



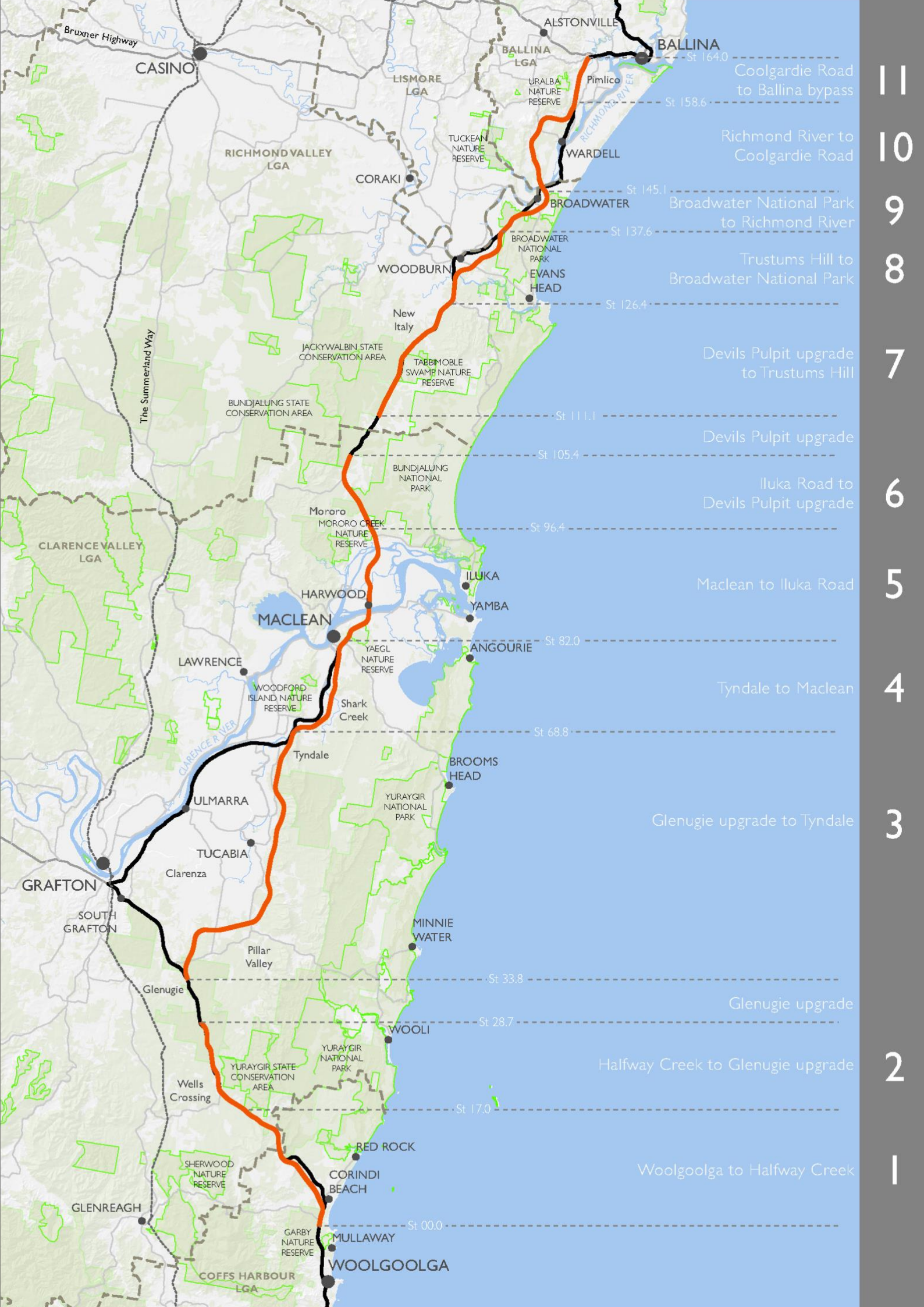
Transport for New South Wales

WOOLGOOLGA TO BALLINA | PACIFIC HIGHWAY UPGRADE KOALA MANAGEMENT PLAN

Sections 1-11

Version 6

September 2024



11
10
9
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5
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Coolgardie Road to Ballina bypass
Richmond River to Coolgardie Road
Broadwater National Park to Richmond River
Trustums Hill to Broadwater National Park
Devils Pulpit upgrade to Trustums Hill
Devils Pulpit upgrade
Iluka Road to Devils Pulpit upgrade
Maclean to Iluka Road
Tyndale to Maclean
Glenugie upgrade to Tyndale
Glenugie upgrade
Halfway Creek to Glenugie upgrade
Woolgoolga to Halfway Creek

BRUXNER HIGHWAY
CASINO
LISMORE LGA
RICHMOND VALLEY LGA
CORAKI
WOODBURN
NEW ITALY
JACKY WALBIN STATE CONSERVATION AREA
BUNDJALUNG STATE CONSERVATION AREA
CLARENCE VALLEY LGA
HARWOOD
MACLEAN
LAWRENCE
TYNDALE
ULMARRA
TUCABIA
CLARENZA
SOUTH GRAFTON
GRAFTON
GLENREAGH
SHERWOOD NATURE RESERVE
COFFS HARBOUR LGA
WOOLGOLGA
MULLAWAY
CORINDI BEACH
RED ROCK
WELLS CROSSING
YURAYGIR STATE CONSERVATION AREA
YURAYGIR NATIONAL PARK
WOOLI
MINNIE WATER
BROOMS HEAD
ANGOURIE
YAMBA
ILUKA
MORORO MORORO CREEK NATURE RESERVE
BUNDJALUNG NATIONAL PARK
TABBIMBLE SWAMP NATURE RESERVE
TUCKEAN NATURE RESERVE
URALBA NATURE RESERVE
BALLINA LGA
ALSTONVILLE
BALLINA
PIMLICO
WARDDELL
BROADWATER
EVANS HEAD
THE SUMMERLAND WAY
CLARENCE RIVER
WOODFORD ISLAND NATURE RESERVE
YAEGL NATURE RESERVE
SHARK CREEK
