved to enhance ecological values of the local area. Other considerations that have been addressed as part of the final package include the:

- types and areas of habitat and vegetation types that will be offset
- size and shape of the offsets
- relationship of the offsets to other areas of vegetation
- role the offset areas play in the wider vegetation/habitat network
- contribution of the offset areas towards reservation targets for vegetation communities
- ability of the offset areas to contribute towards maintaining and improving biodiversity values including viable populations and viable examples of terrestrial ecosystems throughout their range.

6. Offsets should aim to result in a net improvement in biodiversity over time

The long-term protection of habitats and species in off-reserve areas will contribute to an overall net improvement in biodiversity values over time. The proposed offset approach using the NSW BioBanking Scheme (combining long-term protection of existing habitat and restoration, rehabilitation and re-establishment of the degraded habitats) will protect, actively manage, and create habitat for the range of threatened species and ecological communities impacted by the project and two plant species and two threatened ecological community not impacted upon by the project. This will result in a net improvement in biodiversity over time.

The proposed offsets are likely to result in a net improvement over time in both size and scale, through which a ratio (offset: clearing) of approximately 4:1 for areas of high conservation (i.e. threatened ecological communities and poorly conserved vegetation communities identified as being more than 75% cleared in the CMA) and 2:1 for the remainder of native vegetation (i.e. threatened species habitat and non-threatened riparian vegetation) as outlined in the CoA.

7. Offsets must be enduring and they must offset the impact of the development for the period that the impact occurs

The BOP incorporates offsets under the NSW BioBanking Scheme which will place legal restrictions on the future use and management of the land that would exist within the title for the land in perpetuity. This will ensure that the offsets are enduring and that they will offset the impact of the development for the period that the impact occurs.

8. Offsets should be agreed prior to the impact occurring

Given the residual impacts of the project on native vegetation, a BOS was developed by Biosis Research (2012), on behalf of Roads and Maritime and submitted with the EIS. The project was granted approval subject to CoA in 22 July 2013 which required a BOS be prepared in accordance with conditions outlined in the CoA. Subsequently, a revised BOS was prepared by Parsons Brinckerhoff (2014c) describing the biodiversity offsets required to compensate for the identified residual impacts and medium to long term measures required to improve ecological outcomes.

The BOS was quantified in accordance with the principles for the use of Biodiversity Offsets in NSW and prescribed offset ratios detailed in the project's CoA. Under Condition B7 the BOS was to be submitted to the Director General for approval no later than 6 weeks prior to the commencement of construction unless otherwise agreed by the Director General. The BOS was submitted greater than 6 weeks prior to the commencement of construction.

9. Offsets must be quantifiable (the impacts and benefits must be reliably estimated)

The BOP has been quantified using the prescribed offset ratios detailed in Condition B7 of the project's CoA and are based on comparison of offset site values with the residual impacts on biodiversity identified in the EIS. It has been assessed for adequacy in accordance with the Principles for the use of Biodiversity Offsets in NSW, and CoA (using a ratio (offset: clearing) of approximately 4:1 for areas of high conservation (i.e. threatened ecological communities and poorly conserved vegetation communities identified as being more

than 75% cleared in the CMA) and 2:1 for the remainder of native vegetation (i.e. threatened species habitat and non-threatened riparian vegetation)).

10. Offsets must be targeted

The proposed offset sites have been targeted to contain the specific species, habitat and vegetation requirements as impacted by the project. The proposed offset sites generally contain vegetation types of similar or greater conservation value, located in the same IBRA subregion (Illawarra), contain similar habitat values for threatened species and provide additional areas of threatened ecological communities listed on the TSC Act.

11. Offsets must be located appropriately

The proposed offsets are located within the locality of the project, with the Kiama and Shoalhaven LGAs. All offsets are located in the same IBRA subregion (Illawarra), contain similar habitat values for threatened species and threatened ecological communities listed on the TSC Act, and contribute to locally important conservation priorities including wildlife and riparian corridors.

12. Offsets must be supplementary

The areas identified for offsetting have not been proposed as offsets for any other project. All four of the land parcels are located on private freehold land and not subject to current or on-going conservation management. The offset properties will be supplementary to the existing Council and OEH conservation reserves.

13. Offsets and their actions must be enforceable through development consent conditions, licence conditions, conservation agreements or a contract.

To ensure the conservation of lands in-perpetuity, the approach adopted in this BOP provides for the purchase of ecosystem credits in accordance with the NSW BioBanking Scheme, and includes the dedication of the identified offsets under a secure conservation arrangement.

6 CONCLUSION

The project resulted in the clearing of 30.4 hectares of vegetation of which 28.2 hectares comprises of native vegetation and 2.2 hectares of non-native vegetation (closed grassland / sedgeland). Of the vegetation removed, approximately 25.3 hectares was considered non-threatened native vegetation that requires a 2:1 offset ratio, and 2.9 hectares form part of the threatened ecological community River-flat Eucalypt Forest listed as Endangered under the TSC Act, which requires a 4:1 offset ratio. Therefore Roads and Maritime are required to provide 66.6 hectares of biodiversity offsets (including 11.6 hectares of threatened native vegetation and 55 hectares of non-threatened vegetation) to meet the CoA and approved BOS.

The proposed offset approach adopted in this BOP, was to identify and establish BioBanking agreements on priority sites. Sites were identified using the BOS selection methodology that specifically targeted high priority conservation values and vegetation types impacted by the project, in consultation with OEH, DPI and local Landcare groups. The final four proposed offset sites are outlined in Table 6.1 below.

