Planning, Industry & Environment

Mr Scott Lawrence
Environmental Manager
Transport for NSW – Northern Project Office
PO Box 576
Grafton NSW 2460

24/06/2021

Dear Mr Lawrence

Coffs Harbour Bypass (SSI 7666)
Threatened Species Management Plan

I refer to your submission of the Threatened Species Management Plan (TSMP), Revision 4, dated 24 March 2021, for information required under condition E16 of the project approval (SSI 7666). I also acknowledge your response to the Department's request for additional information.

I note that the TSMP:

- has been reviewed by Transport for NSW, and no issues have been raised;
- has been prepared by a suitably qualified and experienced ecologist; and
- has been prepared in consultation with the EESG, DAWE, DPI Fisheries and Council.

It is acknowledged that the Threatened Species Management Plan (Revision 4) relates specifically to 'early works', please ensure that the document is updated prior to commencement of construction and operational activities.

You are reminded that if there is any inconsistency between the TSMP and the conditions of approval, then the requirements of the conditions of approval will prevail. Please ensure that you make the document publicly available on the project website.

If you wish to discuss the matter further, please contact Lee McCourt on lee.mccourt@planning.nsw.gov.au.

Yours sincerely

Jake Shackleton
Director – Infrastructure Management

As nominee of the Planning Secretary

Transport for
New South Wales

Coffs Harbour Bypass

Threatened Species Management Plan

Transport for New South Wales | Working Draft | May 2021

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Document Review

Date	Version	Status	Sent to	Represent	Dispatched by	Purpose of review/update
17/12/2020	2	Draft	T. Gooley	TfNSW	D. Rohweder	Preliminary review and update for purpose of pre-construction work.
18/3/2021	3	Draft	T. Gooley	TfNSW	D. Rohweder	Preliminary review and update for purpose of pre-construction work.
24/3/2021	4	Working draft	T. Gooley	TfNSW	D. Rohweder	Preliminary review and update for purpose of pre-construction work.

Document Distribution

Date	Version	Status	Sent to	Represent	Delivered Format	Dispatched By

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1. Introduction

1.1 Overview

Transport for New South Wales (TfNSW) received state approval on 2 November 2020 and federal approval on 8 December 2020 to construct the Coffs Harbour Bypass (the project). The project is situated in the Coffs Harbour local government area (LGA) and located to the west of the Coffs Harbour urban area in northern NSW (Figure 1).

The Coffs Harbour Bypass complements the Pacific Highway upgrade program which, when complete, will provide free flowing dual carriageway conditions for the Pacific Highway between Hexham and the Queensland border. The principal objectives of the Pacific Highway upgrade program are to:

- Improve traffic safety
- Reduce travel times and freight costs
- Engage the community and consider their issues
- Support economic development
- Support Ecologically Sustainable Development (ESD) principles
- Provide a safe workplace
- Achieve value for money.

The Pacific Highway upgrade program also seeks to create public value and ensure safety of its workers and travelling public.

An Environmental impact statement (EIS) was prepared for the project. Appendix H, Biodiversity assessment report (2019) of the EIS provided a detailed assessment of impacts to terrestrial and aquatic biodiversity associated with the project and strategies to avoid, mitigate and manage these impacts during each project phase.

TfNSW has refined several aspects of the project as exhibited in the EIS. These changes have been developed in response to:

- Consultation with the community and landowners during the EIS public exhibition period (11 September 2019 to 27 October 2019)
- Submissions received during the EIS public exhibition period
- Continued development and refinement of the concept design and consultation with government agencies.
- Consultation with the community, landowners and stakeholder groups during the design changes display period (27 November 2019 to 13 December 2019).

The proposed design changes are:

- Englands Road interchange
- North Boambee Valley vertical alignment
- Coramba Road bus stop
- Coffs Creek flood mitigation
- Korora Hill interchange
- Kororo Public School bus interchange and Luke Bowen footbridge
- Pine Brush Creek and Williams Creek realignment
- Water quality basins.

The proposed construction changes are:

- Additional blasting
- New and revised ancillary sites
- Revised traffic management
- Construction sediment basins

Additional ecological field surveys have been completed in response to submissions received on the EIS and proposed design and construction changes. This Threatened Species Management Plan (TSMP) supports the Coffs Harbour Bypass Amendment Report (TfNSW 2020) which summarised project changes and included an updated Biodiversity Assessment Report with impact assessment.

1.2 The Project

The project includes a 12 km bypass of Coffs Harbour from south of Englands Road to Korora Hill in the north and a two kilometre upgrade of the existing highway between Korora Hill and Sapphire. The project would provide a four-lane divided highway that bypasses Coffs Harbour, passing through the North Boambee Valley, Roberts Hill and then traversing the foothills of the Coffs Harbour basin to the west and north to Korora Hill. The key features of the project include:

- Four-lane divided highway from south of Englands Road roundabout to the dual carriageway highway at Sapphire
- Bypass of the Coffs Harbour urban area from south of Englands Road intersection to Korora Hill
- Upgrade of the existing Pacific Highway between Korora Hill and the dual carriageway highway at Sapphire
- Grade-separated interchanges at Englands Road, Coramba Road and Korora Hill
- A one-way local access road along the western side of the project between the southern tie-in and Englands Road, connecting properties to the road network via Englands Road
- A new service road, located east of the project, connecting Solitary Islands Way with James Small Drive and the existing Pacific Highway near Bruxner Park Road
- Three tunnels through ridges at Roberts Hill (around 190 metres long), Shephards Lane (around 360 metres long), and Gatelys Road (around 450 metres long)
- Structures to pass over local roads and creeks as well as a bridge over the North Coast Railway
- A series of cuttings and embankments along the alignment
- Tie-ins and modifications to the local road network to enable local road connections across and around the alignment
- Pedestrian and cycling facilities, including a shared path along the service road tying into the existing shared path on Solitary Islands Way, and a new pedestrian bridge to replace the existing Luke Bowen footbridge with the name being retained
- Relocation of the Kororo Public School bus interchange
- Noise attenuation, including low noise pavement, noise barriers and at-property treatments
- Fauna crossing structures including glider poles, underpasses and fauna exclusion fencing
- Ancillary work to facilitate construction and operation of the project, including:
  - Adjustment, relocation and/or protection of utilities and services
  - New or adjusted property accesses as required
  - Operational water quality measures and retention basins
  - Temporary construction facilities and work including compound and stockpile sites, concrete/asphalt batching plant, sedimentation basins and access roads (if required).

Legend

- Construction footprint
- North Coast Railway
- Watercourse
- Park/Reserve

Coffs Harbour Bypass
Project area
Figure 1

0 0.45 0.9 1.35 km

Scale @A4: 1:48,565
GDA 1994 MGA Zone 56

N

1.3 Purpose

This working draft TSMP has been prepared to inform the site-specific and species-specific mitigation measures and management protocols to be implemented during the Project to further avoid or reduce project impacts to threatened flora and fauna. The plan provides an overarching management framework for any part of the project that is of relevance to the subject threatened flora and fauna species.

This working draft TSMP is a live document that will be reviewed and updated prior to construction and operation as new information is identified and/or confirmed as a result of implementing the actions and mitigation measures detailed within. This version of the TSMP has been prepared to facilitate early works and as such Section 5 “Pre-construction and design management measures” is most relevant. Early works are low impact and will be designed and implemented to avoid sensitive environments, threatened species and Endangered Ecological Communities. This plan will undergo further revision prior to construction, with key additions being a Rusty Plum Salvage and Relocation Plan, Nest Box Management Plan, Microbat Management Plan, updated information on threatened flora, and detailed review of construction and operational phase mitigation measures.

The plan details monitoring and reporting requirements to be implemented during the design, construction and operational phases of the project. Details have been provided on how the final monitoring sites will be selected and specifies the monitoring methods and objectives.

The TSMP will operate in conjunction with the Construction Environmental Management Plan (CEMP) and the project specific flora and fauna management plan (FFMP) to be prepared prior to construction commencing.

The TSMP includes:

- Setting out roles and responsibilities for the implementation and updating of the TSMP
- A description of the threatened flora and fauna species known to occur and be impacted by the project
- Description of potential impacts to threatened flora and fauna as a result of the project
- Established mitigation goals and targets for the management of threatened flora and fauna
- Management measures specific to threatened flora and fauna to be investigated and/or refined during the design and pre-construction, construction and operational phases of the project
- A monitoring program to assess success management measures and inform adaptive management.

1.4 Roles and responsibilities

The key environmental management roles and responsibilities for the project are described below. It is important to note that some roles and responsibilities are shared or overlap. General responsibilities for environmental management will be outlined in the CEMP and FFMP. Prior to construction, the key environmental management roles will be updated to reflect the Contractor’s organisational structure. However, key responsibilities will be assigned to relevant roles.

1.4.1 Environment Manager

Roles and responsibilities include:

a) Implementation of multi-disciplinary design review processes involving the Project Ecologist to review placement of infrastructure in relation to habitat for threatened flora and fauna

b) Ensure project design incorporates the implementation of fauna connectivity structures and suitable engineering solutions to facilitate fauna movement within the vicinity of threatened flora and fauna habitat

c) Investigate opportunities in design for installation of permanent fauna exclusion fencing along the alignment to funnel ground and arboreal fauna movements to safe crossing opportunities at the fauna crossing structures

d) Collaborate with design leads to ensure engineering/design solutions are developed to incorporate measures to maintain the background hydrology

e) Identify suitable locations for artificial microbat roosting sites and nest boxes within adjacent native vegetation, and incorporate the provision of artificial microbat roosting sites and nest boxes

f) Ensure progressive habitat restoration and revegetation in accordance with the Place Design and Landscape Plan specifications

g) Develop and facilitate induction, toolbox talks and other training programs regarding threatened species and their requirements for all site personnel.

1.4.2 Structures and drainage design lead

Roles and responsibilities include:

a) Design fauna connectivity structures and suitable engineering solutions to facilitate fauna movement within the vicinity of threatened flora and fauna habitat.

1.4.3 Civil design lead

Roles and responsibilities include:

a) Design measures to maintain the background hydrology

b) Design lighting to minimise amount of light spill into adjacent threatened flora and fauna habitat

c) Design of permanent fauna exclusion fencing along the alignment to funnel ground and arboreal fauna movements to safe crossing opportunities at the fauna crossing structures.

1.4.4 Project Ecologist

Roles and responsibilities include:

a) Identify habitat exclusion zones prior to clearing to guide the placement of infrastructure and ancillary facilities outside of threatened flora and fauna habitat areas, where possible

b) Carry out the approved fauna rehabilitation protocol

c) Carry out pre-clearing surveys undertaken in accordance with approved procedures

d) Supervise the removal of habitat trees during clearing

e) Develop and implement koala-specific management measures for the construction phase

f) Implement the approved monitoring program(s) and undertaking corrective actions when triggered by performance indicators.

1.4.5 Construction Manager

Roles and responsibilities include:

a) Prepare environmental work method statements according to requirements

b) Ensure all site workers are site inducted prior to commencement of works

c) Implement procedures detailed in the CEMP for pre-clearing and clearing activities

d) Progressively install permanent fauna fencing across the project

e) Implement koala-specific management measures for the construction phase

f) Ensure exclusion zones are clearly marked and visible on site

g) Implement measures for erosion and sediment control during construction, and containment of any spills.

h) Apply pathogen management requirements wherever pathogens are known or suspected to occur on or adjacent to the bypass, throughout construction and during maintenance works.

i) Undertake progressive habitat restoration and revegetation in accordance with the Place Design and Landscape Plan

j) Stop activities where there is an actual or immediate risk of harm to a threatened species or threatened species habitat and advise the Environment Manager.

1.4.6 Transport for New South Wales

Roles and responsibilities include:

a) Prepare a salvage and establishment plan outlining procedures for the re-establishment of rusty plum species impacted by the project. Identify suitable receiving sites for the species and apply any necessary protection/ stewardship arrangements

b) Prepare monitoring program(s), undertake reporting in consultation with relevant agencies and ensure corrective actions are implemented when triggered by performance.

It should be noted that salvage and re-establishment of scrub turpentine *Rhodamnia rubescens* individuals is not appropriate given the risk associated with spreading myrtle rust *Austropuccinia psidii* pathogens into unaffected populations of scrub turpentine.

2. Threatened flora

Two threatened flora species are addressed in this management plan, as summarised in **Table 1.**

Table 1: Threatened flora species

Scientific name	Common name	Conservation status^	
		EPBC Act	BC Act
Niemeyera whitei	Rusty plum	-	V
Rhodamnia rubescens	Scrub turpentine	-	CE

^ Conservation Status:

EPBC – Indicates the Commonwealth conservation status of each taxon under the *Environment Protection and Biodiversity Conservation Act 1999*, coded as Extinct in the wild (XW), Critically Endangered (CE), Endangered (E), Vulnerable (V) or Conservation Dependent (CD).

BC Act – indicates conservation status under the *Biodiversity Conservation Act 2016*, coded as Critically Endangered (CE), Endangered species (E1), Endangered populations (E2), Endangered ecological communities (E3), Vulnerable (V). As the CHB project commenced in the transition period to the current *Biodiversity Conservation Act 2016*, the assessment of biodiversity offsets has been undertaken under the TSC Act.

2.1 Existing knowledge and key threats

2.1.1 Rusty plum

Rusty plum *Niemeyera whitei* occurs in the coast and adjacent ranges of northern NSW from the Macleay River into southern Queensland. Its distributional stronghold is on the mid north coast around Coffs Harbour (OEH 2018).

Rusty plum typically occurs in gullies of warm temperate or littoral rainforests and the adjacent understorey of moist eucalypt forest, on poor soils below an altitude of 600 metres above sea level (OEH 2018).

Habitat clearing, timber harvesting and trampling by domestic stock form key threats to this species. Disturbance due to weed invasion (predominantly lantana) and altered fire regimes are also known to impact the suitability of habitats for this species (OEH 2018).

2.1.2 Scrub turpentine

Scrub turpentine *Rhodamnia rubescens* occurs in coastal districts north from Batemans Bay NSW to areas inland of Bundaberg in Queensland. Populations typically occur in coastal regions (OEH 2019). Scrub turpentine occurs in littoral, warm temperate and subtropical rainforest and wet sclerophyll forest usually on volcanic and sedimentary soils (OEH 2019).

Decline in health/loss of mature plants and a lack of seed based recruitment due to infection by myrtle rust *Austropuccinia psidii* is a major threat to this species. Scrub turpentine is highly to extremely susceptible to infection by myrtle rust. Habitat degradation and competition from transformer weed species, clearing from rural, agricultural, urban development and forestry operations form key threats to the species. Altered fire regimes, inappropriate use of four-wheel drive vehicles and road and track development and maintenance are also known to impact the suitability of habitats for this species (OEH 2019).

2.2 Known or expected occurrence within the project area

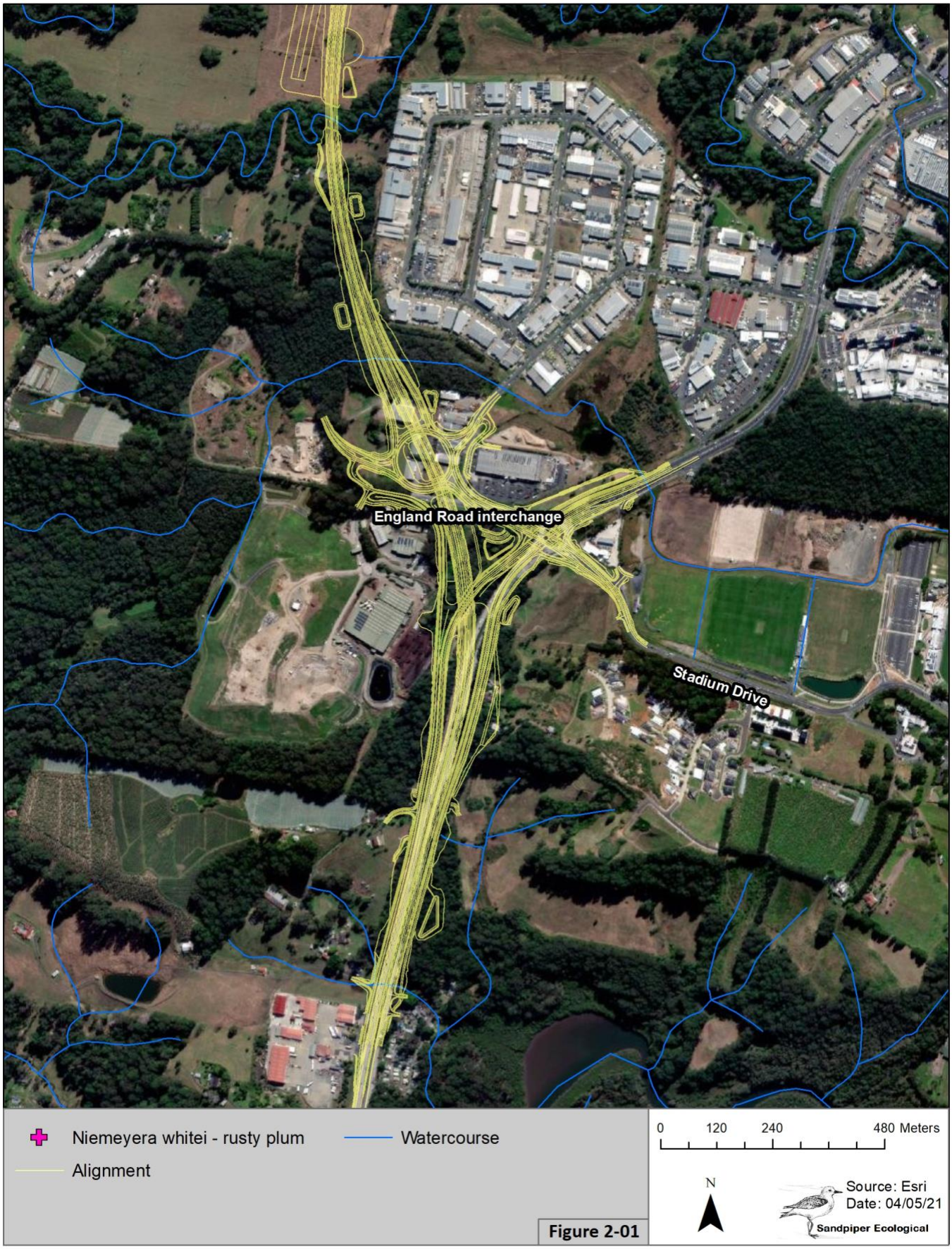
Threatened flora known and expected occurrence is provided for the project area in **Table 2** and shown in **Figure 2**.

The targeted survey for rusty plum were completed as part of the EIS field surveys in October/November 2016, February 2017, and January-March 2021. Surveys for scrub turpentine were completed in January 2020. The field survey carried out for scrub turpentine in 2016 and 2017 were completed over a slightly larger construction footprint than was surveyed in 2020. This has resulted in records for rusty plum being mapped outside the current construction footprint. The number of records for each threatened plant species presented in **Table 2** are the number of plants within the construction footprint for the amended design.

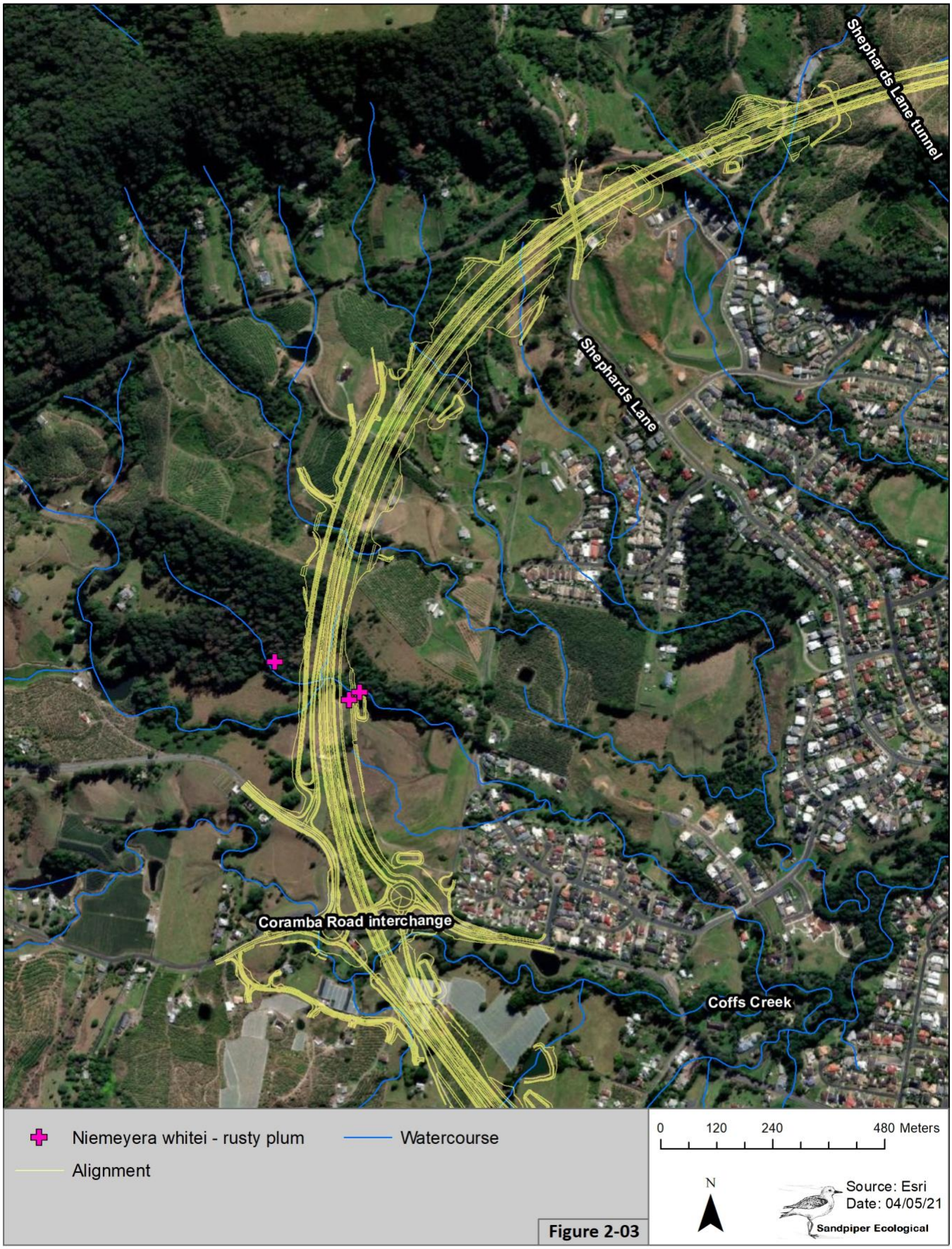
Table 2: Threatened flora records and habitat