YURAYGIR NATIONAL PARK

1. Contents

Contents

Acronyms and abbreviations

2.	Introduction.....	2-4
2.1	Project overview	2-4
2.2	Purpose of the Plan	2-5
2.3	Management structure and plan updates	2-13
2.4	Plan authors and expert review	2-17
3.	Koala populations	3-19
3.1	Existing knowledge	3-19
3.2	Distribution of the Koala and its habitat.....	3-23
3.3	Key populations in the project area.....	3-28
3.4	Survey adequacy of existing reports informing the Koala Management Plan	3-33
3.5	Key threats	3-35
4.	Potential impacts and management approach	4-48
4.1	Potential impacts associated with the project	4-48
4.2	Detailed design considerations.....	4-58
4.3	Mitigation and monitoring.....	4-59
4.4	Effectiveness of mitigation measures.....	4-59
4.5	Section 10.....	4-64
4.6	Adaptive management approach.....	4-67
5.	Pre-construction management measures	5-69
5.1	Potential impacts during pre-construction phase	5-69
5.2	Main goals for management	5-69
5.3	Management measures.....	5-69
5.4	Performance thresholds and corrective actions	5-73
6.	Construction management measures	6-75
6.1	Potential impacts during construction	6-75
6.2	Main goals for management	6-75
6.3	Management measures.....	6-75
6.4	Performance thresholds and corrective actions	6-99
7.	Operational management measures	7-103
7.1	Potential impacts during operational phase	7-103
7.2	Main goals for management	7-103
7.3	Management measures.....	7-103
7.4	Performance thresholds and corrective actions	7-104