Table 6.1 Final proposed offset sites

SITE ID	LOT & DP	ADDRESS	BIOBANKING SITE AREA (ha)
7	Part of L81 DP1188079	A371 Princes Highway, Broughton	30.45
30	Part of L401 DP1176501	83 Agars Lane, Berry	23
45	Part of LA DP377518	37 Princes Highway, Broughton Village	11.2
47[1]	Part of L4 DP778833 L79 DP1186383 L414DP1186383 L416 DP1186383	161 & 199 Princes Highway, Broughton Village	6.1

Biodiversity assessments have been completed at each of the four proposed offset sites. These will support the BioBanking Agreement applications that will be submitted to OEH by the landholders. Negotiations are underway with private landholders and early indications from the landholders are positive. Any future BioBanking Agreement and subsequent generation of credits for purchase by Roads and Maritime, is therefore still subject to landholder and OEH approval at each of the proposed offset sites.

In the event that negotiations fail, additional shortlisted properties have been earmarked to fulfil the required vegetation type offsets. These properties include two Council managed reserves being Moeyan Hill (Site 43) and Coolangatta Mountain (Site 44) along with a privately owned land parcel on Woodhill Mountain Road, Woodhill (Site 25).

Once established and the credits retired, the BioBanking sites will meet the project's offset requirements in accordance with the NSW OEH *Principles for the use of biodiversity offsets in NSW* (Department of Environment and Climate Change, 2008) and the project's CoA. The proposed BOP will provide the quantum of area ratios and subsequent ecosystem credits required for the project to achieve an improved net outcome.

The proposed offsets will provide for the equivalent of in perpetuity conservation of approximately 71.65 ha of native vegetation.

The proposed offsets will deliver a total of approximately 71.65 hectares of native vegetation of which 50.85 hectares comprises non-threatened native vegetation and 20.8 hectares of threatened native vegetation. This exceeds the required non-threatened vegetation offset (50.6 hectares) by 0.25 and delivers 50.85 hectares of non-threatened vegetation. This is consistent with the 2:1 ratio offset outlined under CoA B7 and the approved BOS.

In terms of threatened native vegetation, the proposed offsets will deliver a total of 20.8 hectares, which greatly exceeds the 4:1 ratio offset of 11.6 ha outlined in the BOS.

The proposed offsets will also provide supplementary net gain biodiversity outcomes in the form of in perpetuity protection and funded management for two endangered flora species being *Daphnandra johnsonii* (Illawarra Socketwood) and *Zieria granulata* (Illawarra Zieria).

The proposed offsets will be delivered in accordance with the NSW BioBanking scheme. Once BioBanking Agreements are established on the proposed offset sites, enduring funded management actions and monitoring will be provided to enable biodiversity gain over time.

6.1 Next steps in the process

In order to meet the project's CoA, this BOP is to be submitted to the DP&E for approval prior to 27 October 2016.

Negotiations are underway with private landholders and BioBanking Agreement applications are being prepared for the four priority offset sites. Should negotiations or agreements fail, Roads and Maritime will consult with DP&E and provide an alternative proposal in accordance with this BOP.

Once the BioBanking Agreements are established, Roads and Maritime will purchase credits and inform DP&E of the subsequent retirement of credits against this BOP.

7 REFERENCES

AECOM 2012. Princess Highway Upgrade - Foxground and Berry bypass Environmental Assessment - For Roads and Maritime. Sydney.

BIOSIS RESEARCH 2012. Foxground and Berry bypass, Princes Highway upgrade - Environmental assessment, Volume 2 - Appendix F - Technical paper: Terrestrial flora and fauna - For Roads and Maritime Services. . Alexandria.

CARDNO ECOLOGY LAB 2012. Foxground and Berry bypass, Princes Highway upgrade - Environmental assessment, Volume 2 - Appendix G - Technical paper: Aquatic ecology and water quality management - For Roads and Maritime Services. St Leonards.

DEPARTMENT OF ENVIRONMENT AND CLIMATE CHANGE 2007. Biodiversity Banking and Offsets Scheme - Scheme Overview. Sydney South.

DEPARTMENT OF ENVIRONMENT AND CLIMATE CHANGE. 2008. *Principles for the use of biodiversity offsets in NSW* [Online]. Hurstville, Sydney. Available: http://www.environment.nsw.gov.au/biocertification/offsets.htm.

DEPARTMENT OF PRIMARY INDUSTRIES 2013. Fisheries NSW Policy and Guidelines for Fish Habitat Conservation and Management (2013 upate). Wollongbar: NSW Department of Primary Industries,.

OFFICE OF ENVIRONMENT AND HERITAGE 2014a. BioBanking Assessment Methodology 2014. Sydney.

OFFICE OF ENVIRONMENT AND HERITAGE 2014b. Framework for Biodiversity Assessment - NSW Biodiveristy Offsets Policy for Major Projects. Sydney: Office of Environment and Heritage for the NSW Government.

PARSONS BRINCKERHOFF 2014a. Foxground and Berry bypass Princes Highway upgrade: nest box managment plan. Sydney: Parsons Brinckerhoff.

PARSONS BRINCKERHOFF 2014b. Princes Highway Upgrade - Foxground and Berry Bypass Project - Ecological Monitoring Program - For Roads and Maritime. Sydney.

PARSONS BRINCKERHOFF 2014c. Princess Highway Upgrade - Foxground and Berry Bypass Project - Biodiversity Offsets Strategy - for Roads and Maritime Sydney.

ROADS AND MARITIME 2011. Guideline for Biodiversity Offsets. *In:* ROBERTS, K. (ed.).

ROADS AND MARITIME SERVICES 2014. Flora and Fauna Management Sub Plan Toolijooa Road Fill Works stage of Foxground and Berry bypass 4ed. Sydney.

WSP | PARSONS BRINCKERHOFF