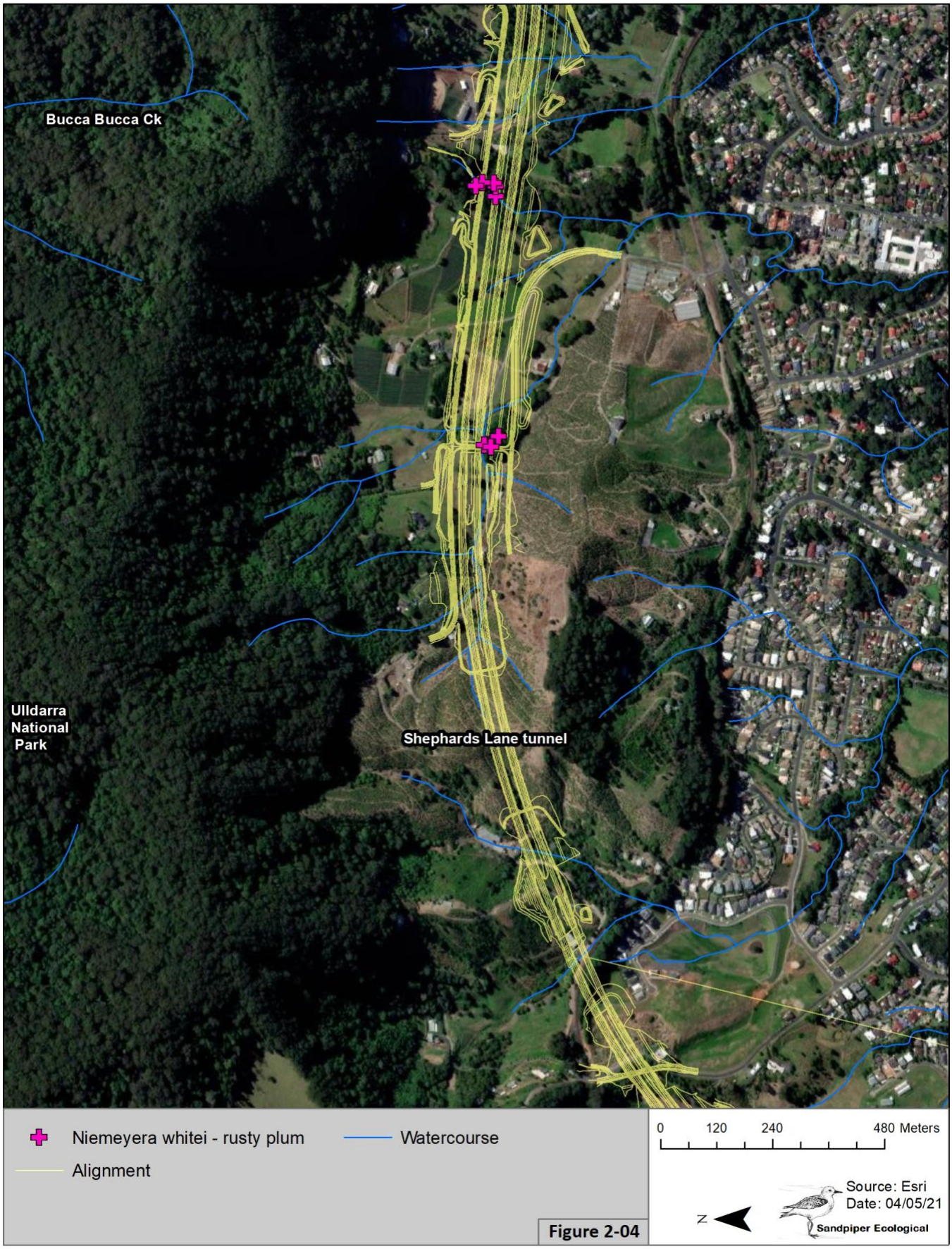
Species	Habitat within project area	Number of records	Species credit polygon (ha)
Rusty plum	Predominantly in the northern extent of the project area in gullies and depressions associated with the riparian corridors of Pine Brush Creek and Jordans Creek. This species occurred across six PCTs including: • PCT 670 Black Booyong – Rosewood – Yellow Carabeen subtropical rainforest of the North Coast • PCT 747 Brush Box - Tallowwood - Sydney Blue Gum tall moist forest of the ranges of the central NSW North Coast Bioregion • PCT 692 Blackbutt – Tallowwood moist ferny open forest of the coastal ranges of the North Coast • PCT 695 Blackbutt – Turpentine shrubby open forest of the coastal foothills of the central North Coast • PCT 1285 Turpentine moist open forest of the coastal hills and ranges of the NSW North Coast Bioregion • PCT 1262, Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast • PCT 1302 White Booyong – Fig subtropical rainforest of the NSW North Coast	74	7.95 ha
Scrub turpentine	The most records of this species were within PCT 692. This species occurred across four PCTs including: • PCT 747 Brush Box - Tallowwood - Sydney Blue Gum tall moist forest of the ranges of the central NSW North Coast Bioregion • PCT 692 Blackbutt – Tallowwood moist ferny open forest of the coastal ranges of the North Coast • PCT 695 Blackbutt – Turpentine shrubby open forest of the coastal foothills of the central North Coast • PCT 1285 Turpentine moist open forest of the coastal hills and ranges of the NSW North Coast Bioregion	14	3.05 ha

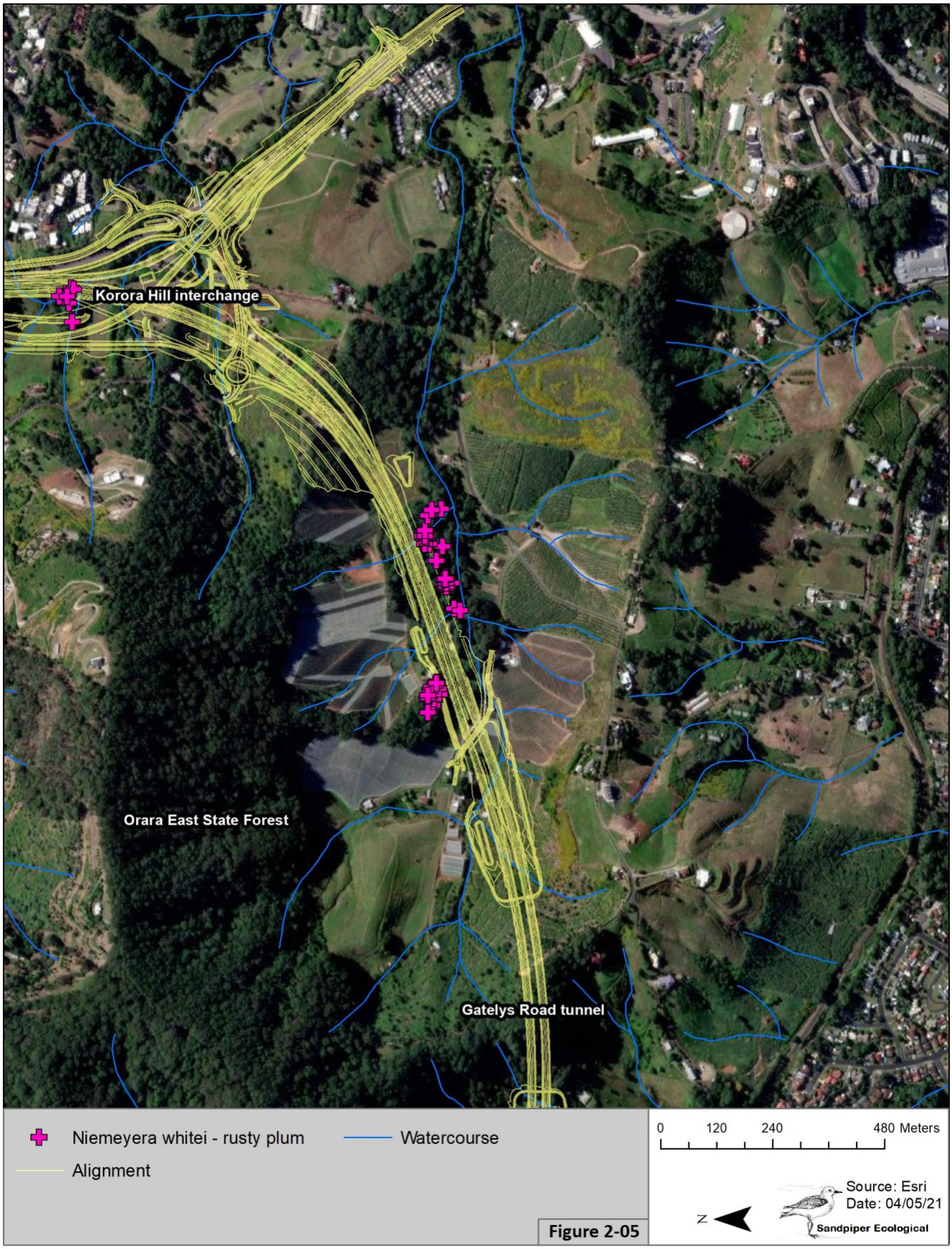
As Scrub Turpentine is a newly listed threatened species, it is not available in the FBA calculator. As such, rather than the Project's offset requirement being directly expressed as biodiversity credits, supplementary measures and/or direct offsets will be used to offset the Project's impact to the species in accordance with project (SSI-7666) condition of approval *E8 Supplementary Measures for Scrub Turpentine.*

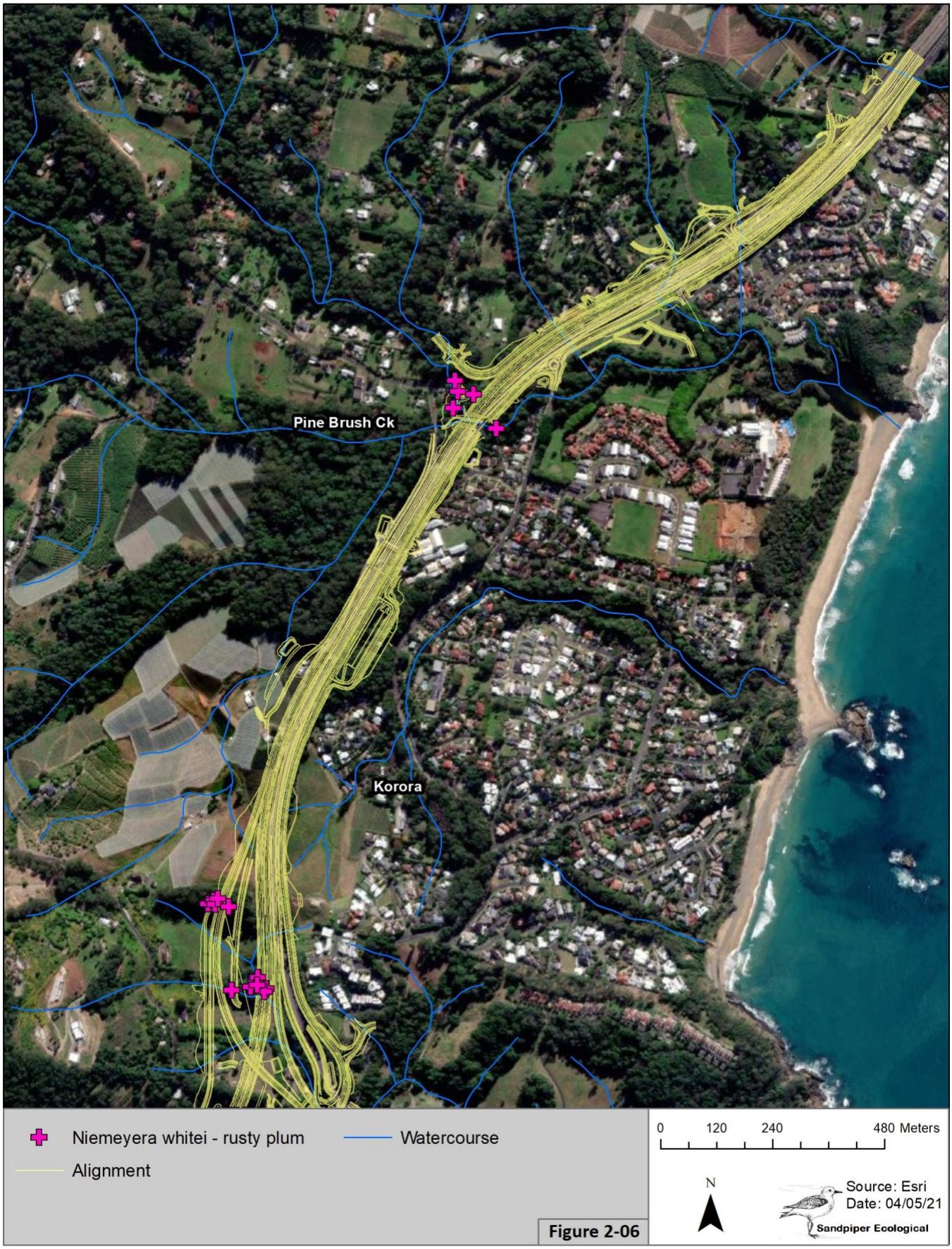

England Road interchange
Stadium Drive
Niemeyera whitei - rusty plum
Watercourse
Alignment
0
120
240
480 Meters
N
Source: Esri
Date: 04/05/21
Sandpiper Ecological
Figure 2-01


Roberts Hill tunnel
North Boambee Rd
Newports Ck
Niemeyera whitei - rusty plum
Watercourse
Alignment
0
120
240
480 Meters
N
Source: Esri
Date: 04/05/21
Sandpiper Ecological
Figure 2-02


Shephards Lane tunnel
Shephards Lane
Coramba Road interchange
Coffs Creek
Niemeyera whitei - rusty plum
Watercourse
Alignment
0
120
240
480 Meters
N
Source: Esri
Date: 04/05/21
Sandpiper Ecological
Figure 2-03


Bucca Bucca Ck
Ulldarra National Park
Shephards Lane tunnel
Niemeyera whitei - rusty plum
Watercourse
Alignment
0
120
240
480 Meters
N
Source: Esri
Date: 04/05/21
Sandpiper Ecological
Figure 2-04


Korora Hill interchange
Orara East State Forest
Gatelys Road tunnel
Niemeyera whitei - rusty plum
Watercourse
Alignment
0
120
240
480 Meters
N
Source: Esri
Date: 04/05/21
Sandpiper Ecological
Figure 2-05


Pine Brush Ck
Korora
Niemeyera whitei - rusty plum
Watercourse
Alignment
0
120
240
480 Meters
N
Source: Esri
Date: 04/05/21
Sandpiper Ecological
Figure 2-06

3. Threatened fauna

Fourteen threatened fauna species were recorded within the study area during targeted surveys completed in accordance with the Framework for Biodiversity Assessment (FBA) for the project EIS. One threatened fauna species, common planigale *Planigale maculata,* was not directly observed, however a precautionary approach has been applied for this species and the presence of common planigale has been assumed in areas of optimal habitat (refer to the **Appendix C, Updated biodiversity assessment report** Section 4.2.4 for further details).

Table 3: Threatened fauna species

Scientific name	Common name	Conservation status^	
		EPBC Act	BC Act
Phascolarctos cinereus	Koala	V	V
Planigale maculata	Common planigale	-	V
Myotis macropus	Southern myotis	-	V
Falsistrellus tasmaniensis	Eastern false pipistrelle		V
Micronomus norfolkensis	Eastern coastal free-tailed bat	-	V
Scoteanax reuppellii	Greater broad-nosed bat	-	V
Pteropus poliocephalus	Grey-headed flying-fox	V	V
Miniopterus australis	Little bent-winged bat	-	V
Pachycephala olivacea	Olive whistler	-	V
Amaurornis moluccana	Pale-vented bush-hen	-	V
Lophoictinia isura	Square-tailed kite	-	V
Haliaeetus leucogaster	White-bellied sea-eagle	-	V
Mixophyes iteratus	Giant barred frog	E	E1
Petalura litorea	Coastal petaltail	-	E1

^ Conservation Status:

EPBC – Indicates the Commonwealth conservation status of each taxon under the Environment Protection and Biodiversity Conservation Act 1999, coded as Extinct in the wild (XW), Critically Endangered (CE), Endangered (E), Vulnerable (V) or Conservation Dependent (CD).

BC Act – Indicates the New South Wales conservation status of each taxon under the Biodiversity Conservation Act 2016 coded as Endangered species (E1), Vulnerable (V)

In addition to the species above, **Appendix C, Updated biodiversity assessment report** noted the potential for spotted-tailed quoll and regent honeyeater to move through the project area. As these species are MNES under the EPBC Act, mitigation measures have been included in this TSMP.

3.1 Existing knowledge and key threats

3.1.1 Mammals

Koala

The koala has a fragmented distribution throughout eastern Australia from north-east Queensland to the Eyre Peninsula in South Australia. In NSW it mainly occurs on the central and north coasts with some populations west of the Great Dividing Range. It was briefly historically abundant in the 1890s in the Bega

District on the south coast of NSW, although not elsewhere, but it now occurs in sparse and possibly disjunct populations. Koalas are also known from several sites on the southern tablelands (OEH 2018b).

Koalas naturally inhabit a range of temperate, sub-tropical and tropical forest, woodland and semi-arid communities dominated by Eucalyptus species (Martin & Handasyde 1999). Koala habitat can be broadly defined as any forest or woodland containing species that are known koala food trees, or shrubland with emergent food trees. The distribution of this habitat is largely influenced by land elevation, annual temperature and rainfall patterns, soil types and the resultant soil moisture availability and fertility. Preferred food and shelter trees are naturally abundant on fertile clay soils. Koalas are also known to occur in modified or regenerating native vegetation communities, as well as urban and rural landscapes where food trees or shelter trees may be highly scattered.

Koalas are inactive for most of the day, feeding and moving mostly at night. They spend most of their time in trees, but will descend and traverse open ground to move between trees (OEH 2018b). Home range size varies with quality of habitat, ranging from less than two hectares to several hundred hectares in size. The koala is generally solitary, but have complex social hierarchies based on a dominant male with a territory overlapping several females and sub-ordinate males on the periphery.

Threats to the species include loss/modification/fragmentation of habitat, mortality due to dog attacks and vehicle strikes, climate change and drought affecting health and contracting of the species' range, and koala disease in particular Chlamydia and Koala Retrovirus (KoRV). Additional potential threats to koala habitat include Bell Miner Associated Dieback (BMAD) and myrtle rust, as well as intense prescribed burns or bushfires that scorch or burn the tree canopy.

Common planigale

The common planigale is found in coastal north-eastern NSW, coastal east Queensland and Arnhem Land. The species reaches its confirmed southern distribution limit on the NSW lower north coast however there are reports of its occurrence as far south as the central NSW coast west of Sydney (OEH 2018f).

Common planigale inhabit rainforest, eucalypt forest, heathland, marshland, grassland and rocky areas where there is surface cover, and usually close to water. They are active at night and during the day shelter in saucer-shaped nests built in crevices, hollow logs, beneath bark or under rocks. They breed from October to January.

Threats to the species include predation by foxes, cats and cane toads, loss of habitat from a variety of land uses resulting in species fragmentation and habitat degradation (including changes to riparian areas and hydrology as well as loss of ground cover vegetation and woody debris), frequent burning that reduces ground cover such as hollow logs and bark, and over grazing that reduces ground cover (OEH 2018f).

Southern myotis

The southern myotis is found in the coastal band from the north-west of Australia, across the top-end and south to western Victoria. It is rarely found more than 100 km inland, except along major rivers (OEH 2017e).

Southern myotis generally roost in groups of 10 - 15 close to water in caves, mine shafts, hollow-bearing trees, storm water channels, buildings, under bridges and in dense foliage. They forage for insects and small fish at streams and pools.

Threats to the species include loss or disturbance of roosting sites, clearing adjacent to foraging areas, application of pesticides in or adjacent to foraging areas and reduction in stream water quality affecting food resources (OEH 2017e).

Eastern false pipistrelle

The eastern false pipistrelle is found on the south-east coast and ranges of Australia, from southern Queensland to Victoria and Tasmania. The species prefers moist habitats with trees taller than 20 m and

generally roosts in eucalypt hollows, but has also been found under loose bark on trees or in buildings. It hunts flying insects above or just below the tree canopy. The eastern false pipistrelle hibernates in winter. Females are pregnant in late spring to early summer (OEH 2017i).

Threats to the species include disturbance to winter roosting and breeding sites, loss of roosting habitat (primarily hollow-bearing eucalypts), loss and fragmentation of foraging habitat particularly extensive areas of continuous forest and areas of high productivity (OEH 2017i).

Eastern coastal free-tailed bat

The eastern coastal free-tailed bat is found along the east coast from south Queensland to southern NSW. It occurs in dry sclerophyll forest, woodland, swamp forests and mangrove forests east of the Great Dividing Range. The eastern coastal free-tailed bat roosts mainly in tree hollows, but will also roost under bark or in man-made structures. It is usually solitary but has also been recorded roosting communally (OEH 2017j).

Threats to the species include loss of hollow-bearing trees, loss of foraging habitat, application of pesticides in or adjacent to foraging areas, artificial light sources spilling onto foraging and/or roosting habitat, and large-scale bushfire or hazard reduction burns on foraging and/or roosting habitat (OEH 2017j).

Greater broad-nosed bat

The greater broad-nosed bat is found mainly in the gullies and river systems that drain the Great Dividing Range, from north-eastern Victoria to the Atherton Tableland. It extends to the coast over much of its range. In NSW, the species is widespread on the New England Tablelands, however it does not occur at altitudes above 500 m (OEH 2017k).

The species utilises a variety of habitats from woodland through to moist and dry eucalypt forest and rainforest, though it is most commonly found in tall wet forest. Although the greater broad-nosed bat usually roosts in tree hollows, it has also been found in buildings. It forages along creek and river corridors. Open woodland habitat and dry open forest suit the direct flight of this species as it searches for prey. Little is known of its reproductive cycle, however generally a single young is born in January. Females will congregate prior to the birth at maternity sites located in suitable trees.

Threats to this species include disturbance to roosting and summer breeding sites, foraging habitats being cleared for residential and agricultural developments (including clearing by residents within rural subdivisions), loss of hollow-bearing trees, pesticides and herbicides which may reduce the availability of insects or result in the accumulation of toxic residues in bat's fat stores, and changes to water regimes that impact food resources including the use of pesticides and herbicides near waterways (OEH 2017k).

Grey-headed flying-fox

The grey-headed flying-fox is Australia's only endemic flying-fox. Grey-headed flying-foxes are generally found within 200 km of the eastern coast of Australia, from Rockhampton in Queensland to Adelaide in South Australia, though in times of natural resource shortages, they may be found in unusual locations (OEH 2017c).

It occurs in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are generally located within 20 km of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy. Individual camps may have tens of thousands of animals and are used for mating, and for giving birth and rearing young.

Site fidelity to camps is high; some camps have been used for over a century. Grey-headed flying-fox can travel up to 50 km from the camp to forage; commuting distances are more often <20 km. The species feeds on the nectar and pollen of native trees, in particular eucalyptus, melaleuca and banksia, and fruits of rainforest trees and vines. It also forages in cultivated gardens and fruit crops.

There is currently incomplete knowledge of its abundance and distribution across the species' range.

Threats to the species include loss and fragmentation of habitat, heat stress, conflict with humans due to destruction of fruit crop, electrocution on power lines, indirect competition favouring other bat species, and possibly pathogens such as Australian bat Lyssavirus (ABL), Bat Paramyxovirus and Menangle Pig virus.