8.	Monitoring program	8-108
8.1	Objectives.....	8-108
8.2	Phased resource reduction – Koala monitoring at Wardell Road and Laws Point ‘hot-spots’ ..	8-109
8.3	Koala population monitoring	8-110
8.4	Koala activity and fauna crossing structures.....	8-117
8.5	Road mortality monitoring.....	8-121
8.6	Koala revegetation monitoring	8-122
8.7	Evaluation, project review and reporting.....	8-125
8.8	Corrective actions.....	8-126
9.	Summary table and implementation schedule.....	9-129
10.	References	10-133
Appendix A	Ballina Koala Plan.....	10-138
Appendix B	Expert review: Associate Professor Robert Close CV	10-140
Appendix C	Expert review: Comments and recommendations, and responses by Roads and Maritime Services.....	10-142
Appendix D	Agency reviews: Comments and requirements, and responses by Roads and Maritime Services	10-143
Appendix E	Koala Pre-construction Surveys - Ecosure Report (2014).....	10-218
Appendix F	Broadwater Koala Population Survey - Ecosure Report (2015)	10-219
Appendix G	Adequacy Reviews	10-220
Appendix H	NSW Code of Practice for Injured, Sick or Orphaned Koalas	10-221
Appendix I	Section 10 Koala Revegetation Strategy.....	10-222
Appendix J	Guidelines and conditions for Koala Care in NSW	10-223
Appendix K	Associate Professor Jonathon Rhodes’ adequacy review of the Plan.....	10-224
Appendix L	Addendum to the Ballina Koala Plan.....	10-225
Appendix M	Addendum to Appendix I – Koala Revegetation Strategy	10-226

Acronyms and abbreviations

Acronym / abbreviation	Description
BACI	Before After Control Impact
CEMP	Construction Environmental Management Plan
NSW CoA	New South Wales Conditions of Approval
Cth	Commonwealth
DP&E	NSW Department of Planning and Environment
DoE	Commonwealth Department of Environment,
EIS	Environmental Impact Statement
EPA	NSW Environmental Protection Authority
ER	Environmental Representative
EMS	Environmental Management System
EP&A Act	<i>Environmental Planning and Assessment Act 1979 (NSW)</i>
EPA	NSW Environment Protection Authority
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
EWMS	Environmental Work Method Statement
FFMP	Flora and Fauna Management Plan
LGA	Local Government Area
NSW	New South Wales
OEH	NSW Office of Environment and Heritage
Project area	Area within the project boundary
Qld	Queensland
Roads and Maritime	Roads and Maritime Service
S/PIR	Supplementary Preferred Infrastructure Report
The Project	Woolgoolga to Ballina Pacific Highway Upgrade (Sections 1-8, 11)
TSC Act	<i>Threatened Species Conservation Act 1995 (NSW)</i>

2. Introduction

2.1 Project overview

NSW Roads and Maritime Services (Roads and Maritime) has received approval for the Woolgoolga to Ballina (W2B) Pacific Highway upgrade project (the project / the action), on the NSW North Coast. Approvals were granted, subject to conditions, under Part 5.1 of the *Environmental Planning and Assessment Act 1979* (NSW EP&A Act) on 24 June 2014 and the *Environment Protection and Biodiversity Conservation Act 1999* (Australian EPBC Act) on 14 August 2014. The location of the project is shown in the figure above.

Since 1996, both the Australian and NSW governments have contributed funds to the upgrade of the 664-kilometre section of the Pacific Highway between Hexham and the Queensland border as part of the Pacific Highway Upgrade Program.

The project will upgrade around 155 kilometres of highway and represents the final priority in achieving a four-lane divided road between Hexham and the NSW/Queensland Border. The project has been divided into 11 Sections as illustrated in the figure above and construction is to be staged. Construction and delivery of the project will be undertaken in a number of separate stages. These stages are detailed in the Staging Report prepared to satisfy NSW Minister's Condition of Approval (MCoA) A7.