Little bent-winged bat

The little bent-winged bat occurs in the east coast and ranges of Australia from Cape York in Queensland to Wollongong in NSW. Its habitats include moist eucalypt forest, rainforest, vine thicket, wet and dry sclerophyll forest, melaleuca swamps, dense coastal forests and banksia scrub. It is generally found in well-timbered areas (OEH 2018c).

Little bent-winged bats roost in caves, tunnels, tree hollows, abandoned mines, stormwater drains, culverts, bridges and sometimes buildings during the day, and at night forage for small insects beneath the canopy of densely vegetated habitats. They often share roosting sites with the common bent-winged bat and, in winter, the two species may form mixed clusters.

Threats to the species include disturbance of colonies especially in nursery or hibernating caves which may be catastrophic, destruction of caves that provide seasonal or potential roosting sites, changes to habitat especially surrounding maternity/nursery caves and winter roosts, pesticide poisoning, predation from foxes and feral cats, exotic pathogens such as the white-nosed fungus, fire during the breeding season and fire impacting on foraging resources (OEH 2018c).

3.1.2 Birds

Olive whistler

The olive whistler inhabits the wet forests on the ranges of the east coast above 500 m though during the winter months they may move to lower altitudes. It has a disjunct distribution in NSW chiefly occupying the beech forests around Barrington Tops and the MacPherson Ranges in the north and wet forests from Illawarra south to Victoria. In the south it is found inland to the Snowy Mountains and the Brindabella Range (OEH 2017d).

Olive whistler forage in trees and shrubs and on the ground, feeding on berries and insects. Their nests are built in low forks of shrubs.

Threats to the species include clearing and fragmentation of habitat, inappropriate fire regimes causing changes to vegetation, predation by foxes and cats, loss of understorey and midstorey habitat via grazing or other disturbances, weeds, aggressive exclusion from forest and woodland habitat by over abundant noisy miners and climate change impacts including drought (OEH 2017d).

Pale-vented bush-hen

In Australia, the pale-vented bush-hen occurs mainly in coastal and sub coastal regions from the top end of the Northern Territory and Cape York Peninsula south through eastern Queensland to north-eastern NSW. There are a few records in the Kimberley Division of northern Western Australia. In NSW, bush-hens are an apparently uncommon resident from the Queensland border south to the Clarence River, though the species appears to be expanding its range southwards with recent records as far south as the Nambucca River (OEH 2018d).

The pale-vented bush-hen inhabits tall dense understorey or ground-layer vegetation on the margins of freshwater streams and natural or artificial wetlands, usually within or bordering rainforest, rainforest remnants or forests. It also occurs in secondary forest growth, rank grass or reeds, thickets of weeds, such as Lantana, and pastures, crops or other farmland, such as crops of sugar cane, and grassy or weedy

fields, or urban gardens where they border forest and streams or wetlands, such as farm dams. They can also occur in and around mangroves, though rarely do so, if at all, in NSW.

Key elements of their habitat are dense undergrowth two to four metres tall and within 300 metres of water. Nests are built close to water in thick ground vegetation such as dense blady grass (*Imperata cylindrica*), mat rush (Lomandra) or reeds, often under or growing through shrubs or vine or beneath a tree (OEH 2018d).

Threats to the species include clearing/filling/draining of wetlands, pollution of wetlands from run-off including herbicides and pesticides, changes to wetlands caused by weed invasion, predation particularly by feral animals, destruction of habitat and predation by feral pigs, alteration to the natural flow regimes in their habitats, and loss of dense and rank understorey vegetation near streams and wetlands (OEH 2018d).

Square-tailed kite

The square-tailed kite ranges along coastal and sub coastal areas from south-western to northern Australia, Queensland, NSW and Victoria. In NSW, scattered records of the species throughout the state indicate that the species is a regular resident in the north, north-east and along the major west-flowing river systems. It is a summer breeding migrant to the south-east, including the NSW south coast, arriving in September and leaving by March (OEH 2017h).

The species is found in a variety of timbered habitats including dry woodlands and open forests. It shows a particular preference for timbered watercourses. In arid north-western NSW, it has been observed in stony country with a ground cover of chenopods and grasses, open acacia scrub and patches of low open eucalypt woodland. It appears to occupy large hunting ranges of more than 100km^2.

Nest sites during breeding season are generally located along or near watercourses, in a fork or on large horizontal limbs (OEH 2017h).

Threats to this species include clearing, logging, burning and grazing of habitats (resulting in a reduction in nesting and feeding resources), disturbance to or removal of potential nest trees near watercourses, illegal egg collection and deliberate shooting (OEH 2017h).

White-bellied sea-eagle

The white-bellied sea-eagle is distributed around the Australian coastline, including Tasmania, and well inland along rivers and wetlands of the Murray Darling Basin. In NSW, it is widespread along the east coast, and along all major inland rivers and waterways (OEH 2017f).

Habitats are characterised by the presence of large areas of open water including larger rivers, swamps, lakes, and the sea. The species occurs at sites near the sea or sea-shore, such as around bays and inlets, beaches, reefs, lagoons, estuaries and mangroves; and at, or in the vicinity of freshwater swamps, lakes, reservoirs, billabongs and saltmarsh. Terrestrial habitats include coastal dunes, tidal flats, grassland, heathland, woodland, and forest (including rainforest).

Breeding habitat consists of mature tall open forest, open forest, tall woodland, and swamp sclerophyll forest close to foraging habitat. Nests are sometimes located in other habitats such as remnant trees on cleared land (Emison & Bilney 1982). Nest trees are typically large emergent eucalypts and often have emergent dead branches or large dead trees nearby which are used as ‘guard roosts’. Nests are large structures built from sticks and lined with leaves or grass (OEH 2017f).

The main threats to the species include land clearing (this can force birds to nest in sub-optimal habitats where their breeding success is greatly reduced) and disturbance when nesting resulting in abandonment of young and nest sites.

Potential threats to the white-bellied sea-Eagle include poisoning, shooting, competition with wedge-tailed eagles, and the deterioration of inland water resources. Processes that affect the quality or availability of inland water systems (such as increased sediment input into rivers and streams due to erosion, drainage of wetlands for agriculture, flood mitigation works) could, potentially, have adverse effects on inland

populations of the sea-eagle (Clunie 1994).

3.1.3 Frogs

Giant barred frog

The giant barred frog is distributed along the coast and ranges from Eumundi in south-east Queensland to Warrimoo in the Blue Mountains. Declines appear to have occurred at the margins of the species' range, with no recent records south of the Hawkesbury River and disappearances from a number of streams in QLD. Northern NSW, particularly the Coffs Harbour-Dorrigo area, is a stronghold (OEH 2017g).

Giant barred frogs are found along freshwater streams with permanent or semi-permanent water, generally (but not always) at lower elevation. Moist riparian habitats such as rainforest or wet sclerophyll forest are favoured for the deep leaf litter that they provide for shelter and foraging, as well as open perching sites on the forest floor. However, giant barred frogs will also sometimes occur in other riparian habitats, such as those in drier forest or degraded riparian remnants, and even occasionally around dams.

Breeding takes place from late spring to summer. Although generally found within about 20 m of the stream, outside the breeding season, the giant barred frog may disperse away from the stream (e.g. 50m or further).

A major threat to the species is clearance of riparian vegetation. Other threats to the species include weed infestations decreasing the quality and amount of habitat available, reduction in water quality or alterations to flow patterns, siltation, infections of the fungal pathogen *Batrachochytrium dendrobatidis*, and predation and disturbance of habitat or destruction of eggs by feral pigs (OEH 2017g).

3.1.4 Invertebrates

Coastal petaltail

The coastal petaltail is known from Byfield (near Yeppoon in Queensland) to Bonville (south of Coffs Harbour). In NSW it is known from a very small number of locations, including Brooms Head, Tucabia, Diggers Camp and Bonville (OEH 2017h).

The coastal petaltail occupies a variety of permanent to semi-permanent coastal freshwater wetlands. Adults spend most of their time settled on low vegetation on or adjacent to the swamp. Suitable egg laying sites are within the swamp. It is thought that the larvae use underwater entrances to hunt for food in the aquatic vegetation.

The key threat to the species is modification of swamp habitat. Threats include loss or modification of natural swamps/wetlands/sedgelands through regulation of river flows and changes in surface water flows and groundwater levels, damage to breeding habitat by feral pigs and domestic stock, weed invasion of wetland breeding sites, application of herbicides or pesticides in or adjacent to breeding habitat decreasing water quality of swamps through pollution/eutrophication/sedimentation, clearing and degradation of foraging and breeding habitat, and climate change (OEH 2017h).

3.2 Known or expected occurrence in the project area

Known or expected occurrence of threatened fauna is provided for the project area in **Table 4**, with the species credit polygons from **Appendix C, Updated biodiversity assessment report** in Figure 3. The habitat descriptions provided in **Table 4** include areas of known habitat in the study area, as well as potential habitat that these species could use.

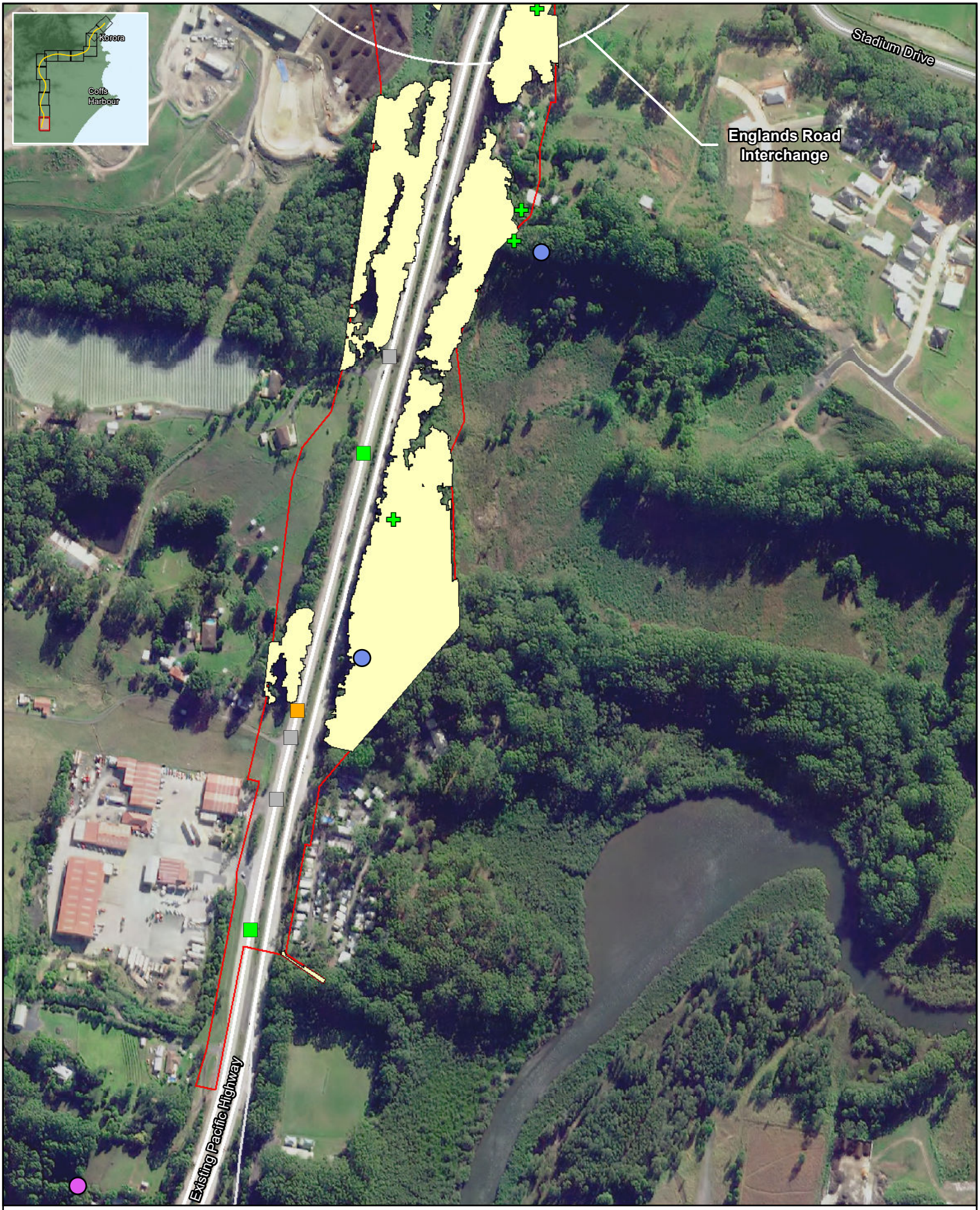
Additional detail on project wide koala habitat, corridors and records is provided in Figure 4.

Table 4: Known or expected occurrence of threatened fauna and habitat area for the project area

Species	Habitat within project area
Koala	Koala were recorded throughout the project area in association with the following suitable habitats: • 692 Blackbutt - Tallowwood moist ferny open forest of the coastal ranges of the NSW North Coast Bioregion. • 695 Blackbutt - Turpentine - Tallowwood shrubby open forest of the coastal foothills of the central NSW North Coast Bioregion. • 747 Brush Box - Tallowwood - Sydney Blue Gum tall moist forest of the ranges of the central NSW North Coast Bioregion. • 1064 Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion. • 1244 Sydney Blue Gum open forest on coastal foothills and escarpment of the North Coast • 1262 Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast. • 1285 Turpentine moist open forest of the coastal hills and ranges of the NSW North Coast Bioregion. • 1302 White Booyong - Fig subtropical rainforest of the NSW North Coast Bioregion. • Modified riparian vegetation.
Common planigale	Although common planigale was not recorded in the project area during surveys, a precautionary approach has been applied for this species and the presence of common planigale has been assumed in areas of optimal habitat. High quality habitat within the study area includes rainforest and wetter forest areas. Suitable habitat is associated with the following vegetation communities: ☐ PCT670 Black Booyong - Rosewood - Yellow Carabeen subtropical rainforest ☐ PCT695 Blackbutt - Turpentine - Tallowwood shrubby open forest ☐ PCT747 Brush Box - Tallowwood - Sydney Blue Gum tall moist forest ☐ PCT1244 Sydney Blue Gum open forest.
Southern myotis	Southern myotis were recorded adjacent to Coffs Creek (chainage 14600), an unnamed tributary (chainage 11200) and Jordans Creek (chainage 20300). Suitable habitat was also identified within the vicinity of Pine Brush Creek (chainage 21800 to 22800). Suitable habitat is located within the project area in association with the following vegetation communities: • 692 Blackbutt - Tallowwood moist ferny open forest of the coastal ranges of the NSW North Coast Bioregion. • 695 Blackbutt - Turpentine - Tallowwood shrubby open forest of the coastal foothills of the central NSW North Coast Bioregion. • 747 Brush Box - Tallowwood - Sydney Blue Gum tall moist forest of the ranges of the central NSW North Coast Bioregion. • 1064 Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion. • 1244 Sydney Blue Gum open forest on coastal foothills and escarpment of the North Coast • 1285 Turpentine moist open forest of the coastal hills and ranges of the NSW North Coast Bioregion. • Modified riparian vegetation.
Eastern false pipistrelle	Eastern false pipistrelle were recorded using ultrasonic detectors at approximate chainage 12500 and 16500. All vegetated areas within the project area offer potential habitat for this species
Eastern coastal free-tail bat	Eastern freetail bats were recorded using ultrasonic detectors at approximate chainage 15200 and 20300. All vegetated areas within the project area offer potential habitat for this species

Greater broad-nosed bat	A single greater broad-nosed bat was recorded outside the construction footprint using ultrasonic detectors at approximate chainage 13700. All vegetated areas within the project area offer potential habitat for this species
Grey-headed flying-fox	Grey-headed flying-fox were recorded throughout the project area with suitable habitat including vegetated areas within the project area.
Little bent-winged bat	Little bentwing-bat were recorded by means of harp trapping and within an existing culvert located adjacent to Coffs Creek (chainage 14600). All vegetated areas within the project area offer potential habitat for this species. Other existing culverts and approximately 94 hollow-bearing trees located within the project area may also offer suitable roosting sites.
Olive whistler	Recorded during diurnal bird surveys. All vegetated areas within the project area offer potential habitat for this species.
Pale-vented bush-hen	Remote camera traps detected pale-vented bush-hen at two sites (between chainages 17500 and 20000) in proximity to vegetated creek lines dominated by PCT 695 Blackbutt - Turpentine - Tallowwood shrubby open forest of the coastal foothills of the central NSW North Coast Bioregion. Modified riparian vegetation.
Square-tailed kite	Recorded during diurnal bird surveys. All vegetated areas within the project area offer potential habitat for this species.

White-bellied sea-eagle	This species was observed flying over the project area at chainage 13300. All vegetated areas within the project area offer potential habitat for this species.
Giant barred frog	Giant barred frog were recorded within the vicinity of Pine Brush Creek (chainage 22300) in association with the following vegetation communities: • 695 Blackbutt - Turpentine - Tallowwood shrubby open forest of the coastal foothills of the central NSW North Coast Bioregion. • 1285 Turpentine moist open forest of the coastal hills and ranges of the NSW North Coast Bioregion. • 1244 Sydney Blue Gum open forest on coastal foothills and escarpment of the North Coast • 1262 Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast. • Modified riparian vegetation. There are also recent Bionet records at Newports Creek where the proposed alignment crosses this waterway.
Coastal petaltail	Approximately 50 dragonfly burrows likely to support coastal petaltail were recorded within a 0.5ha area adjacent to Highlander Drive off North Boambee Road (chainage 12600). Potential habitat for the species within the project area includes PCT 1064 Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion and PCT 780.



Legend

- Construction footprint
- North Coast Railway
- Watercourse
- Hollow bearing tree

Threatened fauna records

- Grey-headed flying-fox
- Koala

Species credit species habitat polygons

- Koala

Culverts - potential microbat roost

- Medium
- Low
- None

Coffs Harbour Bypass
Threatened fauna records and species credit habitat polygons
Figure 3-01

0 0.05 0.1 0.15 km

Scale @A4: 1:5,000
GDA 1994 MGA Zone 56

N

Legend

- Construction footprint
- North Coast Railway
- Watercourse
- Hollow bearing tree

Threatened fauna records

- Koala
- Southern myotis

Species credit species habitat polygons

- Coastal petaltail
- Giant barred frog
- Southern myotis
- Koala

Culverts - potential microbat roost

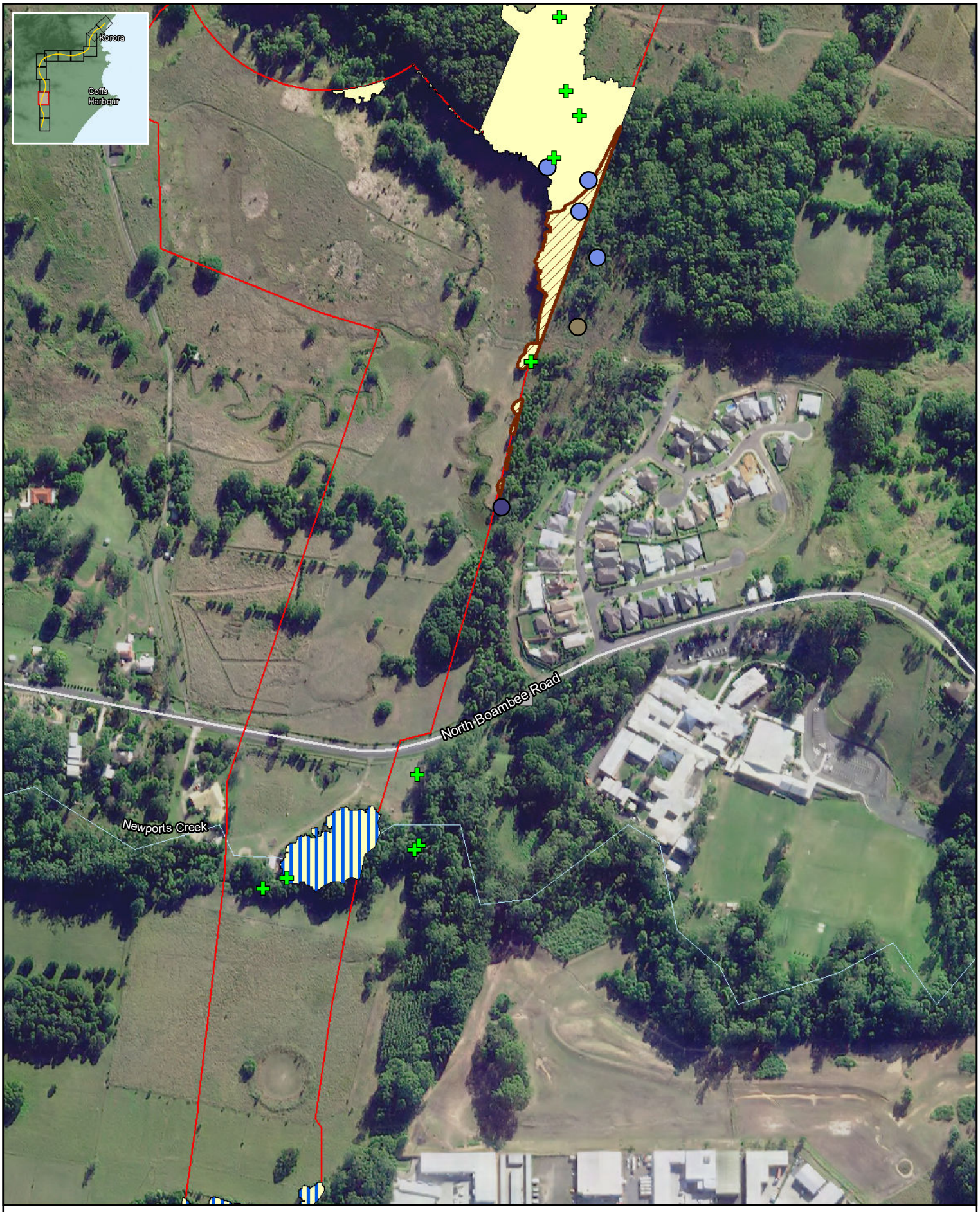
- High

Coffs Harbour Bypass
Threatened fauna records and species credit habitat polygons
Figure 3-02

0 0.05 0.1 0.15 km

Scale @A4: 1:5,000
GDA 1994 MGA Zone 56

N



Legend

- Construction footprint
- North Coast Railway
- Watercourse
- Hollow bearing tree

Threatened fauna records

- Eastern false pipistrelle
- Koala
- Coastal petaltail

Species credit species habitat polygons

- Coastal petaltail
- Giant barred frog
- Koala

Culverts - potential microbat roost

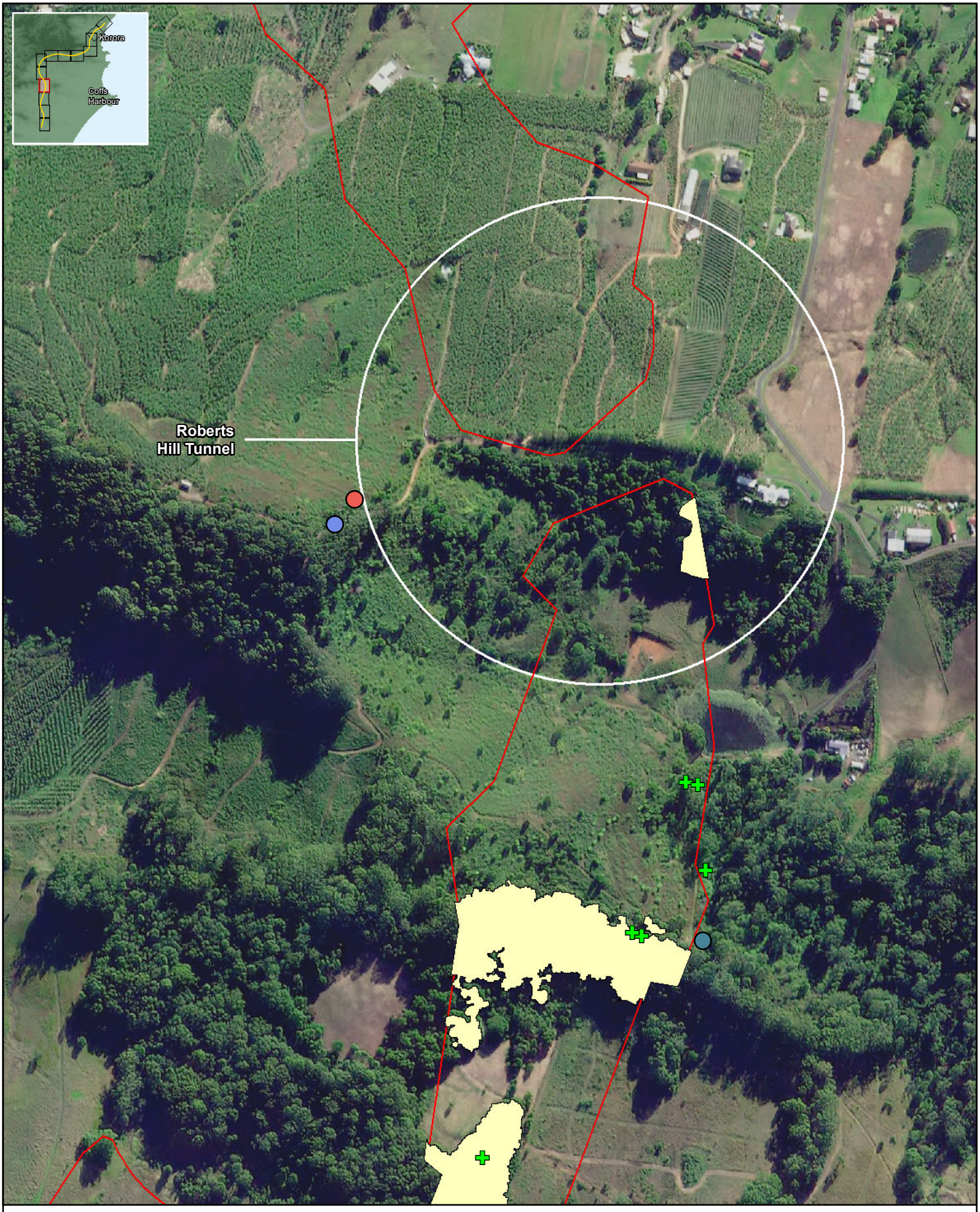
- None

Coffs Harbour Bypass
Threatened fauna records and species credit habitat polygons
Figure 3-03

0 0.05 0.1 0.15 km

Scale @A4: 1:5,000
GDA 1994 MGA Zone 56

N



Legend

- Construction footprint
- North Coast Railway
- Watercourse
- Hollow bearing tree

Threatened fauna records

- Greater broad-nosed bat
- Koala
- White-bellied sea-eagle

Species credit species habitat polygons

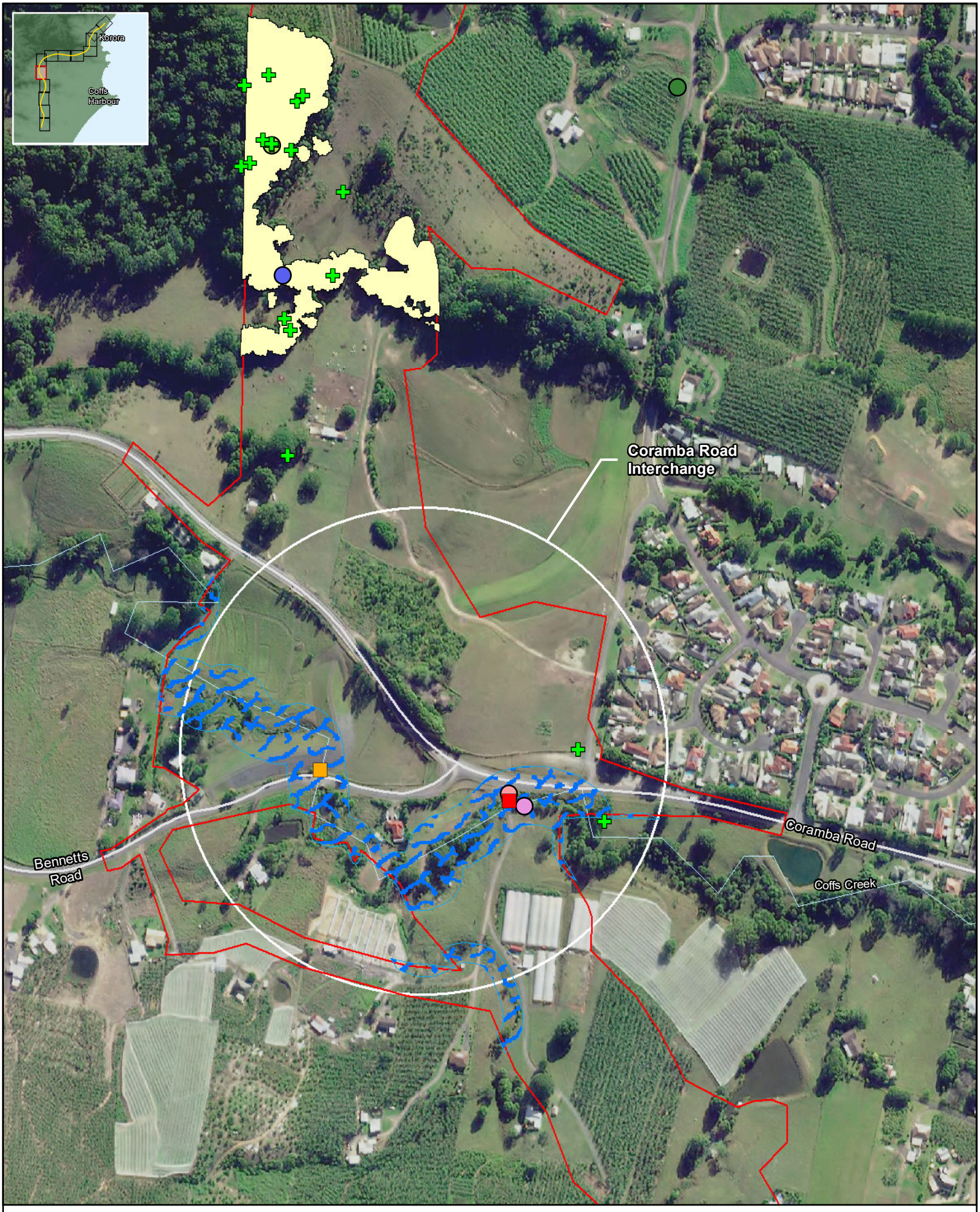
- Koala

Coffs Harbour Bypass
Threatened fauna records and species credit habitat polygons
Figure 3-04

0 0.05 0.1 0.15 km

Scale @A4: 1:5,000
GDA 1994 MGA Zone 56

N



Legend

- Construction footprint
- North Coast Railway
- Watercourse
- Hollow bearing tree

Threatened fauna records

- Little bentwing-bat
- Eastern freetail-bat
- Southern myotis
- Olive whistler
- Square-tailed kite

Species credit species habitat polygons

- Southern myotis
- Koala

Culverts - potential microbat roost

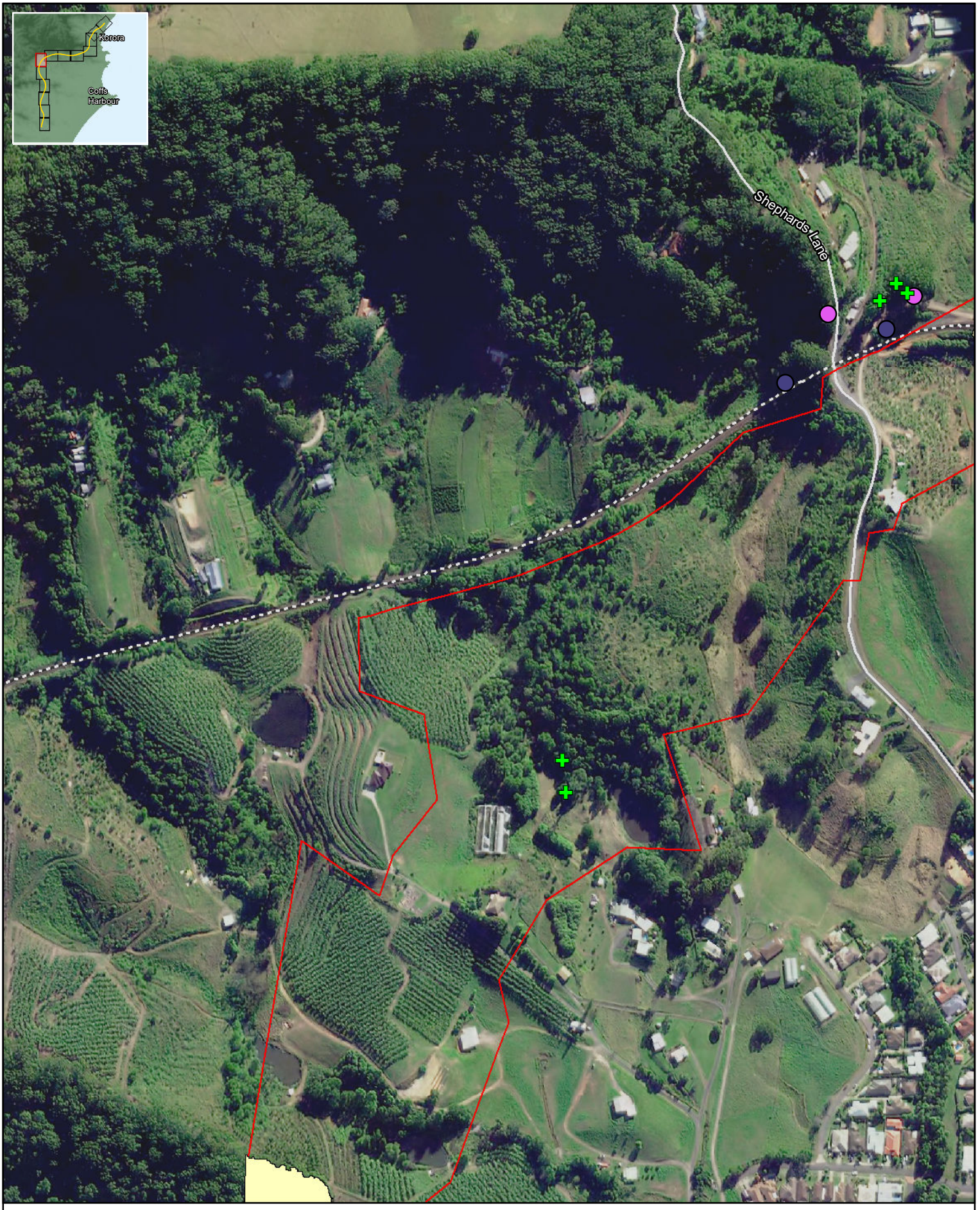
- High
- Medium

Coffs Harbour Bypass
Threatened fauna records and species credit habitat polygons
Figure 3-05

0 0.05 0.1 0.15 km

Scale @A4: 1:5,000
GDA 1994 MGA Zone 56

N



Legend

- Construction footprint
- North Coast Railway
- Watercourse
- Hollow bearing tree

Threatened fauna records

- Eastern false pipistrelle
- Grey-headed flying-fox

Species credit species habitat polygons

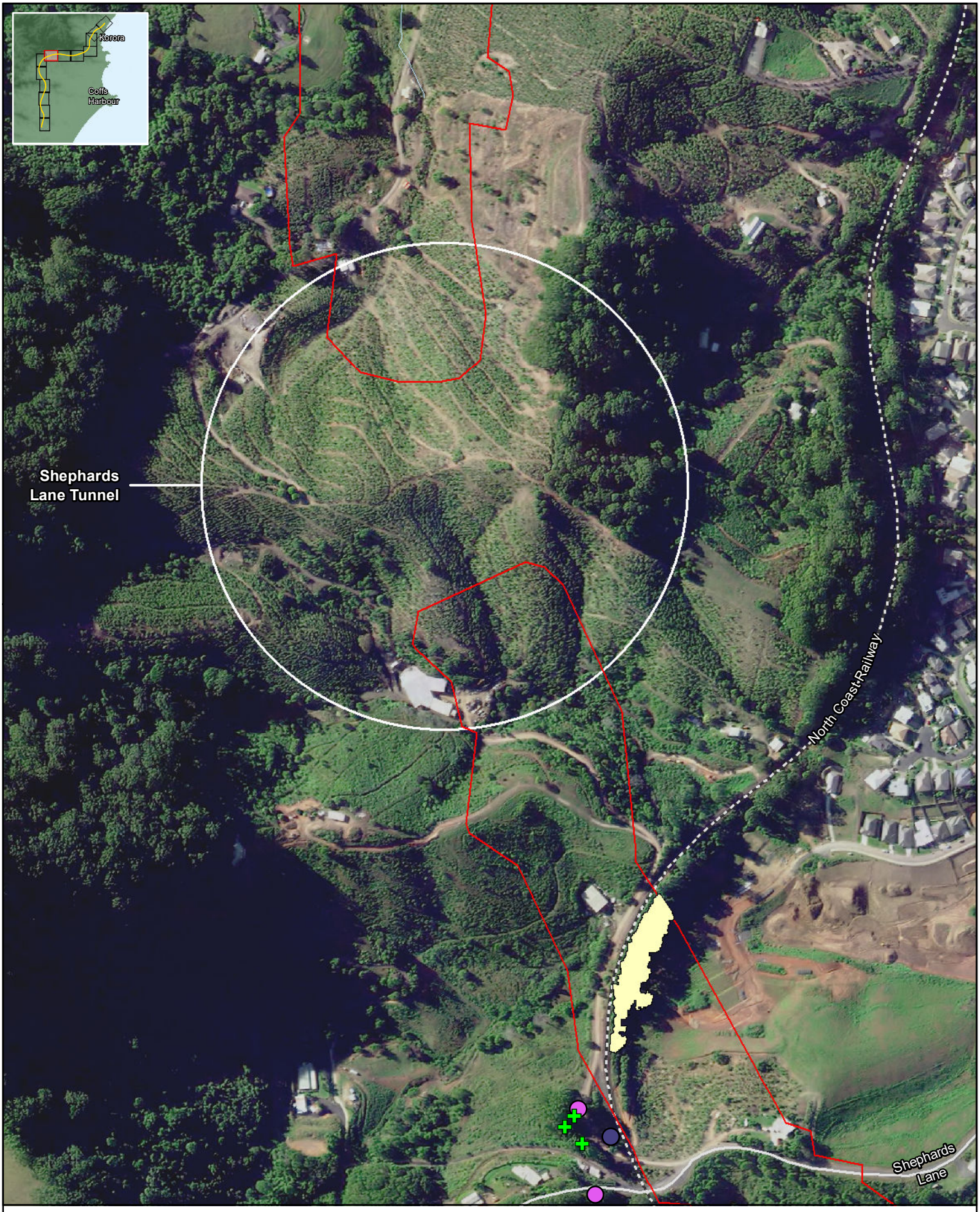
- Koala

Coffs Harbour Bypass
Threatened fauna records and species credit habitat polygons
Figure 3-06

0 0.05 0.1 0.15 km

Scale @A4: 1:5,000
GDA 1994 MGA Zone 56

N



Legend

- Construction footprint
- North Coast Railway
- Watercourse
- Hollow bearing tree

Threatened fauna records

- Eastern false pipistrelle
- Grey-headed flying-fox

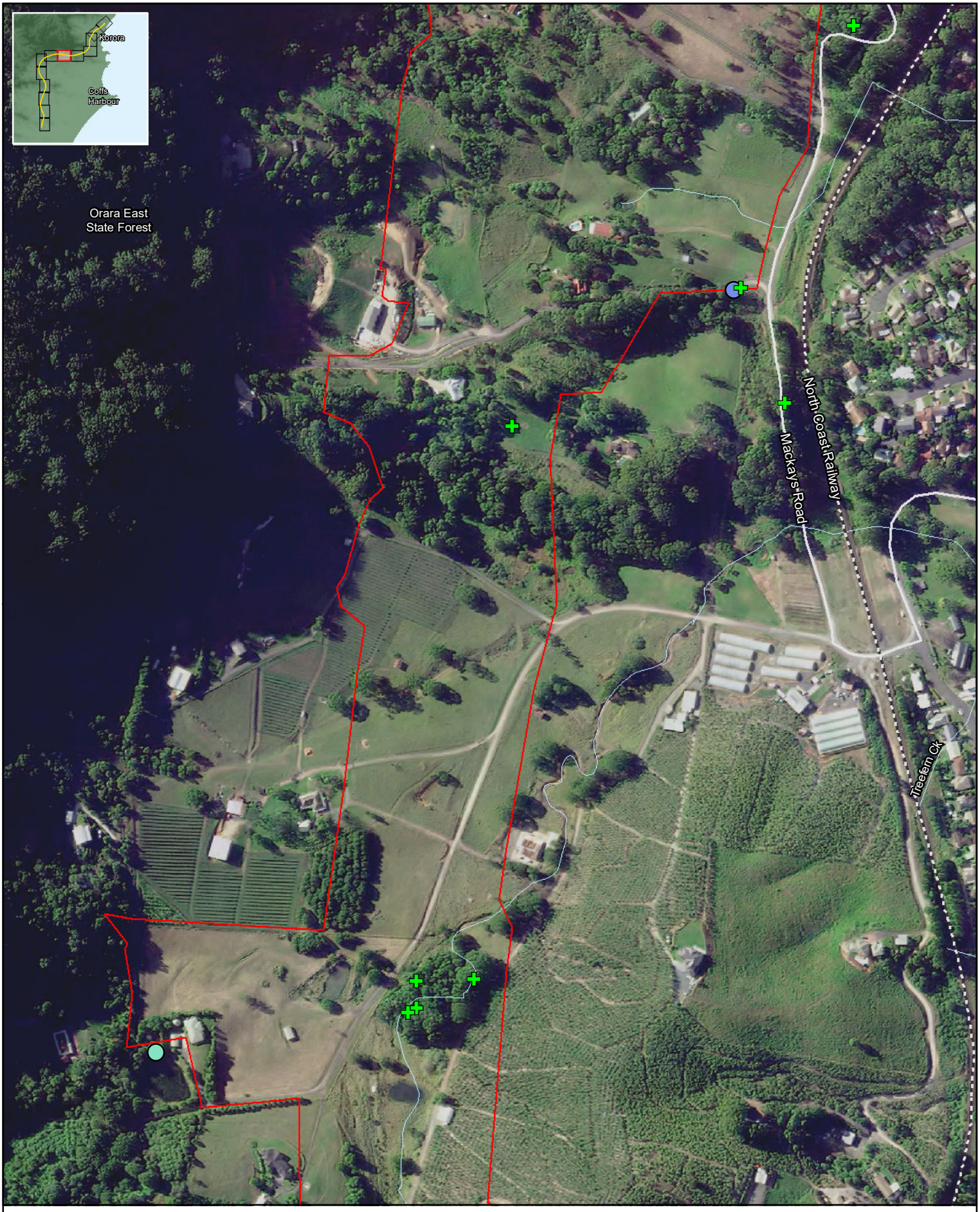
Species credit species habitat polygons

- Koala

Coffs Harbour Bypass
Threatened fauna records and species credit habitat polygons
Figure 3-07

0 0.05 0.1 0.15 km

Scale @A4: 1:5,000
GDA 1994 MGA Zone 56



Legend

- Construction footprint
- North Coast Railway
- Watercourse
- Hollow bearing tree

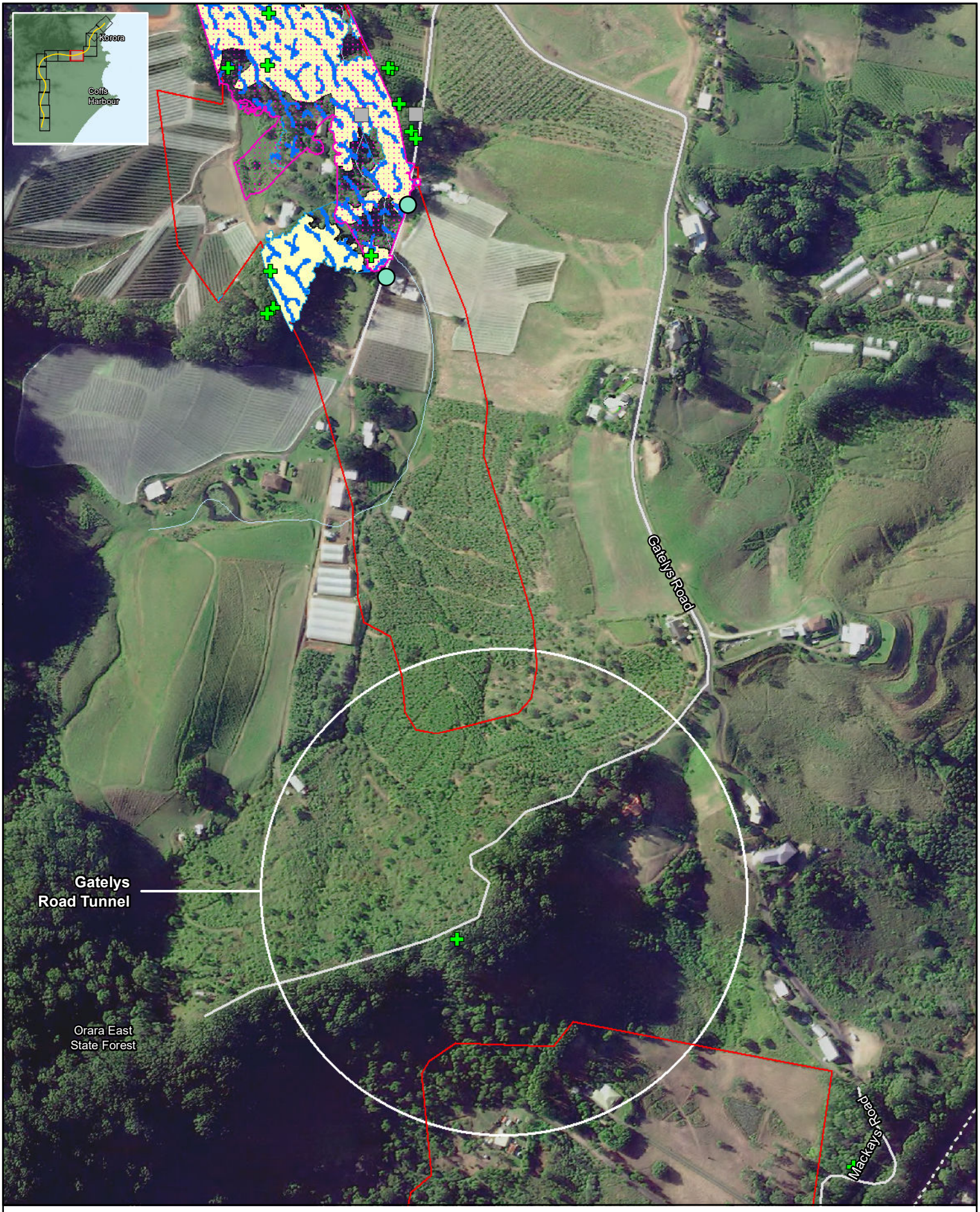
Threatened fauna records

- Koala
- Pale-vented bush-hen

Coffs Harbour Bypass
Threatened fauna records and species credit habitat polygons
Figure 3-08