Stage 1 (as outlined in W2B Staging Report Version 1, March 2015 and approved) includes:

- Pre-construction activities
- Selected utility relocations
- Archaeological salvage works
- Construction of Section 1 (Woolgoolga to Halfway Creek)
- Construction of Section 2 (Halfway Creek to Glenugie)
- Soft soil early works: Wave 1 - between Koala Drive and Chatsworth Road (Harwood) with material extraction from Tyndale, Green Hill and Mororo cutting; Wave 2 - Whytes Road to Pimlico 2; Wave 3 - Tyndale and Maclean; and Wave 4 - Tuckombil Canal, Woodburn.

Stage 2 (this report) will be for construction of Sections 3-11, between Glenugie and Ballina. With regards for the need to balance available funding with the completion of a dual separated carriageway, the intent of Stage 2 is to upgrade the section between Glenugie and Ballina to a combination of M and A Class. EIS Sections 3 and 4 will be upgraded to the final M Class. Sections 5 and 6 will be a combination of A and M class. Sections 7, 8 and 9 will be a combination of A and M Class. Sections 10 and 11 will be constructed to the final M Class.

The combination of the A and the M class has been determined such that the available funding is used efficiently while achieving the 2020 project objectives. These works are being managed by Pacific Complete and will include the progressive opening of the highway to traffic in the required configuration to meet the 2020 project objectives.

The detailed design phase is currently underway for the sections between Glenugie and Ballina. Should the available funding not be sufficient to achieve the proposed combination of A and M class outlined above, as a contingency measure, opportunities to re-use existing sections of the existing Pacific Highway are being explored.

Stage 2 of the upgrade includes two options to achieve the 2020 objective. Stage 2 Option A represents the construction of the full combination of the A and M class. Stage 2 Option B represents the potential combination of reused sections of the Pacific Highway.

Stage 3 will involve progressive rehabilitation of pavement reuse areas along the project length. This will see the reused sections upgraded to A or M class as funding becomes available.

Stage 4 will involve the upgrade of the remaining sections of the highway to the ultimate M-Class configuration.

Key features of the upgrade include:

- Duplication of 155 kilometres of the Pacific Highway to a motorway standard (Class M) or arterial road (Class A), with two lanes in each direction and room to add a third lane if required in the future
- Split-level (grade-separated) interchanges at Range Road, Glenugie, Tyndale, Maclean, Yamba / Harwood, Woombah (Iluka Road), Woodburn, Broadwater and Wardell
- Bypasses of South Grafton, Ulmarra, Woodburn, Broadwater and Wardell
- About 40 bridges over rivers, creeks and floodplains, including major bridges crossing the Clarence and Richmond rivers
- Bridges over and under the highway to maintain access to local roads that cross the highway
- Access roads to maintain connections to existing local roads and properties
- Structures designed to encourage animals over and under the upgraded highway where it crosses key animal habitat or wildlife corridors
- Rest areas located at about 50 kilometre intervals at Pine Brush (Tyndale), north of Mororo Road and north of the Richmond River
- A heavy vehicle checking station near Halfway Creek and north of the Richmond River.

The project will be jointly funded by the NSW and Australian governments. Both governments have a shared commitment to finish upgrading the highway to a four-lane divided road as soon as possible. Construction for Sections 1 and 2 commenced in May 2015 and completion of the entire project is planned for 2020. The project does not include the Pacific Highway upgrades at Glenugie and Devils Pulpit which are located between Woolgoolga and Ballina. These are separate projects and are now complete. Altogether, these three projects will upgrade 164 kilometres of the Pacific Highway. The project includes a partial upgrade of the existing dual carriageways at Halfway Creek.

A more detailed description of the Woolgoolga to Ballina Pacific Highway upgrade is found in the *Pacific Highway upgrade: Woolgoolga to Ballina Environmental Impact Statement* prepared by Roads and Maritime in December 2012. Further information is found in the Roads and Maritime Services *Woolgoolga to Ballina Pacific Highway Upgrade – Submissions/Preferred Infrastructure Report* (PIR) dated 2013 and the W2B Staging Plan.