0 0.05 0.1 0.15 km

Scale @A4: 1:5,000
GDA 1994 MGA Zone 56



Legend

- Construction footprint
- North Coast Railway
- Watercourse
- Hollow bearing tree

Threatened fauna records

- Pale-vented bush-hen

Species credit species habitat polygons

- Pale-vented bush-hen
- Southern myotis
- Koala

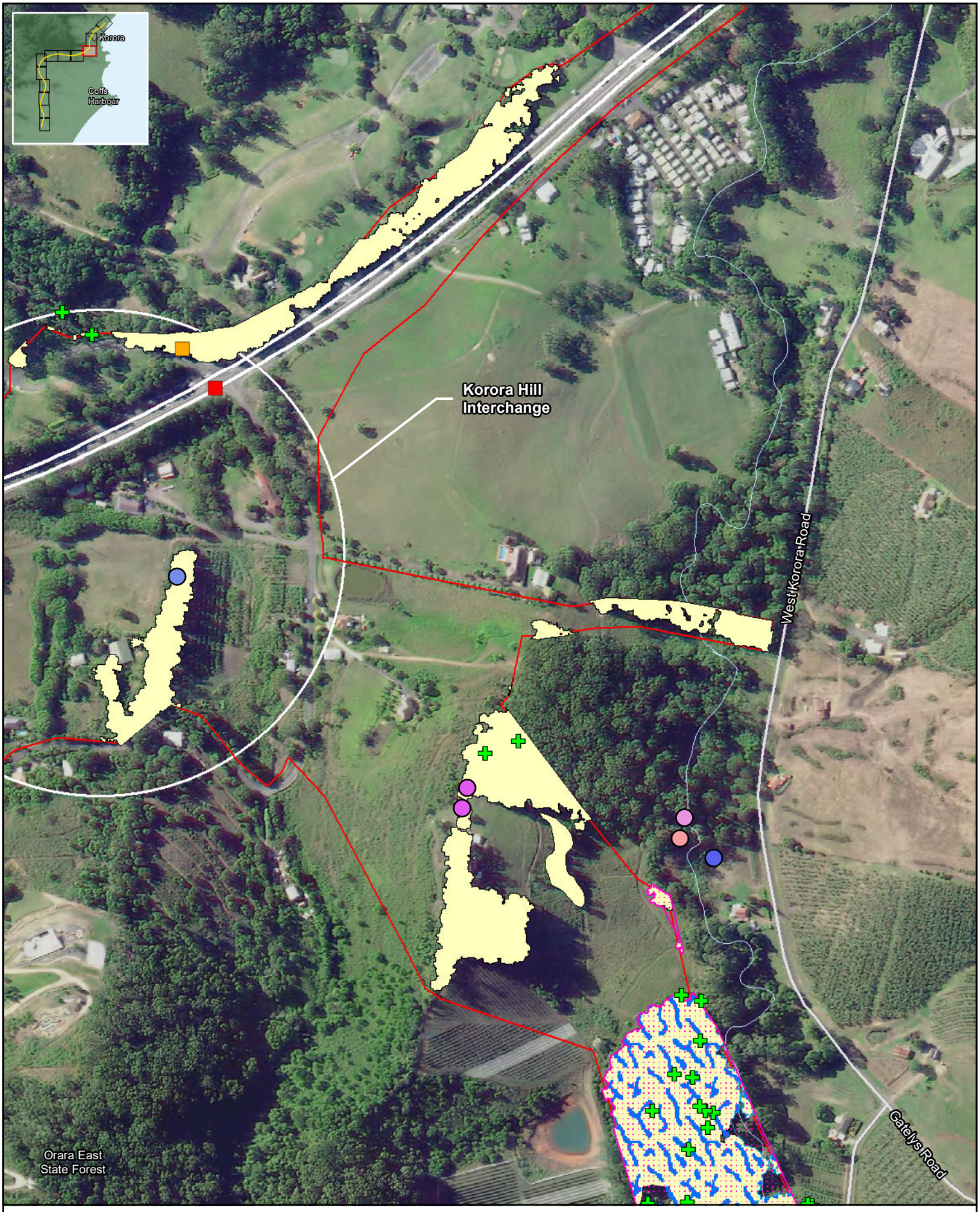
Culverts - potential microbat roost

- None

Coffs Harbour Bypass
Threatened fauna records and species credit habitat polygons
Figure 3-09

0 0.05 0.1 0.15 km

Scale @A4: 1:5,000
GDA 1994 MGA Zone 56



Legend

- Construction footprint
- North Coast Railway
- Watercourse
- Hollow bearing tree

Threatened fauna records

- Little bentwing-bat
- Eastern freetail-bat
- Grey-headed flying-fox
- Koala
- Southern myotis

Species credit species habitat polygons

- Pale-vented bush-hen
- Southern myotis
- Koala

Culverts - potential microbat roost

- High
- Medium

Coffs Harbour Bypass
Threatened fauna records and species credit habitat polygons
Figure 3-10

0 0.05 0.1 0.15 km

Scale @A4: 1:5,000
GDA 1994 MGA Zone 56

Legend

- Construction footprint
- North Coast Railway
- Watercourse
- Hollow bearing tree

Threatened fauna records

- Bentwing-bat (sp)
- Grey-headed flying-fox
- Southern myotis
- Giant barred frog
- Green-thighed frog

Species credit species habitat polygons

- Giant barred frog
- Green-thighed frog
- Southern myotis
- Koala

Culverts - potential microbat roost

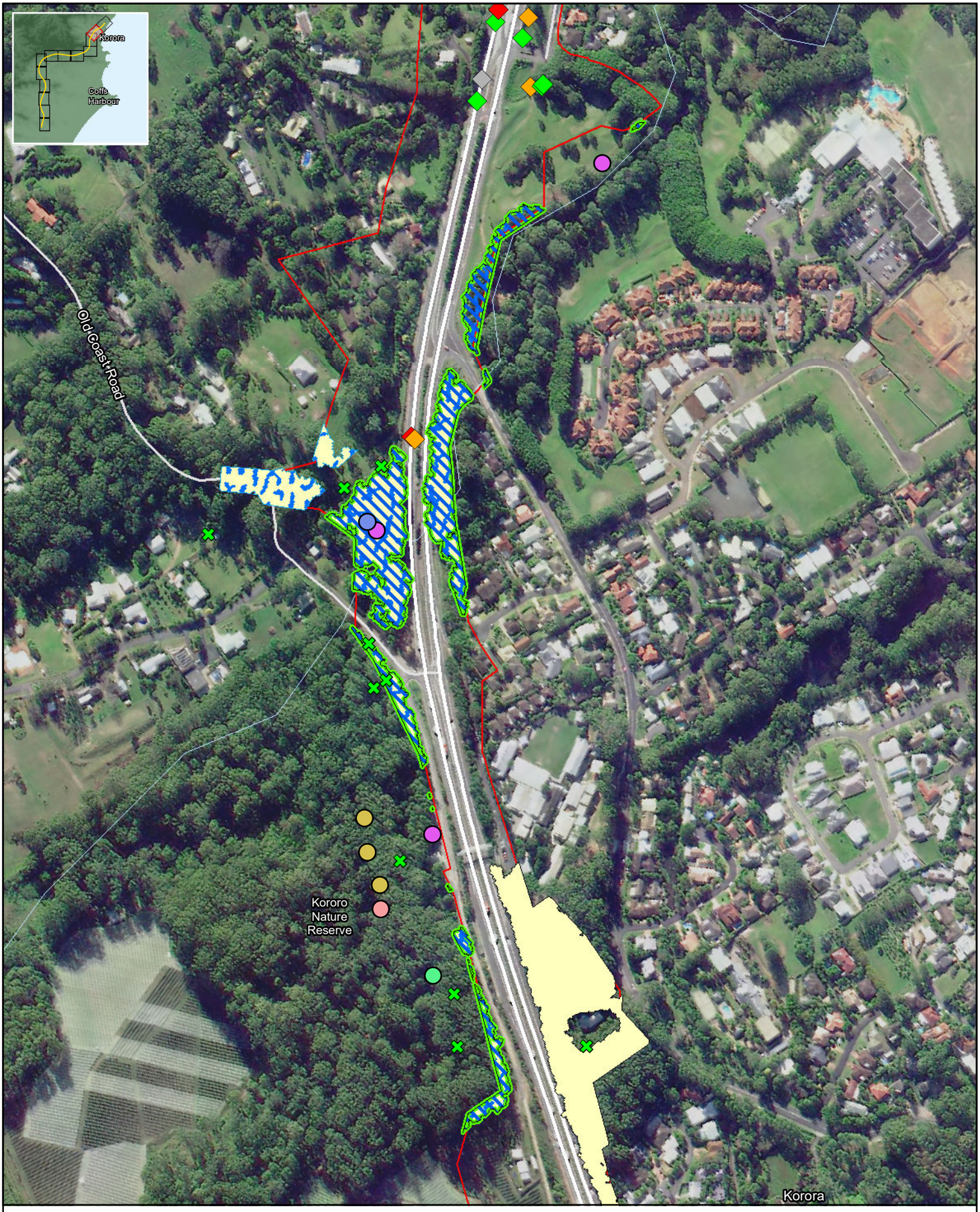
- High
- Unknown

Coffs Harbour Bypass
Threatened fauna records and species credit habitat polygons
Figure 3-11

0 0.05 0.1 0.15 km

Scale @A4: 1:5,000
GDA 1994 MGA Zone 56

N



Legend

- Construction footprint
- North Coast Railway
- Watercourse
- Hollow bearing tree

Threatened fauna records

- Grey-headed flying-fox
- Koala
- Southern myotis
- Giant barred frog
- Green-thighed frog

Species credit species habitat polygons

- Giant barred frog
- Green-thighed frog
- Southern myotis
- Koala

Culverts - potential microbat roost

- High
- Medium
- Low
- None

Coffs Harbour Bypass
Threatened fauna records and species credit habitat polygons
Figure 3-12

0 0.05 0.1 0.15 km

Scale @A4: 1:5,000
GDA 1994 MGA Zone 56

Legend

- Construction footprint
- North Coast Railway
- Watercourse
- Hollow bearing tree

Species credit species habitat polygons

- Koala

Culverts - potential microbat roost

- High
- Medium
- Low

Coffs Harbour Bypass
Threatened fauna records and species credit habitat polygons
Figure 3-13

0 0.05 0.1 0.15 km

Scale @A4: 1:5,000
GDA 1994 MGA Zone 56

N

Legend

- Construction footprint
- North Coast Railway
- Watercourse
- Park/Reserve
- Koala Records (EIS Targeted Survey)
- Koala Records (Bionet)
- Koala Habitat Polygons (EIS)
- Koala corridors

Coffs Harbour City Council Koala Habitat

- Primary
- Secondary
- Tertiary

Coffs Harbour Bypass
Koala records, habitat areas and dispersal corridors
Figure 4

0 0.45 0.9 1.35 km

Scale @A4: 1:48,565
GDA 1994 MGA Zone 56

N

4. Potential impacts associated with the project

This section summarises potential impacts to threatened flora and fauna species as a result of the project. A more detailed assessment of project impacts to threatened flora and fauna is provided in **Appendix C, Updated biodiversity assessment report**. **Chapters 5, 6** and **7** of this TSMP outlines the mitigation measures proposed to minimise impacts during the detailed design, construction and operational phases of the project. **Chapter 8** of this TSMP outlines the monitoring required to assess the effectiveness of the mitigation measures. **Table 5** provides a summary of impacts, proposed mitigation measures and monitoring requirements.

Table 5: Summary of impacts, mitigation measures and recommended monitoring

Impact	Applicable species	Mitigation measures	Monitoring
Direct loss of a single plant/s	Rusty plum Scrub turpentine	Identify and implement exclusion zones. Salvage and re-establish threatened flora according to the approved salvage and re-establishment plan. Direct translocation of scrub turpentine will not be possible due to risk of myrtle rust spread.	Pre-clearing surveys Monitor salvaged and translocated plants in accordance with the approved salvage and re-establishment plan
Direct mortality of fauna	All species	Identify and implement habitat exclusion zones Apply standard pre-clearing and clearing protocols in accordance with RMS Biodiversity Guidelines and FFMP. Implement microbat management plan.	Project ecologist
Disturbance and degradation of remaining habitats due to weed and pathogen invasion, altered fire regimes or changes in hydrology	Rusty plum Scrub turpentine All fauna species	Landscaping plans to identify revegetation zones to buffer retained populations and habitats	Revegetation monitoring
Direct loss of known and potential habitat	All fauna and flora species	Establish exclusion to limit clearing extents. Landscaping design to include habitat restoration and revegetation elements	Revegetation monitoring

Impact	Applicable species	Mitigation measures	Monitoring
Loss of habitat elements providing potential breeding and roosting sites including stags, hollow-bearing trees and existing culvert and bridge structures.	All bat species and hollow-dependent fauna	Provide roosting habitat for microbats in new bridge and culvert structures adjacent to areas of known microbat habitat would be investigated where future maintenance would not be compromised. Apply nest box management plan.	Monitoring use of new structures for bat roosts
Increased fragmentation of habitats and reduced connectivity	All fauna species	Design and installation of fauna crossing structures and exclusion fencing. Landscape design to improve fauna connectivity along the road corridor.	Monitoring use and success of fauna crossing structures
Direct mortality due to vehicle strike	Koala Giant barred frog	Design and installation of fauna crossing structures and exclusion fencing. During construction install temporary fencing and escape structures where appropriate	Road mortality monitoring Monitor use and effectiveness of structures. Ongoing monitoring and repair of fencing during operation.
Habitat disturbance during construction as a result of increased light, noise and vibration or bushfire.	All fauna species	Minimise noise, light and dust during construction.	Monitor in accordance with CEMP
Altered hydrological regimes and impacts to habitat quality	Giant barred frog Coastal petaltail	Detailed design to minimise changes to surface and ground water hydrology.	Water quality monitoring
Impacts to surface water quality	Giant barred frog Coastal petaltail	Detailed design to minimise changes to surface and ground water hydrology. Design and implement erosion and sediment control plans	Water quality monitoring
Spread of disease causing pathogens, including chytrid fungus, myrtle rust phytophthora during construction	Giant barred frog Scrub turpentine Fauna habitat	Implementation of management measures consistent with Guide 7: Pathogen management (RTA 2011) and FFMP	If pathogen outbreaks are detected, monitoring for pathogens, e.g. infected plants or animals (laboratory analysis may be conducted for suspected infected areas or plants) may be required.

4.1 Threatened flora

4.1.1 Rusty plum

Project impacts to rusty plum are likely to include:

- Direct loss of plants
- Fragmentation of habitats and loss of pollination opportunities
- Disturbance and degradation of remaining habitats due to weed and pathogen invasion, altered fire regimes or changes in hydrology.

The species occurs throughout the project footprint associated with warm temperate or littoral rainforests and moist eucalypt forests located within gullies.

4.1.2 Scrub turpentine

Project impacts to scrub turpentine are likely to include:

- Direct loss of plants
- Fragmentation of habitats and loss of pollination opportunities
- Disturbance and degradation of remaining habitats due to weed and pathogen invasion, altered fire regimes or changes in hydrology.

The species was located across four PCTs with most records within PCT 692 Blackbutt –Tallowwood moist ferny open forest of the coastal ranges of the NSW North Coast Bioregion. All of the recorded individuals are likely to be impacted by the project.

4.2 Threatened fauna

4.2.1 Mammals

Microchiropteran Bat species

Project impacts to bat species are likely to include:

- Direct loss of habitat.
- Loss of habitat elements providing potential breeding and roosting sites including stags, hollow-bearing trees and existing culvert and bridge structures.

Opportunities to salvage and/or provide temporary replacement habitat for these microbat species to mitigate project impacts are to be investigated. Project impacts on these species are largely confined to areas supporting suitable vegetation communities and roosting habitats at:

- Englands Road in the south of the alignment (Culvert 8 listed in Table 4.12 of **Appendix C, Updated biodiversity assessment report**)
- Coramba Road beneath a property access road at 353 Coramba Road (Culvert 10 listed in Table 4.12 of **Appendix C, Updated biodiversity assessment report**)
- Culvert under the existing Pacific Highway about 800 m north of the intersection with James Small Drive (Culvert 28, listed in Table 4.12 of **Appendix C, Updated biodiversity assessment report**).

- Old Coast Road Bridge number 1 (identified as Bridge 14, listed in Table 4.12 of **Appendix C, Updated biodiversity assessment report**).

Grey-headed flying-fox

Project impacts to grey-headed flying-fox are likely to include:

- Direct loss of known and potential foraging habitat
- Increased fragmentation of habitats.

No roost sites are likely to be impacted by the project.

Koala

Project impacts to koala are likely to include:

- Direct loss of known and potential habitat
- Loss of connectivity through habitat fragmentation and barriers to movement
- Direct mortality due to vehicle strike
- Edge effects leading to increased pest, weed and human disturbance
- Additional stress on koalas making the spread of diseases including Chlamydia or retrovirus more likely
- Habitat disturbance during construction as a result of increased light, noise and vibration or bushfire.

Common planigale

Project impacts to common planigale are likely to include:

- Direct loss of known and potential habitat
- Loss of connectivity through habitat fragmentation and barriers to movement
- Direct mortality due to vehicle strike
- Edge effects leading to increased pest, weed and human disturbance
- Habitat disturbance during construction as a result of increased light, noise and vibration or bushfire.

4.2.2 Birds

Olive whistler

Project impacts to olive whistler are likely to include:

- Direct loss of known and potential habitat
- Edge effects leading to increased pest, weed and human disturbance
- Habitat disturbance during construction as a result of increased light, noise and vibration or bushfire.

This species is unlikely to be impacted significantly as a result of the project.

Pale-vented bush-hen

Project impacts to pale-vented bush-hen are likely to include:

- Direct loss of known and potential habitat
- Fragmentation and isolation of adjacent habitat
- Edge effects leading to increased pest, weed and human disturbance
- Habitat disturbance during construction as a result of increased light, noise and vibration or bushfire.

Project impacts to this species are largely restricted to riparian vegetation associated with Jordans Creek.

This species is considered transient and is unlikely to be impacted significantly as a result of likely project impacts.

Square-tailed kite

Project impacts to square-tailed kite are likely to include:

- Direct loss of potential habitat
- Habitat disturbance during construction as a result of increased light, noise and vibration or bushfire.

This species is considered to be resident or locally dispersive in northern NSW, however is unlikely to be impacted significantly as a result of the project.

White-bellied sea-eagle

Project impacts to white-bellied sea-eagle are likely to include:

- Direct loss of potential habitat
- Habitat disturbance during construction as a result of increased light, noise and vibration or bushfire.

Adult birds are considered sedentary. The absence of a nest within the alignment means the species is unlikely to be impacted significantly as a result of the project.

4.2.3 Frogs

Giant barred frog

Project impacts to giant barred frog are likely to include:

- Direct loss of known and potential habitat
- Fragmentation of two known areas of habitat
- Altered hydrological regimes and impacts to habitat quality
- Impacts to surface water quality
- Edge effects leading to increased pest and weed disturbance
- Disturbance of habitat and loss of individuals due to bushfire
- Potential for introduction of Chytrid virus

Project impacts are likely to be limited to riparian areas associated with Pine Brush Creek, Williams Creek and Newports Creek.

4.2.4 Invertebrates

Coastal petaltail

Project impacts to coastal petaltail are likely to include:

- Direct loss of known habitat
- Altered hydrological regimes and impacts to habitat quality
- Impacts to surface water quality
- Edge effects leading to increased pest and weed disturbance
- Disturbance of habitat and loss of individuals due to bushfire.

Project impacts are likely to be limited to areas of swamp vegetation adjacent to Highlander Drive off North Boambee Road and north of the Englands Road interchange near Industrial Drive.

5. Pre-construction and design management measures

5.1 Potential impacts during pre-construction and design

- Direct loss of threatened flora and fauna and their habitats
- Location of road infrastructure may impact flora and fauna habitats, habitat connectivity and habitat condition.

5.2 Mitigation goals

- Placement of infrastructure, including access tracks, haul routes and ancillary sites, to avoid threatened flora and fauna habitats where possible
- Project design is to include solutions for maintaining the connectivity of adjacent threatened flora and fauna habitats
- Project design is to minimise changes in hydrology within areas of adjacent threatened flora and fauna habitat
- Design lighting to minimise amount of light spill into adjacent threatened flora and fauna habitat
- Salvage and re-establish threatened flora species impacted by the project.

5.3 Management measures

The following management measures are recommended to address potential impacts to threatened flora and fauna prior to construction.

5.3.1 Permanent fauna connectivity structures

Data relating to the occurrence of threatened flora and fauna, suitable habitats and movement corridors within the project area was gathered during baseline surveys. These data have been used to inform requirements for permanent fauna crossing structure types to be developed as part of detailed design. Six different types of crossing structures are proposed to improve fauna connectivity within the project area, including:

- Retained ridgelines over tunnels
- Dedicated fauna underpasses (culverts)
- Combined waterway bridges incorporating fauna underpasses
- Combined road bridges incorporating fauna underpasses
- Combined rail bridge incorporating fauna underpasses
- Combined fauna and drainage underpasses (culverts)
- Glider poles.

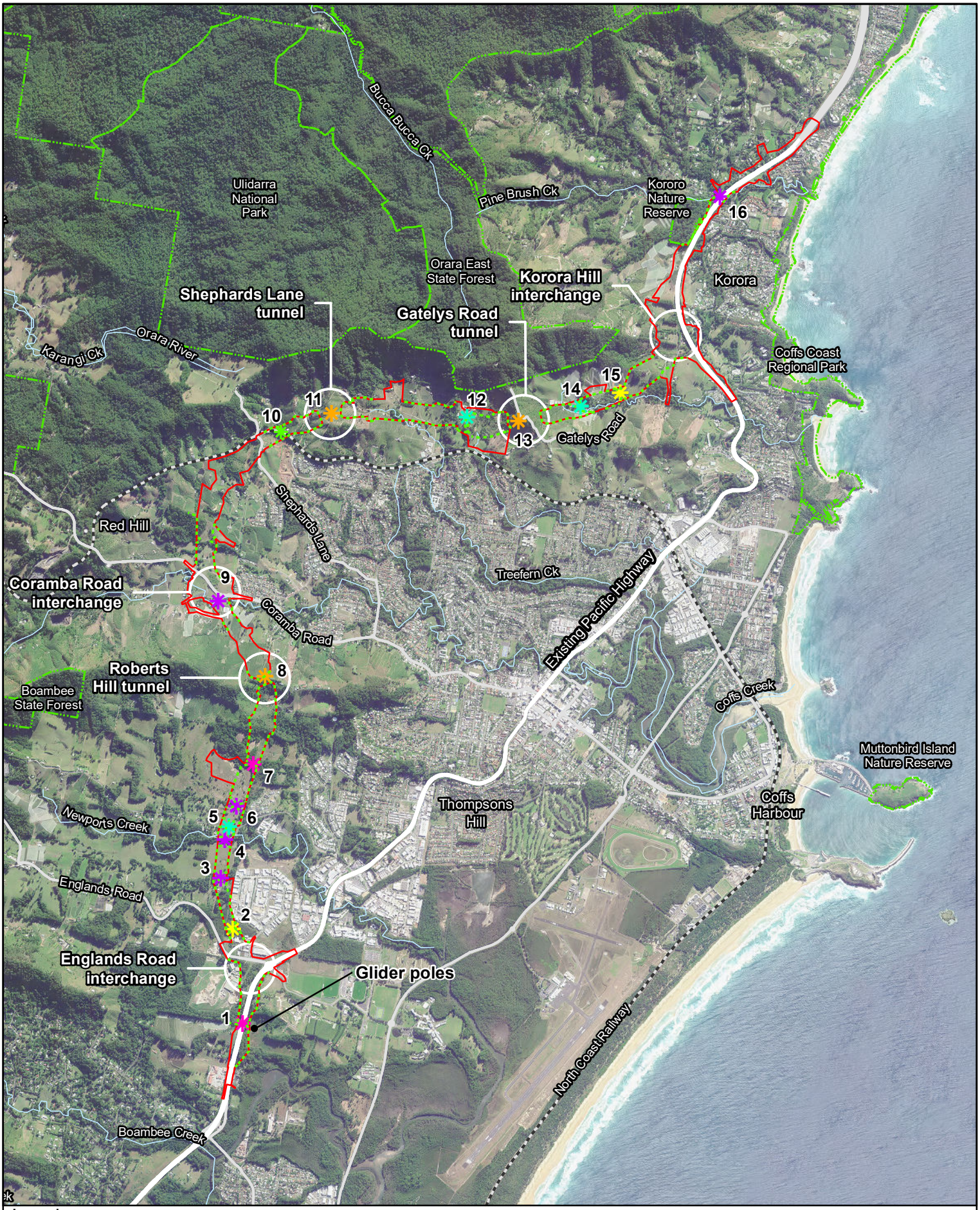
Crossing structures have been proposed based on the requirements of the target species, the alignment and condition of fauna corridors and the design and topographic constraints of the project. Sixteen locations have been identified along the 14 km alignment where connectivity structures can be placed, as identified in **Table 6** and shown in **Figure 5**. The location and final details of these structures will be subject to detailed design.

In addition to threatened species known to be impacted by habitat fragmentation as a result of the project, requirements for fish passage have also been considered during the design phase. In accordance with the Regions, Industry, Agriculture and Resources Group, DPIE guidelines, fish passage will be required on all Class 1, 2 and 3 waterways. This will include bridge crossings over Pine Brush Creek, which is the only

Class 1 waterway within the study area. Where culverts are proposed on Class 2 and 3 waterways, fish passage elements will be included in the design.

Opportunities for improving connectivity for gliders are included at the southern end of the study area. In areas where there are historical records of these species, and where there is movement and foraging habitat either side of the alignment, the installation of glider poles has been included in the design.

Detailed specifications to inform the design of each structure are provided in **Table 7** to **Table 12**.



Legend

- Construction footprint
- North Coast Railway
- Watercourse
- Park/Reserve
- Indicative fauna fencing location

Fauna Structures

- Combined fauna and drainage underpass
- Combined rail bridge incorporating fauna underpass
- Combined road bridge incorporating fauna underpass
- Combined waterway bridge incorporating fauna underpass
- Dedicated fauna underpass
- Retained ridgeline over tunnel overpass

Coffs Harbour Bypass
Permanent fauna connectivity structures and fencing
Figure 5

0 0.45 0.9 1.35 km

Scale @A4: 1:48,565
GDA 1994 MGA Zone 56

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Table 6: Fauna connectivity structures

Site No.	Design chainage	Connectivity structure type	Description, indicative dimensions and target species
1	10160	Dedicated fauna underpass Glider poles	Existing fauna underpass under the Pacific Highway would be demolished and a new fauna underpass constructed 10 m north of the existing underpass. The new fauna crossing would be built before the existing underpass is demolished. Underpass dimensions to match existing (2.7 m high and 5.5 m wide at base). Length about 80 m. Glide poles would be installed with final design based on site features. Target species: koala, spotted-tail quoll, and gliders
2	11100	Combined fauna and drainage underpass	Culvert across unnamed tributary of Newports Creek (Class 2 waterway) (5 x 2700W x 1500H & 1 x 3000W x 3300 H & approximately 90 m long). Target species: koala, spotted-tail Quoll, giant barred frog, fish.
3	11650	Combined waterway bridge incorporated fauna underpass	Bridge across unnamed tributary of Newports Creek (Class 2 waterway) (80 m length x 24.5 m width). Target species: koala, spotted-tail quoll, giant barred frog, pale-vented bush hen, fish
4	12000	Combined waterway bridge incorporated fauna underpass	Bridge crossing Newports Creek (Class 2 waterway) (90 m length x 25 m width). Target species: koala, spotted-tail quoll, common planigale, giant barred frog, pale-vented bush hen, fish
5	12150	Combined road bridge incorporating fauna underpass	Bridge crossing of North Boambee Road (99 m length x 23 m width). Target species: koala, spotted-tail quoll,
6	12400	Combined fauna and drainage underpass	Culvert crossing across unnamed tributary of Newports Creek (Class 2 waterway) (6 x 2400W x 2400 H approx. 45m long). Target species: koala, spotted-tail quoll, giant barred frog, pale-vented bush hen and fish
7	12800	Dedicated fauna underpass	Vegetation corridor identified for terrestrial fauna movement (1 x 3000 W x 3000 H RCBC approximately 89 m long). Target species: koala, spotted-tail quoll, common planigale, pale-vented bush hen
8	13750	Retained ridgeline over tunnel overpass	Roberts Hill ridgeline, 190 m ridgeline retained Target species: koala, spotted-tail quoll, pale-vented bush hen
9	14600	Combined waterway bridge incorporated fauna underpass	Three bridge crossings across Coffs Creek (Class 2) (64m length x 8m width; 64 m length x 25.5 m width; 72 m length x 8m width). Target species: koala, spotted-tail quoll, pale-vented bush hen, fish.

Site No.	Design chainage	Connectivity structure type	Description, indicative dimensions and target species
10	16600	Combined rail bridge incorporating fauna underpass	Bridge crossing over North Coast Rail Line. Vegetated corridor along rail verge (180 m length x 28.5 m width). Target species: koala, spotted-tail quoll,
11	17200	Retained ridgeline over tunnel overpass	Shephards Lane tunnel, 360 m ridgeline retained Target species: No proposed target as this location would only provide opportunities for fauna connectivity due to existing land use. To be used by highly mobile threatened and non-threatened fauna
12	17800	Combined road bridge incorporating fauna underpass	Fauna passage included with access road underpass (30 m length x 24.5 m width). Target species: koala, spotted-tail quoll, common planigale
13	19000	Retained ridgeline over tunnel overpass	Gatelys Road tunnel, 450 m ridgeline retained Target species: koala, spotted-tail quoll, pale-vented bush hen.
14	19750	Combined road bridge incorporating fauna underpass	Fauna passage included with West Korora Road underpass (34 m length x 27 m width). Target species: koala, spotted-tail quoll, pale-vented bush hen
15	20150	Combined fauna and drainage underpass	Culvert crossing across tributary of Jordans Creek (Class 2) (1 x 3000 W x 3000 H, approximately 60 m long). Target species: koala, spotted-tail quoll, pale-vented bush hen, fish
16	22450	Combined waterway bridge incorporated fauna underpass	Bridge length reduced because of the Pine Brush Creek and Williams Creek realignment design change. Bridge crossing across Pine Brush Creek (Class 1) (37 m length x 32 m width). Target species: koala, spotted-tail quoll, pale-vented bush hen, giant barred frog.

Table 7: Retained ridgelines over tunnel overpasses

Design principles
The existing vegetation communities on the ridges will be retained where feasible (there may be need for some minor clearing associated with utilities/associated tunnel infrastructure).
Fauna exclusion fencing, with appropriate mechanisms to prevent climbing and burrowing animals, is to be installed on both sides of the tunnel approaches, extending above both portals and tying into the fauna fencing along the road corridor. The design of any barriers must not cause a barrier to the movement of any of the target fauna species. Clearing of native vegetation on tunnel approaches will be minimised. Areas where existing native vegetation has been removed during the construction of the project and is located within the fauna exclusion fencing area shall be revegetated with native vegetation.

Table 8: Waterway bridges incorporating fauna underpass

Design Principles
Clearing of vegetation adjacent to bridges across waterways will be minimised. Design and construction methodology is to retain as much vegetation within the riparian zone of the waterway as is practicable. Bridges are the preferred crossing structure for identified Class 1 waterways (major fish habitat), preferably being single- span or multi-span bridges with the pylons/piers located outside the main channel. Where feasible and reasonable, the design is to avoid placing piers in permanent water channels and on-stream banks, to minimise alteration to water flow and/or damage to stream bank vegetation. This is important for the identified Class 1 waterways. Bridges should be designed with a natural substrate at the abutment, such as soil or vegetation, where feasible and reasonable. Scattered rocks could be included. Bridges should be designed to allow unimpeded water flow, stream bank and riparian vegetation, preferably on both sides of the water course Any scour protection associated with the entries and exits to waterway bridges should accommodate and provide for the safe and effective passage of fauna, be constructed with the smallest reasonably possible rock size, be as level as possible and have minimal gaps between the rocks. A minimum width of 3 m is to be retained between the toe of the scour protection and the top of bank to maintain fauna passage below the bridge on both sides. For effective connectivity, the 3m passage should consist of a natural substrate or other surface type that will not hinder fauna movement. Note: location of piers should not restrict the designated fauna passage area or the width of the passage should be widened to accommodate the pier. Bridges should be designed (height, carriageway separation) to allow sufficient light and moisture to encourage growth of vegetation between twin bridge structures. A minimum height of 1.5 m should be allowed for in areas proposed for terrestrial fauna passage. Bridges (and culverts) should be designed to ensure physical, hydraulic and behavioural barriers are minimised for aquatic fauna movements. Impacts should be minimised by ensuring that: • Natural system flow and velocity is maintained as closely as possible • Habitat within a culvert is to be as natural as possible (e.g. allow rocks and bed materials to infill the culvert base) Revegetation works should be completed as soon as practicable following bridge construction and include restoration of a natural, riparian zone vegetation community underneath the bridge structure. Revegetation works on the entry/exit side of the structure are to provide for a continuous strip of native vegetation and habitat from each side of the bridge. Where possible, the vegetation community created as part of the revegetation works is to match the PCT of the retained vegetation communities. Planting underneath the bridge structures should include the use of groundcovers, with shrubs to be used when the height and light penetration allow for larger species to establish. All plant species are to be consistent with the PCT retained on each side of the bridge. Where the bridges cross areas of habitat identified for threatened frog species the creek channels are to be reinstated to include habitat elements to support these species, including consideration for fringing riparian vegetation, emergent aquatic vegetation, suitable instream habitats to support species-specific life cycles. The approaches to the fauna passage on each side of the bridge is to include fauna fencing that ties into the abutments to funnel fauna towards the crossing and to exclude fauna from the road surface.

Table 9: Road bridges incorporating fauna underpasses

Design Principles
Bridges should be designed with a natural substrate at the abutment, such as soil or vegetation, where feasible and reasonable.
A minimum width of 3m is to be retained between the toe of the bridge and the edge of the road to maintain fauna passage below the bridge on one side.
Bridges should be designed (height, carriageway separation) to allow sufficient light and moisture to encourage growth of vegetation between the structures. A minimum height of 1.5m should be allowed for in areas proposed for terrestrial fauna passage Revegetation work should be completed as soon as practicable following bridge construction and include restoration of a natural, vegetation community underneath the bridge structure. To ensure there is a contiguous link between adjacent vegetation and the structure, revegetation work shall occur up to each side of the structure. Where possible, the vegetation community created as part of the revegetation work is to match the adjacent PCT. Planting underneath the bridge structures should include the use of groundcovers, with shrubs to be used when the height and light penetration allow for larger species to establish. All plant species are to be consistent with the PCT retained on each side of the bridge.
The approaches to the fauna passage on each side of the bridge is to include fauna fencing that ties into the abutments to funnel fauna towards the crossing and to exclude fauna from the road infrastructure.

Table 10: Rail bridges incorporating fauna underpasses

Design Principles
Bridges should be designed with a natural substrate at the toe of abutment, such as soil or vegetation, where feasible and reasonable. Scattered rocks could be included. Any scour protection associated with the entries and exits to bridges should accommodate and provide for the safe and effective passage of fauna, be constructed with the smallest reasonably possible rock size, be as level as possible and have minimal gaps between the rocks.
A minimum width of 3m is to be retained between the toe of the scour protection or the abutment and the edge of the road to maintain fauna passage below the bridge on both sides. For effective connectivity, the 3m passage should consist of a natural substrate with refuge areas (scattered rocks, logs) and landscaping of each side to provide connectivity with adjacent forest, not consisting of all rock and not consisting of scour protection. Bridges should be designed (height, carriageway separation) to allow sufficient light and moisture to encourage growth of vegetation under the structures. A minimum height of 1.5m should be allowed for in areas proposed for terrestrial fauna passage.
Revegetation work should be completed as soon as practicable following bridge construction and include restoration of a natural, vegetation community underneath the bridge structure. To ensure there is a contiguous link between adjacent vegetation and the structure revegetation work shall occur up to each side of the structure. Where possible, the vegetation community created as part of revegetation shall match the PCT of the adjoining vegetation communities. Planting beneath bridges should include the use of groundcovers, with shrubs to be used when the height and light penetration allow for larger species to establish. All plant species are to be consistent with the PCT retained on each side of the bridge.

Design Principles
The approaches to the fauna passage on each side of the bridge is to include fauna fencing that ties into the abutments to funnel fauna towards the crossing and to exclude fauna from the road surface.

Table 11: Dedicated fauna underpasses (culverts)

Design Principles
Crossings should provide an unobstructed view, for fauna using the underpass, of the horizon or habitat on either side of the structure. The location of underpasses on embankment fills should be optimized to provide these views, although structures shall not be positioned too far above or below natural ground level. Culvert underpass structures that exceed 50m in length shall be a minimum 3x3m (height x width) box culvert. Culvert structures that are less than 50m length shall be a minimum 2.4mx2.4m box culvert should fill embankments heights not permit 3x3m box culvert. Approach grades to the underpass structures would be no steeper than 3H:1V. Dedicated underpasses shall have a natural substrate, such as soil (sandy loam preferable) or mulch. In order to achieve dry passage in dedicated underpasses, the following design principles apply: • Dedicated underpasses are to be located above flow lines, gullies and depressions • Basin outlets should not lead to or run to dedicated underpasses • Basins should not be located in front of underpass structures • Locations are to be ground-truthed to ensure the correct conditions • Underpasses are to be designed with a longitudinal grade and to be free draining to reduce frequency and levels of any ponding water within the culverts • Fauna furniture is to be incorporated into dedicated structure design and at each entrance • A horizontal timber bridge with vertical supports shall be installed for the entire length of culvert and extend to the apron. There shall be a minimum 0.6 m ceiling clearance above the horizontal bridge. • Refuge poles (minimum 3m above ground and 200mm diameter with a forked top) shall be installed between the apron and forest edge. External refuge poles shall be located at least 3 m from koala exclusion fencing. Clearing of existing native vegetation shall be minimised at dedicated fauna underpasses. The approaches to the underpasses on either side of the road should be subject to revegetation work to connect each side to areas of retained native vegetation.

Table 12: Combined fauna and drainage underpasses (culverts)

Design Principles
Combined underpasses are designed to facilitate drainage or property access with fauna passage, and in some cases including fish passage. Combined underpasses must be located and installed so that entrance slopes are not steeper than 3H:1V nor rocky and must provide suitable fauna passage. Combined underpass floors and exit / entry points that are designed to cater for terrestrial fauna passage must provide dry fauna passage during a one in 1-year ARI three day storm event or must not have wet sections that retain water for longer than three days. A dry ledge or similar within combined underpasses to maintain dry passage may be required. Minimum ledge width of 1.2m is recommended.

Design Principles
For aquatic species, the natural width, depth and gradient of the watercourse is to be maintained within the culvert, with no vertical drops created at the entrance or exit. All designs should be in accordance with NSW Fisheries Guideline “Why do Fish Need to Cross the Road” (now incorporated into DPI 2013). Ensure that pathways to fauna underpasses are not affected by noise mounds or ancillary sites or rest areas. Any scour protection associated with the entries and exits to combined drainage / fauna crossings must accommodate and provide for the safe and effective passage of fauna, be constructed with the smallest reasonably possible rock size, be as level as possible and have minimal gaps between the rocks. Where feasible and not affecting the hydrological performance of the drainage structure, fauna furniture is to be installed in combined structures that have been designed to provide for terrestrial fauna movement, with consideration for raised ledges, shelter rocks and resting poles. Furniture is to be designed and located so it does not obstruct movement of the target fauna species through the underpass.

5.3.2 Permanent fauna exclusion fencing

During detailed design, opportunities are to be fully explored to install permanent fauna exclusion fence along the alignment to funnel fauna to safe crossing opportunities at the fauna crossing structures. Much of the 14 km alignment is likely to be subject to dedicated fauna exclusion fencing deemed appropriate for the habitat type adjoining the project area. Sections to remain unfenced are likely to include larger interchange areas, agricultural areas or urban fringes. Fauna fencing should be installed on the outside edge of the on-load and off-load ramps where interchanges are located, as outlined in **Table 13**. As a general rule the linear extent of fauna fence will be the same on both sides of the carriageway.

Detailed specifications to inform the design of permanent fauna fencing is provided in **Table 14**.

Temporary fauna exclusion fencing will be required if existing fauna fence at the southern end of the project on the Pacific Highway is removed during construction.

Table 13: Proposed indicative fencing locations

Approximate chainage (northbound and southbound)	Fencing type	Comment
9750-13750	General fauna fencing where specific species fencing not proposed. Combine general fauna fence and frog fence at known threatened frog habitat	Mapped koala habitat Known giant barred frog habitat at Chainage 11500-11700 and Chainage 12000-12150
14300-14500	General fauna fencing where specific species fencing not proposed.	Mapped koala habitat
14750-15500	General fauna fencing where specific species fencing not proposed.	Mapped koala habitat
15750-16250	General fauna fencing where specific species fencing not proposed.	Mapped koala habitat

Approximate chainage (northbound and southbound)	Fencing type	Comment
16600-20700	General fauna fencing where specific species fencing not proposed.	Mapped koala habitat
21000-22500	General fauna fencing where specific species fencing not proposed. Combine general fauna fence and frog fence at known threatened frog habitat	Mapped koala habitat Known giant barred frog habitat at Chainage 22250-22500

Table 14: Fauna fencing design specifications

Type	Design principles
Integration with crossing structures	Fencing must be tied into crossing structures to guide animals towards the crossing structure and prevent access to the road. Fencing is typically constructed on both sites of the road; otherwise animals are easily trapped on the road.
Returns	Fencing should be continuous and at their ends have a 'return area' to guide animals back into habitat rather than onto the road.
Integration with noise walls	Fauna fencing can be tied into noise walls where required.
Vertical access prevention	• Fence design should prevent animals from jumping over fences where possible. Target fence types should be designed depending on the threatened fauna in the area. • The fence must prevent animals from digging underneath. Install metal flaps at the base of fencing where the fence crosses drainage lines to ensure fauna cannot move under the fence at these points.
Mesh size	The size of the mesh must prevent the target species from climbing through.
Fencing tops for koalas	Fauna fencing where koalas are the target species will require either floppy-top or smooth metal sheeting on the top portion of the fence to prevent animals from climbing over.
Frog fencing	• Where frog fencing is required, it would extend a minimum of 50m either side of crossing structure • Frog fencing is to consist of a galvanised grid mesh fence <4mm, 400-500 mm high with a 150 mm wide sloped roof to discourage amphibian access. This can be attached to other fauna fencing. • Fencing in areas of giant barred frog habitat should be a minimum of 1000 mm in height. • Frog fences must be buried at least 10 cm or alternatively pegged down to prevent frogs crawling underneath.

Type	Design principles
Maintenance	• Fencing would require regular inspection and maintenance. A vehicle access track adjacent to the fence would facilitate rapid inspection, and maintenance and allow regrowth vegetation to be managed. • Maintenance of fencing is critical to identify and repair breaches, periodic inspections are likely to be required.

5.3.3 Identify habitat exclusion zones

An exclusion zone is a designated 'no go' area that is clearly identified and appropriately delineated on site to prevent damage to ecological features that require protection. The location of any features such as native vegetation, threatened species and fauna habitat will be ground-truthed prior to clearing and used to inform the locations of exclusion zones. The project ecologist will identify exclusion zones in accordance with the TfNSW Biodiversity Guidelines (RTA 2011). Zones will be mapped and included in project documentation and clearly marked on the ground with appropriate fencing or tape prior to construction.

5.3.4 Salvage/re-establish threatened flora

Threatened flora directly impacted by the project are to be salvaged and re-established in adjacent suitable habitat areas prior to construction or during the commencement of early site works. Baseline surveys suggest, up to 74 rusty plum could be salvaged and re-established. Direct impacts to 14 scrub turpentine trees will also occur, however direct salvage and translocation of this species will not be possible due to risk of spreading myrtle rust. A salvage and re-establishment plan is to be prepared during project design outlining detailed procedures for the preparation of receival sites, plant movement, pre- and post- care of target individuals as well as detailing the objectives, monitoring procedures and contingency measures. The Rusty Plum Salvage and Relocation Plan will form a subplan of this TSMP.

Methods might include the following where appropriate:

- Direct transplanting of salvageable rusty plum saplings
- Either direct transplanting of salvageable rusty plum trees where possible or replacement plantings, e.g. seed or tubestock
- Establish additional individuals by direct seeding for either rusty plum or scrub turpentine using seed collected from the local population prior to establishment period.