2.2 Purpose of the Plan

The Koala is listed as a vulnerable species under the EPBC Act and the *Threatened Species Conservation Act 1995* (NSW) (TSC Act). This Koala Management Plan has been developed to meet the requirements of the NSW Government Approval – Ministers Condition of Approval D8, and Commonwealth EPBC Approval CoA 8 and 9 for Sections 1-11. The Ministers Condition of Approval D9 applies to parts of Sections 5, 8, 9 and 10 as these include key Koala populations located at Woombah-Iluka, Broadwater and Coolgardie-Bagotville.

The Woombah-Iluka Koala population is defined as the population that occurs within a five kilometre radius of the Iluka Road/ Pacific Highway interchange and which occurs approximately between chainage 94,000 – 102,000. A material extraction site for the Wave 1 works is proposed within the northern extent of the Woombah-Iluka population at Mororo cutting between chainage 97,700 and 98,400. Specific Koala measures are proposed to minimise any potential impacts on Koalas within the proposed Mororo cut (borrow) site (refer to Section 6.3 of this Plan).

The Broadwater Koala population is defined as the animals contained within an area 3-5 km either side of an 11.0 km portion of the Pacific Highway Upgrade from Lang Hill (northern part of Section 8) north to the Richmond River (including all of Section 9). These Sections (part 8-9) are one of two areas of the entire Upgrade (along with Section 10) where the greatest numbers of Koala records were encountered in surveys. These two areas were considered by the authors of the Highway Upgrade Environmental Impact Statement and Supplementary Biodiversity Assessment (SPIR) to contain “important populations” according to the now superseded guidelines for assessment described in the *Interim Koala referral advice for proponents* (DSEWPac 2012). The Richmond River forms a major barrier to the west and north, restricting the movements of the Broadwater Koala population.

The Coolgardie-Bagotville Koala population is located in Section 10, which extends 13.5 km north of the Richmond River and includes the localities of Bagotville and Coolgardie west of Wardell. As with the Broadwater population, this population was similarly assessed, as meeting the criteria for an “important population” under the Department of Environment’s *Interim Koala referral advice for proponents* (DSEWPac 2012) (Phillips and Chang (2013). This population has been the subject of detailed field sampling and laboratory studies, culminating in the preparation of a Population Viability Assessment (PVA) (Kavanagh 2016), as part of the associated Ballina Koala Plan for Section 10, in accordance with the Commonwealth CoA 5 and CoA 7. The outcomes of the PVA and BKP have been used to guide the development of the management of Koalas within this area.

It is noted that since the assessments were undertaken to support the Environmental Impact Statement, the Department of Environment have revised its Koala referral guidelines. The revised guideline does not require that ‘important populations’, as defined the Department of Environment’s Significant Impact Guidelines 1.1, to be identified in undertaking impact assessments due to the paucity of information about the distribution of koala populations across the range of the species. The guidelines now focus on habitat assessment, field survey, consideration of the severity of potential impacts and the likely success of mitigation as main factor in assessment.

The requirements of this approval and where they are addressed in this Plan are detailed in Table 2-1 below. This Koala Management Plan forms part of the Roads and Maritime Services’ Biodiversity Mitigation Framework (BMF) which addresses the overall Ministerial Conditions of Approval for the Project. The BMF also details the biodiversity plans, programs and strategies that have been prepared and how they inform and relate to each other.

It is important to note that the Koala Management Plan covering Section 1 through to 8 and Section 11 has previously been approved by DP&E on 4 February 2016 and DoE on 29 February 2016. The current Koala Management Plan has been updated to cover the last remaining sections of the Woolgoolga to Ballina Project i.e. Section 5, 8, 9 and Section 10 and addresses the requirements for NSW MCoA D8 and D9 as well as DoE Condition of Approval 8 and 9.

Table 2-1. Project Approval requirements and where they are addressed.