Any translocation of threatened plants will need to consider soil and plant pathogen management.

5.3.5 Pre-clearing survey for threatened flora

During the pre-construction phase, targeted pre-clearing surveys are to be undertaken for rusty plum and scrub turpentine within the project area including locations of access tracks, particularly where the species have been identified or predicted to occur. Identified plants will be marked with flagging tape and rusty plum mapped as part of the salvage and re-establishment plan (refer Section 5.3.4).

5.3.6 Threatened flora infected with pathogens

Targeted flora surveys for the biodiversity assessment detected myrtle rust on several scrub turpentine's. Myrtle rust is currently widespread along the east coast of Australia and there is no effective practical control for the pathogen. It is likely that a large proportion of the local population within the study area, and at the broader regional scale, is already exposed to the pathogen. Recovery of the species within the vicinity of the project is likely to be poor with many potential offset sites likely to also be infected. Visitation into pathogen affected areas and subsequent movement of people and vehicles around the study area has the potential to result in the introduction or spread of myrtle rust.

Salvage and re-establishment of scrub turpentine individuals is not appropriate given the risk associated with spreading myrtle rust into unaffected populations.

5.4 Mitigation goals and corrective actions

The mitigation goals and associated corrective actions for threatened flora and fauna species to be implemented during the pre-construction phase are summarised in **Table 15**.

Table 15: Mitigation goals and corrective actions - Pre-construction

Mitigation goals	Proposed mitigation measure	Monitoring/ timing frequency	Triggers for corrective actions	Corrective actions	Responsibility
Placement of infrastructure to avoid threatened flora and fauna habitats where possible	Implementation of multi-disciplinary design review processes involving an ecologist to review placement of infrastructure in relation to habitat for threatened flora and fauna.	At each design iteration	Infrastructure intersects, overlaps or fragments habitat for threatened flora and fauna. Uncertainty regarding potential risks to threatened flora and fauna habitat (i.e. insufficient set-backs to vegetation/ sensitive habitat features, potential for significant disturbance, etc)	Conflicts and concerns to be flagged with design lead and appropriate strategies or alternative design / engineering solutions to be discussed and implemented.	Environment Manager
	Identify habitat exclusion zones prior to clearing to guide the placement of infrastructure and ancillary facilities outside of threatened flora and fauna habitat areas, where possible	Prior to commencement of site works	Exclusion zones have not been clearly identified in site plans. Exclusion zones have not been flagged and identified on site.	Sites works must not commence until exclusion zones have been decided and are clearly identified on site by the project ecologist. The site foreman/contractor will be required to implement these during the construction phase.	Project Ecologist

Mitigation goals	Proposed mitigation measure	Monitoring/ timing frequency	Triggers for corrective actions	Corrective actions	Responsibility
Project design is to include solutions for maintaining the connectivity of adjacent threatened flora and fauna habitats	Project design to incorporate the implementation of fauna connectivity structures and suitable engineering solutions to facilitate fauna movement within the vicinity of threatened flora and fauna habitat.	Prior to construction at detailed design stage	Detailed design drawings indicate changes to the location or design specifications for fauna structures that have the potential to impact functionality.	Amend design to meet design standards outlined in Section 5.3.1 of this Plan Additional fauna connectivity structures maybe required if design solution cannot feasibly achieve design principles for the identified fauna crossing locations	Structures and drainage design lead / Environment Manager
A Nest Box Management Plan and Microbat Management Plan will be prepared and implemented as part of the FFMP in accordance with Guide 8: Nest Boxes of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA 2011), and the RMS Microbat Management Plan template. Both Plans would include requirements for monitoring and maintenance. Both plans will be subplans of the TSMP.	Provide supplementary denning habitat for hollow dependent fauna in areas adjoining the alignment. Provide roosting habitat for microbats in new bridges and culverts where future (structure) maintenance would not be compromised.	Prior to construction at detailed design stage	Detailed design drawings indicate negative changes to the locations of and design specifications for artificial microbat roosting sites and nest boxes	Amend design to meet the *Guide 8: Nest Boxes of the TfNSW Biodiversity Guidelines*. Additional artificial microbat roosting sites and nest boxes may be required if design solution cannot feasibly achieve design principles in the guide above for the identified artificial microbat roosting sites and nest boxes locations.	Environment Manager

Mitigation goals	Proposed mitigation measure	Monitoring/ timing frequency	Triggers for corrective actions	Corrective actions	Responsibility
Project design is to minimise changes in hydrology within areas of adjacent threatened flora and fauna habitat	Engineering / design solutions to incorporate measures to maintain the background hydrology.	Confirm drainage design using hydrological modeling during detailed design. Baseline monthly ground and surface water level monitoring to inform natural variation within project area.	Water diverted to or from threatened flora or fauna habitat.	Drainage design reviewed and altered if necessary.	Civil design lead / Environment Manager
Salvage and re-establish threatened flora species impacted by the project	Prepare a salvage and re-establishment plan for rusty plum individuals impacted by the project. Identify suitable receiving sites for the species and apply any necessary protection/ stewardship arrangements. Commission contractor with suitable experience in the re-establishment of the target flora species to undertake the works including pre- and post-management of species.	Prior to construction	Unavailability of suitable receiving sites within proximity to the project area	Increase the search area to locate suitable receival sites.	TfNSW

6. Construction management measures

6.1 Potential impacts during construction phase

- Direct loss of threatened flora as a result of vegetation clearing
- Fauna injury or mortality as a result of vegetation clearing
- Loss of habitat for threatened flora and fauna including hollow-bearing trees and potential roosting sites
- Loss of habitat connectivity and creation of barriers to fauna movement
- Fauna entrapment in excavations
- Indirect impacts include disturbance and degradation of remaining habitats, such as erosion and changes to surface water quality and flows.

6.2 Mitigation goals

- No damage to threatened flora and fauna habitat within marked exclusion zones
- No vehicle collision incidents with threatened fauna species within the construction area
- No threatened fauna injury or mortality due to vegetation clearing activities
- 80 per cent survival rate of re-established threatened flora species
- Minimise noise, light and dust during construction
- Reinstate habitat for threatened flora and fauna in landscape zones
- Minimise impacts to hydrology and water quality during construction including erosion and sediment control.

6.3 Management measures

6.3.1 Environmental work method statements

Environmental Work Method Statements (EWMS) are prepared to manage and control all activities that have the potential to negatively impact the environment. EWMS will be prepared prior to commencing construction activities on site and will incorporate relevant mitigation measures and controls from management plans. They will also identify key procedures to be used concurrently with the EWMS. EWMS are specifically designed to communicate requirements, actions, processes and controls to construction personnel using plans, diagrams and simply written instructions.

EWMS will be prepared progressively in the lead up to and throughout construction in consultation with relevant members from the Project team, and approved by the Environment Manager.

EWMS for activities identified as having high environmental risk will undergo a period of consultation with stakeholders and authorities prior to approval.

EWMS for activities likely to be considered high risk due to their proximity to environmentally sensitive areas which are relevant to the TSMP include:

- Working platforms in or adjacent to waterways.
- Temporary waterway crossings.

- Ancillary site establishment
- Stockpile management
- Clearing and grubbing
- Sediment basin, construction and management
- Dewatering activities
- Blasting.

Contractor to include any additional activities arising from risk review.

All construction personnel and sub-contractors undertaking a task governed by an EWMS must participate in training on the EWMS, and acknowledge that they have read and understood their obligations prior to commencing work.

Regular monitoring, inspections and auditing against compliance with the EWMS will be undertaken by Project management, quality, and environmental personnel to ensure that all controls are being followed and that any non-conformances are recorded and corrective actions implemented.

A register of EWMS will be maintained.

6.3.2 Construction induction and training

Induction and training will be conducted with all contractors and other staff that will be working in the area of known and potential threatened flora and fauna habitat. This training will highlight to staff the threatened species and their habitats to allow them to clearly identify them on site should they be located. Any personnel that will require site access will be informed of the importance of following the clearing, flora re-establishment and rehabilitation protocols.

6.3.3 Fauna rehabilitation protocol

The Project Ecologist will be present on site during all vegetation clearing and habitat removal activities to capture and relocate any fauna species that may be encountered. Identified habitat (including hollow-bearing trees) will be left for at least 48 hours (i.e. 2 nights) after clearing the surrounding vegetation to allow fauna to relocate naturally. If necessary, fauna may need to be trapped or captured and relocated to nearby suitable habitat for release. The trapping and relocating of fauna will be undertaken in accordance with Guide 9: Fauna Handling of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA 2011) and the NSW code of Practice for Injured, Sick or Orphaned Protected Fauna (OEH 2011).

All adverse events or incidents involving fauna mortality that occur due to construction, will be recorded including details of the fauna, location of the incident and measures taken to address the issue. Injured fauna will be transported to the nearest veterinary surgery or wildlife carer for treatment and contact made with Wildlife Information Rescue Service (WIRES) Mid North Coast Branch, as necessary. The ecologist or wildlife carer will be responsible for the relocation and release of displaced fauna upon their recovery. Release sites for fauna are to be within close proximity to the site where the fauna were originally captured, if possible. The GPS location of release sites are to be recorded and provided to TfNSW.

6.3.4 Pre-clearing surveys

Prior to the commencement of clearing operations, pre-clearing surveys will be undertaken in accordance with Guide 1: Pre-clearing Process of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA 2011). The surveys are to be undertaken by the Project Ecologist and are to involve a search of all habitat and animal breeding places within areas where vegetation clearing is to occur. The Project Ecologist is to confirm the location of exclusion zones and proposed clearing methods, such as

staged clearing, to ensure the protection of any threatened flora and fauna that may be encountered. Where necessary, the ecologist will record the location of any fauna to be relocated and identify suitable habitats within proximity for release.

Procedures for pre-clearing activities are detailed within this TSMP.

6.3.5 Clearing procedures

Clearing procedures are to be outlined in the TSMP and undertaken in accordance with Guide 4: Clearing of vegetation and removal of bushrock of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA 2011). These will be finalised with the Project Ecologist during the pre-clearing surveys.

Clearing of vegetation and habitat features will be undertaken in a two stage process following the completion of the pre-clearing surveys. Under scrubbing and the removal of non-habitat trees would be undertaken first. Habitat trees (including hollow-bearing trees) would be removed at least 48 hours (or 2 nights) after the removal of non-habitat trees, to enable resident hollow-dependent fauna to evacuate the tree prior to felling. Canopy separation between habitat trees and non-habitat trees is required before the 48hr timeframe commences. The Project Ecologist must be present to supervise the removal of each habitat tree.

Suitable habitat features including hollow logs, large woody debris and bushrock are to be salvaged and stockpiled during construction for later use for habitat restoration activities, in accordance with Guide 5: Re-use of woody debris and bushrock of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA 2011).

6.3.6 Temporary fencing and fauna management

Installation of temporary fauna fencing will be required if existing fauna fence at the southern end of the project on the Pacific Highway is removed during the construction period. Permanent fauna fencing across the project is to be progressively installed as fauna connectivity structures become operational. The need for temporary frog exclusion fence around known giant barred frog habitat will be assessed prior to clearing and temporary fence design captured in the relevant EWMS.

6.3.7 Koala specific management measures

Measures proposed to mitigate project impacts on koala and facilitate safe movement of the species throughout the project area include the management measures above, in particular permanent fauna connectivity structures with koala as a target species and koala exclusion fencing.

Additional measures to be implemented during the construction phase are:

- Induction training for all contractors and project staff working in areas of known and potential koala habitat in the project area. This training will identify areas of koala habitat, crossing zones and key threats to the species. The importance of following the clearing and rehabilitation protocols will be made clear to all project personnel.
- In areas of koala habitat, pre-clearing surveys (i.e. surveys immediately prior to clearing) will consist of: a pre-dawn (i.e. 1-2hrs before sunrise) spotlight survey by 1-2 ecologists for 20mins/ha of clearing area; and a daylight canopy search of the scheduled clearing area. These surveys will aim to identify trees in which a koala is present and any adjacent trees with overlapping crowns. Surveys will also consider habitat immediately adjoining the clearing area.
- If a koala is located within or immediately adjacent to the clearing area during clearing all activity will be suspended within 50m of the individual until the situation is assessed by the project

Ecologist. Following assessment, some activities (i.e. occasional light vehicle movement) may be permitted within the 50m exclusion zone, although no clearing will occur within the zone. The exclusion zone will remain in place for a minimum of 48hrs to allow the animal to move out of the construction site of its own volition. In the event that a koala remains in the clearing site for more than 48 hours, it may be captured by the Project Ecologist and relocated to the nearest area of suitable habitat where the individual is at no risk of harm.

- Each tree identified by the Project Ecologist as being a risk to a koala if felled, will not be felled, damaged or interfered with until the koala has moved from the clearing site. The Project Ecologist will physically move koalas if necessary in accordance with Biodiversity Guidelines: Protecting and managing biodiversity on RTA Projects (RTA 2011).
- If any koalas are observed showing signed of disease, WIRES must be contacted and direction taken from a wildlife carer regarding further action.

6.3.8 Habitat restoration and landscape design

Procedures for the reinstatement of native vegetation and habitats within the project area will be detailed in the Place Design and Landscape Management Plan, for the project. This would include the provision of replacement foraging resources for target threatened fauna, including plants that provide copious nectar and fruits in locations that would not lead to increase in roadstrike i.e. between noise walls and road edge, where appropriate and targeting areas that are located within:

- Regional and local Biodiversity links / fauna corridors
- Areas adjacent to existing threatened flora and fauna habitats and riparian zones
- CHCC mapped Koala habitat and environmental protection zones.

Where reasonable and feasible salvaged hollows, large woody debris and bushrock are to be re-used as a part of the restoration works in accordance with Guide 5: Re-use of woody debris and bushrock of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA 2011). TfNSW would consult with local Landcare groups and CHCC to determine if these organisations have the capacity to accept rootballs for local restoration works.

6.3.9 Hydrology and water quality

To manage potential impacts associated with water quality, erosion and sedimentation, management considerations have been incorporated into the project design. These designs have taken into account the guidelines, principles and design standards as defined in Managing Urban Stormwater: Soils and Construction Volume 1 (Landcom, 2004) and Management Urban Stormwater: Soils and Construction – Main Road Construction (DECC, 2008). These documents outline target parameters and measures for water quality and soil management during road construction and ongoing operation to prevent environmental pollution.

Water quality objectives for the project relate to the protection of sensitive downstream receiving environments during and post-construction; particularly those environments that provide important habitat for threatened frog species. The key mitigation measures to be implemented during construction will include sediment basins and additional erosion and sediment controls to intercept run-off and retain the associated sediments and pollutants. Procedures for the maintenance and monitoring of these measures during construction are to be incorporated into the Construction Erosion and Sediment Control Plan.

During operation, permanent water quality management and protection measures will be installed to protect adjacent waterways and wetland areas from pollutants generated by the project. These will include grassed swales. Water quality objectives for the project should be consistent with the NSW Water Quality and River Flow Objectives for the Bellinger River Catchment (OEH, 2018).

Water quality monitoring will be conducted prior to, during and post construction comparing upstream and

downstream results to monitor sediment and pollutant levels and to trigger the need for corrective actions.

6.3.10 Disease-causing pathogens

Pathogens are agents that cause disease in flora and fauna and are usually living microorganisms such as a bacterium, virus, or fungus. Such pathogens in NSW include:

- Phytophthora (*Phytophthora cinnamomi*) which is a soil-borne fungus that causing tree death;
- Chytrid fungus (*Batrachochytrium dendrobatidis*) which affects amphibians;
- Myrtle rust which is a plant disease caused by the fungus *Austropuccinia psidii*;
- Fusarium wilt/Panama disease which is a plant disease caused by the fungus *Fusarium oxysporum*.

Pathogens can be spread on footwear, vehicles and machinery, particularly during wet weather or in wet conditions. Myrtle rust is predominantly spread by wind.

Implementation of management measures consistent with Guide 7: Pathogen management (RTA 2011) must be applied wherever pathogens are known or suspected to occur on or adjacent to the bypass and during maintenance works. A Panama Disease Control Management Plan has been developed to manage risks associated with potentially infected plant material during and following clearing and grubbing, movement of the pathogen in soils and water due to erosion and sedimentation during construction and movement of the pathogen via contaminated construction equipment and vehicles entering and leaving the construction footprint.

A Panama Disease Control Management Plan (**PDCMP**) has been prepared. The PDCMP provides instruction on the control measures, monitoring and reporting requirements to manage the risks of spread of Panama disease Tropical Race 1 (**R1**) and Subtropical Race 4 (**STR4**) associated with Coffs Harbour Bypass Project (**CHBP**). The Plan has been prepared to meet the Transport for NSW (**TfNSW**) Environmental Management Measures listed in the **CHBP** Environmental Impact Statement (**EIS**) and all applicable legislation, and addresses environmental management measure AG08 from the **CHBP EIS**, which states:

> *A Panama Disease Control Management Plan will be prepared and implemented during construction in consultation with Department of Planning, Industry and the Environment (DPIE) (Regions, Industry, Agriculture & Resources), representatives of the Banana Growers Association of Coffs Harbour & District and the Coffs Harbour City Council (CHCC).*
>
> *The Plan will be prepared in accordance with relevant Queensland's Department of Agriculture and Fisheries guidelines including Panama disease tropical race 4: Biosecurity standards and guidelines (QDAF 2015) and Panama disease tropical race 4: Decontamination guide (QDAF 2016).*

Under the PDCMP, risk of spread is managed by:

- Categorising the land parcels adjacent to the construction site into Sensitive and Non-sensitive Receivers, as described below in Table 2.
- Construction Site control measures that seek to prevent the introduction of Panama disease from outside the construction site (R1 or STR4) and to prevent the spread of any existing R1 infection from within to outside the construction site into adjoining areas.
- Removing, treating, storing or encapsulating materials within the construction site that potentially contain Panama disease, thereby allowing uninhibited internal access for the remainder of construction.

Notwithstanding the above, low impact and utility relocation works would be undertaken in accordance

with the *TfNSW Working on Banana Plantations Panama Disease Procedure Rev 8* as per project (SSI-7666) condition of approval E76.

6.4 Mitigation goals and corrective actions

The mitigation goals and associated corrective actions for threatened flora and fauna species to be implemented during the construction phase are summarised in **Table 16**.

Table 16: Mitigation goals and corrective actions - Construction

Mitigation goals	Proposed mitigation measure	Monitoring/ timing frequency	Triggers for corrective actions	Corrective actions	Responsibility
No damage to threatened flora and fauna habitat within marked exclusion zones	Exclusion zones kept clearly marked and visible on site. Site inductions mandatory for all new site workers.	Throughout construction	Exclusion zones do not correspond with approved drawings. Fencing moved or damaged. Damage to vegetation or habitat for fauna within exclusion zones.	Stop works until exclusion fencing has been reinstated in accordance with approved plans. Project Ecologist to be contacted and to assess impacts. Breech to be reported to TfNSW Suitable replanting works to be commissioned or biodiversity offsets to be purchased, as necessary.	Construction Manager
No vehicle collision incidents with threatened fauna species within the construction area	Temporary fauna exclusion fencing will be required if existing fauna fence at the southern end of the project on the Pacific Highway is removed during construction period. Construction speed limits applied for all construction vehicles and machinery.	Throughout construction	Fauna injury or mortality due to collision with construction vehicles. Fauna within the construction footprint.	Implementation of fauna rehabilitation protocols. Review placement of fauna fencing/ crossings, haulage routes, as needed.	Construction Manager / Project Ecologist

Mitigation goals	Proposed mitigation measure	Monitoring/ timing frequency	Triggers for corrective actions	Corrective actions	Responsibility
No threatened fauna injury or mortality due to vegetation clearing activities	Pre-clearing survey undertaken in accordance with approved procedures. Site clearing works to be undertaken in accordance with approved clearing procedures and supervised by Project Ecologist.	At all times during vegetation clearing works	Fauna injury or mortality	Immediate stop work procedures and fauna rehabilitation procedures implemented.	Construction Manager / Project Ecologist
80% survival rate of re-established flora species (rusty plum)	Salvage and re-establishment plan (developed during pre-construction) to be implemented. Post-care and monitoring of re-established species.	Weekly for first 12 weeks Monthly 3- 12 months. Annually from 12 months	Plants fail to establish and grow Decline in health or failure	Soil and water sampling Inspect for pest or pathogens Apply appropriate controls/ soil improvement measures, where necessary Alter watering regime if needed.	Project Ecologist
Minimise impacts to hydrology and water quality during construction	Implementation of CEMP measures for erosion and sediment control. Ground and surface water monitoring during construction. Contain any spills	Monthly monitoring of groundwater levels. After rainfall and/or weekly inspection of control devices	Sediments/ pollutants introduced to local waterways and wetlands Groundwater levels outside of expected range	Incident reported to TfNSW. Control devices/ measures inspected for suitability and corrected/ reinstated where necessary. Spill containment procedures implemented where appropriate. Relevant agencies notified and environmental impacts assessed and rectification works commissioned if required	Construction Manager / Environment Manager

Mitigation goals	Proposed mitigation measure	Monitoring/ timing frequency	Triggers for corrective actions	Corrective actions	Responsibility
Minimise noise, light and dust during construction	Implementation of CEMP measures for erosion and sediment control and noise. Temporary site lighting will be installed and operated in accordance with AS4282:1997 Control of the Obtrusive Effect of Outdoor Lighting (Standards Australia 1997).	Monitoring as per CEMP	Excessive amounts of dust and/ or noise. Dust build-up on threatened flora adjoining alignment.	Implement control measures as outlined in CEMP. Wash-down threatened flora.	Construction Manager / Environment Manger
Reinstate habitat for threatened flora and fauna	Progressive habitat restoration and revegetation in accordance with landscape specifications	Monthly inspection of revegetation works	Low survival rates of restored habitat areas and/or high incidence of weed species in revegetation areas.	Habitat suitability assessed and corrective improvement works commissioned as necessary.	Project Ecologist/ Construction Manager

Mitigation goals	Proposed mitigation measure	Monitoring/ timing frequency	Triggers for corrective actions	Corrective actions	Responsibility
Avoid introduction or spread of disease-causing agents that have the potential to impact on the environment and biodiversity	Apply management requirements in Guide 7: Pathogen management (RTA 2011) and the PDCMP	Consider the potential for pathogens on site or in the area at an early stage (e.g. initial site inspection prior to commencement of works). There should be periodic monitoring for pathogens by a suitably qualified person, every month and in particular of revegetation works and interface of retained or adjacent vegetation.	Management activities not being undertaken. New introduction of a disease-causing agent on or adjacent to the project and during maintenance works (e.g. laboratory analysis to confirm suspected plant pathogens observed during monitoring).	Review management actions, from Guide 7 and PDCMP Increase monitoring frequency.	Project Ecologist/ Construction Manager

7. Operational Management Measures

7.1 Potential impacts

- Direct mortality of threatened fauna from vehicle collisions
- Modification or further disturbance to habitats due to weeds, pests, disease-causing agents, edged effects, increased accessibility to people
- Habitat degradation as a result of altered hydrology.