Approval requirements		Where addressed
NSW approval		
NSW CoA D8	<i>The Applicant shall prepare and implement Threatened Species Management Plans to detail how impacts of the SSI will be minimised and managed specifically for each species identified as significantly impacted in the documents listed in condition A2 or in accordance with condition D1.</i>	This Plan

	<i>The Plans shall be developed from the draft Threatened Species Management Plans included in the documents listed in condition A2(c) (subject to condition D9), in consultation with EPA, DPI (Fisheries) and DoE, and to the satisfaction of the Secretary, and shall include but not necessarily be limited to:</i>	
(a)	<i>demonstration that adequate surveys have been undertaken to assess the impacts of the SSI with reference to the Mitigation Framework developed under condition D1, including baseline data collected from surveys, undertaken by a suitably qualified and experienced ecologist on threatened species and ecological communities within all habitat areas to be cleared of vegetation for the SSI, that are likely to contain these species and that are likely to be adversely impacted by the SSI (as determined by a suitably qualified expert). The data shall address the densities, distribution, habitat use and movement patterns of these species;</i>	Chapter 3
(b)	<i>identification of potential impacts on each species;</i>	Chapter 4
(c)	<i>details of and demonstrated effectiveness of the proposed avoidance and mitigation and management measures to be implemented for each threatened species including measures to at least maintain habitat values of habitat areas compared to baseline data and maintain connectivity for the relevant species;</i>	Chapter 5, 6 and 7
(d)	<i>an adaptive monitoring program to assess the use of the mitigation measures identified in conditions B10 and D2. The monitoring program shall nominate appropriate and justified monitoring periods, performance parameters and criteria against which effectiveness of the mitigation measures will be measured and include operational road kill and fauna crossing surveys to assess the use of fauna crossings and exclusion fencing implemented as part of the SSI;</i>	Chapter 8
(e)	<i>monitoring methodology for threatened flora and fauna adjacent to the SSI footprint;</i>	Chapter 8
(f)	<i>goals and performance indicators to measure the success of mitigation measures, which shall be specific, measurable, achievable, realistic and timely (SMART), and be compared against baseline data;</i>	Chapter 8
(g)	<i>methodology for the ongoing monitoring of road kill, the species densities, distribution, habitat use and movement patterns, and the use of fauna crossings during construction and operation of the SSI, including the proposed timing, and duration of that monitoring;</i>	Chapter 8
(h)	<i>provision for the assessment of monitoring data to identify changes to habitat usage and whether this can be attributed to the SSI;</i>	Chapter 8
(i)	<i>details of contingency measures that would be implemented in the event of changes to habitat usage patterns, entities, distribution, and movement patterns attributable to the construction or operation of the SSI, based on adequate baseline data;</i>	Chapter 8
(j)	<i>mechanisms for the monitoring, review and amendment of these plans;</i>	Chapter 8
(k)	<i>provision for ongoing monitoring during operation of the SSI (for operation/ongoing impacts) until such time as the use and effectiveness of mitigation measures can be demonstrated to have been achieved over a minimum of three successive monitoring periods, unless otherwise agreed by the Secretary in consultation with the OEH, DPI (Fisheries) and DoE; and</i>	Chapter 8
(l)	<i>provision for annual reporting of monitoring results to the Secretary and the EPA, DPI (Fisheries) and DoE, or as otherwise agreed by those agencies.</i>	Chapter 8
	<i>In developing the Plans, the Applicant shall demonstrate to the satisfaction of the Secretary and DoE, how the public authorities and</i>	