7.2 Mitigation goals

- Maintain habitat revegetation effort and monitor restoration or enhancement works, until revegetated habitat structure and floristics is representative of target communities
- Maintain fauna exclusion fencing and connectivity structures for the life of the project, including monitoring to ensure crossing structures facilitate natural daily movements and minimise fauna road mortality
- Minimise impacts from pest animals on threatened fauna and their usage of crossing structures and contribute to regional pest control where exotic predators are found using connectivity structures
- Avoid introduction or spread of disease-causing agents that have the potential to impact on the environment and biodiversity
- Monitor activity of threatened fauna species present on site and the success of mitigation measures to avoid or minimise project impacts.
- Maintain stormwater quality devices and ensure water quality outputs are below target pollutant thresholds.

The following section outlines the monitoring programs to be undertaken during the operational phase of the project to achieve the mitigation goals.

7.3 Mitigation goals and corrective actions

The mitigation goals and associated corrective actions for threatened flora and fauna species to be implemented during the operation phase are summarised in **Table 17**.

Table 17: Mitigation goals and corrective actions – operation phase

Mitigation goals	Proposed mitigation measure	Monitoring/ timing frequency	Triggers for corrective actions	Corrective actions	Responsibility
Maintain habitat revegetation effort and monitor restoration or enhancement works, until revegetated habitat structure and floristics is on trajectory to re-establish to target vegetation community	Inspection, monitoring and maintenance of revegetated areas will be specified within the TfNSW specifications including R178 and R179. Native vegetation should be re-established if/where practicable in accordance with Guide 3: Re-establishment of native vegetation of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA 2011). Habitat may be replaced or re-instated in accordance with Guide 5: Re-use of woody debris and bushrock (RTA 2011). Habitat removal will be undertaken in accordance with Guide 4: Clearing of vegetation and removal of bushrock of the Biodiversity Guidelines: Protecting and	For the first twelve months monitoring of revegetation will be quarterly. It will then go to every 6 months for years two and three. Monitoring will occur in spring/summer to evaluate the success of revegetation against performance objectives. A written report to be submitted to TfNSW by contractor after each maintenance inspection.	Monitoring and maintenance activities not being undertaken. Performance measures outlined in TfNSW specifications R178 and/or R179 not met.	Review maintenance schedule for revegetated areas within one month of trigger being identified and plant more trees, as required. Undertake additional weed control Increase monitoring frequency as advised by landscape designer.	Construction Manager

Mitigation goals	Proposed mitigation measure	Monitoring/ timing frequency	Triggers for corrective actions	Corrective actions	Responsibility
	managing biodiversity on RTA projects (RTA 2011).				
Maintain fauna exclusion fencing and connectivity structures for the life of the project, to enable target fauna usage and minimise road mortality	Maintenance of fauna connectivity structures as part of routine highway maintenance to remove debris and replace damaged/degraded furniture etc. Monitoring details are provided in Section 8 of this plan below	Regular inspections as part of the TfNSW routine highway maintenance program. Annual inspection are required targeting inspection of koala underpass structures prior to start of breeding season (July).	A single reported road kill of a threatened species.	A maintenance check is to be performed within 5 days of any reported road mortality . Any fence or structure found to be damaged during a maintenance check is to be repaired. Review need for additional fauna fencing.	TfNSW
Minimise impacts from pest animals on threatened fauna and their usage of crossing structures and contribute to regional pest control where exotic predators are found using connectivity structures	Engage in consultation with regional pest control agencies. Implement pest control program focused at crossing structures where deemed appropriate.	Monitoring for presence of pest animals at crossing structures will form part of fauna connectivity monitoring program described in Section 8.	High usage of crossing structures (>25% increase) by exotic predators reported after the first monitoring period and each subsequent monitoring period as per Section 8.2.	Meet with regional pest control stakeholders as soon as practical and contribute to pest control program where reasonable and feasible. Implement pest control program around crossing structures to reduce pest animal predation.	TfNSW
Sediment and pollutant levels are within acceptable parameter limits during construction and post-construction within a month of the completion of construction.	Monitoring of water quality will be undertaken in accordance with surface and groundwater monitoring requirements as part of meeting requirements of condition D6 Surface and Groundwater operational monitoring program.				TfNSW

8. Monitoring Program

The purpose of the monitoring program is to provide robust information in order to draw sound conclusions around the effectiveness of mitigation measures and inform further actions for adaptive management. The success of mitigation measures will be evaluated against performance indicators and the corrective management actions or contingency plans would be applied where poor performance or failing measures are detected.

Monitoring program methods will be subject to modification and refinement during the course of the program and would be dependent on the on-going results, access to monitoring sites or outcomes of corrective management actions or contingency plans.

8.1 Fauna connectivity structures

8.1.1 Monitoring goal

Objectives:

- Fauna crossing structures effective at facilitating movement of target species.
- Identify structure usage by exotic predators.

8.1.2 Timing and methods

Monitoring of selected structures would commence during the first high detection season for the target species (i.e. year one) following construction completion and would be undertaken biannually (twice a year) for the target species in the first, third and fifth years following construction.

Monitoring would be undertaken at Gatelys Road and Roberts Hill ridgelines, and will include the following systems:

- Motion-detecting cameras with infrared flash installed within suitable fauna movement corridors on the ridgelines.
- Observational audio and visual bird census, spotlighting and active searches during intensive monitoring periods.
- Scat and track searches to be conducted when checking camera traps (i.e. twice per monitoring period).
- Transect monitoring/SAT surveys undertaken within adjacent habitat on both sides of the tunnels and cover 1 ha search area where property access is granted. The surveys are to be undertaken when checking camera traps (i.e. twice per monitoring period).

Underpass monitoring would be undertaken at the following representative underpass structures along the project alignment:

- CH 11650: Bridge crossing across unnamed tributary of Newports Creek
- CH 12000 Bridge crossing Newports Creek
- CH 12800 Dedicated fauna underpass
- CH 16600 Bridge crossing over North Coast Rail Line
- CH 17800 Combined road bridge incorporating fauna underpass
- CH 20150 Culvert crossing across tributary of Jordans Creek and
- CH 22450 Bridge underpass under Pine Brush Creek.

The monitoring of the underpass structures include the following systems:

- Motion-activated infra-red cameras installed at each end of the target fauna crossing structures. Cameras would operate continuously for a period of eight weeks during the autumn/winter period and eight weeks during spring/summer. The rail bridge underpass may require several cameras to ensure adequate coverage.
- Observational audio and visual frog census, spotlighting and active searches during intensive monitoring periods.
- Scat searches within crossing structures including 5 m from the entrance. Searches to be conducted when checking camera traps (i.e. twice per monitoring period).
- Transect monitoring/SAT surveys undertaken within adjacent habitat on both sides of the selected underpass structures and cover 1 ha search area where property access is granted. The surveys are to be undertaken when checking hair tubes and camera traps (i.e. twice per monitoring period).

8.1.3 Performance indicators and corrective actions

Performance indicators and corrective actions for fauna connectivity structures are described in **Table 18**.

If during operation target threatened mammals are found to be unable or unwilling to use designated fauna crossing structures, corrective actions would be implemented. Should such failure be identified, other best practice survey methods would be implemented.

Table 18: Performance indicators and corrective actions – fauna connectivity structures

Triggers for corrective actions	Corrective actions	Responsibility
• Monitoring surveys undertaken identify no evidence of use of designated connectivity structures by target threatened species after three consecutive monitoring periods where target species have been recorded either side of the crossing structure. • High levels of structure usage by exotic predators reported after each monitoring period.	• Review monitoring methods, considering increasing frequency, intensity and duration, to ensure methods are appropriate. • Check connectivity structures for damage. Any structure found to be damaged during a maintenance check is to be repaired. Initiate repair works as soon as possible. • Re-assess suitability of vegetation structure, cover, and density on land bridges for dispersal of target species • Investigate in the road reserve. Consider improving habitat condition and connectivity at underpass entrances. • Consider need for additional fauna furniture/retro fitting existing structures. Where deemed appropriate; work will be completed within six months of identification. • Check fauna exclusion fencing- any fence found to be damaged during a maintenance check is to be repaired. Initiate repair works as soon as possible. • Meet with regional pest control stakeholders as soon as practical and contribute to pest control program where reasonable and feasible. • Implement pest control program around crossing structures to reduce pest animal predation where required.	TfNSW

Triggers for corrective actions	Corrective actions	Responsibility
	After a minimum of three consecutive monitoring periods, TfNSW will evaluate if the monitoring goals have been met. Predator monitoring results will be reviewed after each monitoring period to review species presence and density. Results will guide discussions with relevant stakeholders and management programs at a regional scale.	

8.2 Predator control

Objectives:

- Low activity or absence of pest animals within or in the vicinity of fauna connectivity structures during operation of the project.

Should monitoring of fauna connectivity structures demonstrate feral predators such as wild dogs, cats or foxes to be predating on threatened mammals or inhibiting mammal movement through the structures, TfNSW would engage with DPIE and adjacent landowners to identify and implement strategies to reduce this predation risk. Monitoring results will be reviewed after each monitoring period to address predator and pest densities and identify areas in which regional scale programs can be implemented by the aforementioned parties.

8.3 Road mortality

Roadside surveys would be undertaken along the alignment to identify and record road kill where safe to do so and will be undertaken twice a year by qualified ecologists during the first three years following project completion. Further, surveys for incidental road kill information will be collected from TfNSW road maintenance crews as part of meeting ongoing operational requirements of the highway network. Incidental road kill observations will allow further analysis of areas which fall outside of fenced sections of the carriageway and allow a review of the need to install further fencing or connectivity structures to mitigate fauna vehicular strike. Further, collation of road kill reports from local government authorities, and wildlife care organisations (such as WIRES) where available will be utilised in the monitoring program to aid in identifying any further sections of the road regularly attributable to threatened mammal road mortalities.

The GPS location of each road kill specimen would be recorded and assessed in relation to the closest fauna crossing structure to evaluate its effectiveness. The condition of the crossing structure and fauna exclusion fence in the vicinity of the road kill site would be investigated for any problems or breach and repairs, maintenance carried out as appropriate as described in **Section 8.1** above.

8.3.1 Performance indicators and corrective actions

Performance indicators and corrective actions for road mortality are described in **Table 19**.

Performance of the connectivity structures in preventing threatened mammal road mortalities would be measured by achievement of a zero rate of vehicle strike for threatened species.

Table 19: Performance indicators and corrective actions – road mortality

Triggers for corrective actions	Corrective actions	Responsibility
A single reported road kill of a target threatened mammal species.	• Check fauna exclusion fencing in proximity to road kill for any damage. Any fencing found to be damaged is to be repaired. Initiate repair works as soon as possible. • If road kill is found in an area with no fauna exclusion fencing evaluate the need for additional fencing. • If the road kill is found in proximity to a crossing structure check connectivity structure for damage. Any structure found to be damaged during a maintenance check is to be repaired. Initiate repair works as soon as possible. • Inspect habitat/landscaping at underpass entrances and determine if remediation is required to improve connectivity • Re-evaluate mitigation measures if target threatened mammals are recorded as road-kill in three monitoring periods. • Consider additional mitigation measures. After a minimum of three consecutive monitoring periods TfNSW will evaluate if there is a residual impact to connectivity.	TfNSW

8.4 Artificial microbat roosting sites and nest boxes

Objective:

- Artificial habitats in good condition, free from pests and used by target species.

8.4.1 Timing and methods

Inspections should occur six months after installation of nest boxes and 18 months after completion of structure allowing for microbat usage. Nest box monitoring would occur in autumn and spring for up to five years and microbat structures would be inspected within six months, and again three years after the highway becomes operational. Following these inspections the need for further monitoring, as outlined in Guide 8: Nest Boxes of the Biodiversity Guidelines (RTA 2011), would be determined. Maintenance inspections would occur in conjunction with monitoring events.

The Project Ecologist would physically inspect the nest box or artificial roost site, and record the following as a minimum where possible:

- Identification code of the nest box or roosting site:
- Species present or evidence of use
- Number of individuals present, age, and breeding status
- Occurrence of any pest species such as common mynas, common starling and European bees

- Condition of the nest box (e.g.. any deterioration, holding of water, excess nesting material) if applicable
- Date and time of inspection
- Roost features present
- Record of rainfall during monitoring period.

An annual report would be prepared detailing results of biannual inspections.

8.4.2 Performance indicators and corrective actions

Performance indicators and corrective actions for artificial habitat monitoring are described in **Table 20**.

Table 20: Performance indicators and corrective actions – artificial roost sites and nest boxes

Triggers for corrective actions	Corrective actions	Responsibility
• Monitoring surveys undertaken identify no evidence of use of nest boxes by target species after three consecutive monitoring periods • Monitoring surveys undertaken identify no evidence of use of artificial roost sites by target species within two years after installation • Fallen, damaged or degraded nest boxes and artificial roosting sites (including holding or leaking of water) • Excess nesting material which may impede access over time • High levels of structure usage (>25%) by exotic pest species such as common mynas, common starling and European bees.	• Upgrade maintenance schedule and/or box design if boxes are continually being found to be damaged. • Nest boxes and artificial roosting sites found to be fallen, degraded or damaged during a maintenance check is to be repaired. Initiate repair works within two months of identification. • Excess nesting material to be removed within 5 days of identification. • Re-evaluate nest box strategy if these structures are not used by target species or are used by pest species and identify adaptive management action, e.g. repositioning, relocation, replacement, assessment of whether the microclimatic conditions within the artificial roosting sites and nest boxes are suitable for use by the target species. • If a nest box needs to be removed from the site for repair, then an alternative nest box should be installed in the same location upon removal of the damaged nest box. Upon completion of monitoring review the need for further monitoring as outlined in the Guide 8: Nest Boxes of the Biodiversity Guidelines (RTA 2011).	Environment Manager / Construction Manager – during construction TfNSW – during operation

8.5 Water quality monitoring

Objective:

- Ground and surface water levels and quality within acceptable parameter limits during construction and post-construction.

8.5.1 Timing and methods

Surface and groundwater quality monitoring will be undertaken to evaluate the performance of water management measures and to determine, if any, corrective actions may be required should water levels/ target parameters vary beyond accepted guidelines. Procedures for monitoring of identified locations are to be incorporated into the project's water quality monitoring program.

Environmental management measures to address impacts relating to surface and groundwater are contained in **Chapter 6, revised environmental management** measures of the Amendment Report. These measures have been developed so that appropriate management of surface and ground water would minimise the potential for impacts to the community and environment.

The environmental management measures will be supported by water quality monitoring pre-construction, during construction (monthly sampling with daily visual inspections) and operational monitoring within a month of the completion of construction.

Refer to Figure 6 for the indicative baseline water quality monitoring sites. These locations will be reviewed prior to construction.

Locations for the pre-construction and during construction monitoring will include sites upstream and downstream of the project boundary on:

- Pine Brush Creek
- Williams Creek
- Jordans Creek
- Treefern Creek
- Coffs Creek
- Newports Creek.

In addition to these main waterways, during construction phase, immediate disturbance to any waterway would be visually monitored with support of in situ measurements outlined in **Table 21** to monitor for major exceedances according to the Soil and Water Management Plan and site-specific Erosion and Sediment Control Plans.

Table 21: Monthly surface water monitoring parameters

Assessment Criteria	Parameter
Visual inspections	Water colour
	Clarity
	Surface film, slick, and/or scum
	Flow rate seconds/metre
Physical	Temperature (ºC)
	pH
	Dissolved oxygen (% saturation and mg/L)
	Turbidity (NTU)
	Electro conductivity (µS/cm)
Laboratory analysis	Total Suspended Solids (mg/L)
	Total phosphorus

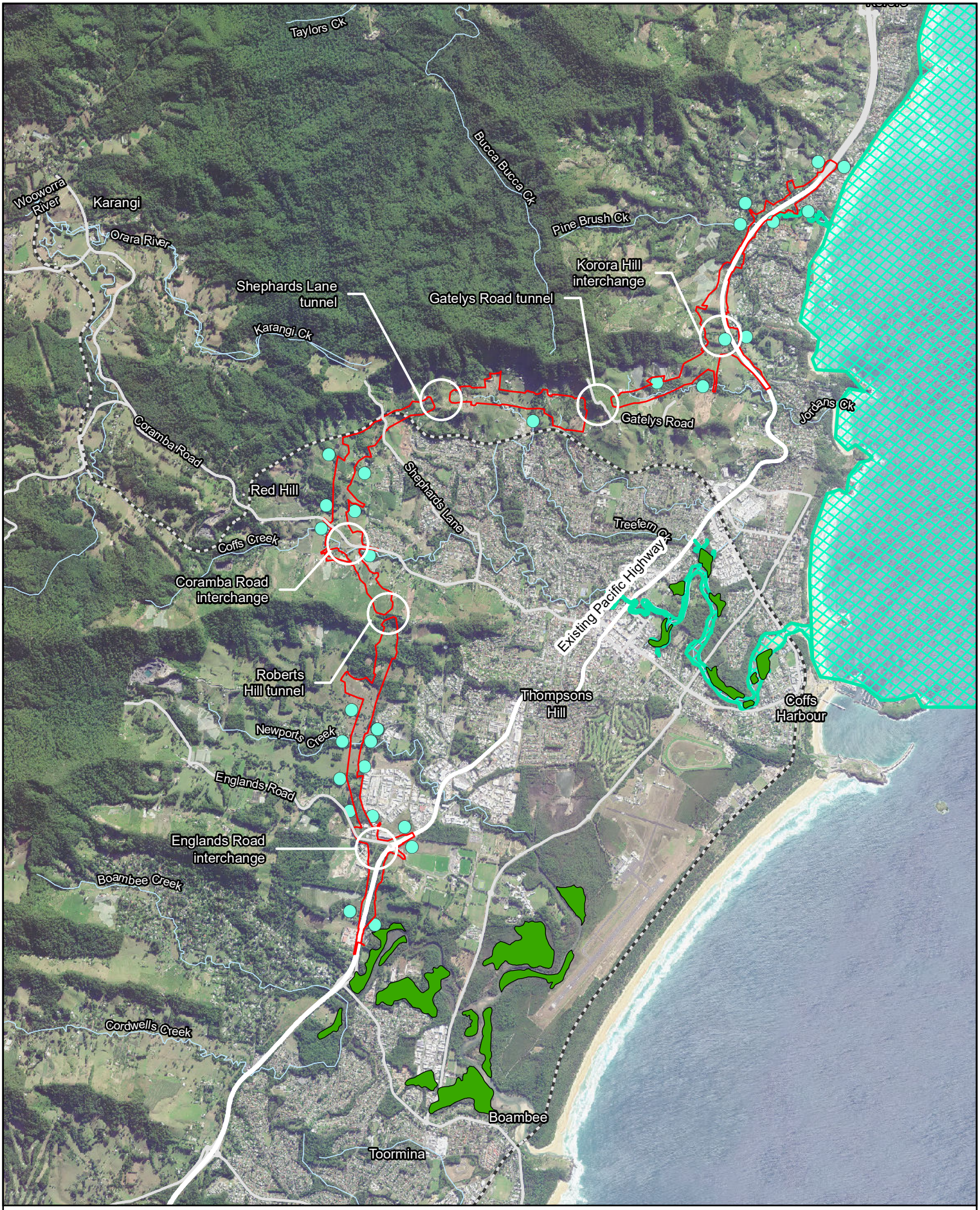
	Total nitrogen

8.5.2 Performance indicators and corrective actions

Performance indicators and corrective actions for ground and surface water monitoring are described in **Table 22**.

Table 22: Performance indicators and corrective actions – ground and surface water monitoring

Triggers for corrective actions	Corrective actions	Responsible party
• Sediment and pollutant levels are outside acceptable parameter limits • Ground and surface water levels outside of expected range • Control devices found to be unsuitable	• Review of rainfall data and inspection of erosion and sediment control measures in the vicinity. Correct measures where necessary. • Review and increase monitoring frequency. • Control devices/ measures inspected for suitability and corrected/ reinstated where necessary. • Incident, e.g. oil spill, reported to TfNSW. • Relevant agencies notified and environmental impacts assessed. • Undertake remedial action on the machinery or process responsible, e.g. in response to oil or fuel spills full inspection and necessary repairs/corrective action to be undertaken on the machinery or process responsible prior to operation re-commencing.	TfNSW / Construction Manager / Environment Manager



Legend

- Construction footprint
- North Coast Railway
- Watercourse
- Indicative Surface Water Quality Sampling Locations
- NSW Coastal Management SEPP wetlands
- Solitary Islands Marine Park (NSW)

Coffs Harbour Bypass
Recommended surface water quality sampling locations
Figure 6

0 0.5 1 1.5 km

Scale @A4: 1:60,000
GDA 1994 MGA Zone 56

N

8.6 Evaluation, project review and reporting

A brief annual report would be prepared outlining the results of the targeted surveys and monitoring undertaken pertaining to the project. This may include a separate monitoring report per target species or a combined report for one or more species. The brief annual report would be prepared by the contractor(s) for distribution to TfNSW and other relevant government agencies for threatened species including DPIE. The reports will be provided no later than three months from the last survey of the year (i.e. in spring as shown in **Table 23**).

The contractor(s) employed to undertake the monitoring would be responsible for the evaluation of the monitoring information collected against performance thresholds.

A final report would be prepared at the conclusion of the monitoring period. This report would incorporate all the results of the monitoring and recommend any additional measures (if deemed necessary) to facilitate the long-term survival of the target threatened mammal population in the locality.

An overall summary of the actions proposed in the above plan is provided in **Table 23**. It also identifies the person responsible for the actions and the estimated timing of the project.

Table 23: Summary table and implementation schedule of management plan

No.	Task.	Responsibility	Pre-Construction	During Construction	Post-Construction	Post-Construction (Seasonal)																			
						Year 1				Year 2				Year 3				Year 4				Year 5			
						Summer	Autumn	Winter	Spring	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter	Spring
Pre-Construction Management																									
	Identify exclusion zones																								
	Finalise design of fauna fencing and connectivity structures																								
	Salvage and re-establish threatened flora																								
Construction Management																									
	Implement work method statements																								
	Induction and training																								
	Fauna rehabilitation protocol																								
	Pre-clearing surveys																								
	Finalise and implement clearing procedures																								
	Installation of permanent fauna fencing																								
	Installation of permanent fauna connectivity structures																								
	Habitat restoration and landscaping																								
	Hydrology and water quality measures				6 months																				
	Inspections for introduction or spread of disease-causing agents	TfNSW																							
Operational Management																									
	Continued habitat revegetation effort and monitoring of revegetated habitat areas (until objective is achieved)	Contractor																							
	Fauna connectivity structures monitoring	TfNSW																							

No.	Task.	Responsibility	Pre-Construction	During Construction	Post-Construction	Post-Construction (Seasonal)																			
						Year 1				Year 2				Year 3				Year 4				Year 5			
						Summer	Autumn	Winter	Spring	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter	Spring
	Road mortality monitoring	TfNSW																							
	Predation control monitoring	TfNSW																							
	Maintenance and monitoring of nest boxes installed	TfNSW																							
	Water quality monitoring	TfNSW																							
Evaluation and Reporting prepared annually for monitoring and correcting actions implemented																									
	Evaluation and reporting yearly	TfNSW																							

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