	<i>expert reviewer recommendations provided for each draft plan in the documents listed in condition A2(c) have been addressed, including detailed justification of any variance from the recommendations of the expert reviewer of the management plans, including analysis of potential risk to the threatened species.</i>	
	<i>The Plans must be submitted and approved by the Secretary prior to commencement of construction of the relevant stages of the action, and implemented prior to commencement of construction of the relevant stages, unless otherwise agreed by the Secretary.</i>	
NSW CoAD9	<i>As part of the Threatened Species Management Plans required under condition D8, the Applicant shall prepare and implement a Koala Management Plan to demonstrate the ongoing survival of the Koala populations at Coolgardie/Bagotville, Broadwater and Woombah/Iluka. The Plan shall be prepared by a suitably qualified and experienced species expert and shall include, but not necessarily be limited to:</i>	This Plan
(a)	<i>results of detailed surveys to determine:</i>	Chapter 3
(a) (i)	<i>the population status of the Coolgardie/Bagotville, Broadwater and Woombah/Iluka Koala populations;</i>	Chapter 3
(a) (ii)	<i>habitat use and movement patterns of Koala populations within five kilometres of the proposed upgrade, or such area as determined by the independent ecologist; and</i>	Chapter 3
(a) (iii)	<i>habitat areas likely to be fragmented by the SSI;</i>	Chapter 3 and 4
	<i>including the results of SPOT assessment and radio tracking.</i> <i>The results and adequacy of surveys shall be verified by an independent suitably qualified and experienced ecologist with appropriate qualifications and experience in Koala and road ecology. Where appropriate, the Applicant may vary the required area of survey specified under condition D9(a)(ii) to the satisfaction of the independent ecologist;</i>	Chapter 3
(b)	<i>a detailed assessment of the impacts to the Koala populations based on the survey results required by condition D9(a), including population impacts and the identification of habitat likely to be fragmented and/or isolated as a result of the SSI;</i>	Chapter 4
(c)	<i>a detailed description, including the location and design, of all proposed avoidance and mitigation measures;</i>	Chapter 4
(d)	<i>justification that the location and design of mitigation measures:</i>	Chapter 4
(d)(i)	<i>have been designed with the objective of no Koala road kill from the commencement of construction of the SSI. In the event that a Koala is injured or killed during construction or operation, this shall be reported on the Applicant's website within 24 hours of this occurring, and the record shall remain available for a period of at least five years, unless otherwise agreed by the Secretary;</i>	Chapter 4

(d)(ii)	<i>include permanent fencing of the entire SSI for the length of the distribution of the Coolgardie/Bagotville, Broadwater and Woombah/Iluka populations and for two kilometres beyond the distribution of the Coolgardie/Bagotville, Broadwater and Woombah/Iluka population, following the highway or to the nearest natural barrier to Koala movement (e.g. river), after baseline surveys are complete in accordance with condition D9(a) and prior to operation;</i>	Chapter 5 and 6
(d)(iii)	<i>result in the complete, safe crossing of fauna crossings by the Koala. Fauna crossings shall be provided at a sufficient frequency to ensure that habitat connectivity is maintained or improved from pre-construction conditions, as determined by the independent ecologist and agreed by EPA;</i>	Chapter 6
(d)(iv)	<i>provide sufficient opportunities for species dispersal and re-colonisation as determined by the independent ecologist and EPA;</i>	Chapter 6
(d)(v)	<i>are in areas that, and are at a sufficient frequency to, achieve (i) - (iv), based on site specific information contained in the survey results required by condition D9(a) and the ecological requirements of the Koala, including but not limited to home range size, local movement patterns and habitat use, in accordance with the advice of the independent ecologist and EPA;</i>	Chapter 3
(d)(vi)	<i>all Koala underpass structures shall have a minimum height and width of 2.4 metres and a maximum length of 40 metres, or a minimum height and width of 3 metres and a maximum length of 50 metres. The underpass/culvert entrance shall be located at ground level, and no higher in the fill. Structures that provide passage over the road shall have a minimum width of 30 metres and shall be treated with contiguous habitat features;</i>	Chapter 6
(d)(vii)	<i>provide passage for Koalas under or over the existing highway (where the existing highway forms part of the SSI) and service roads or local roads (servicing over 100 vehicles per day);</i>	Chapter 6
(d)(viii)	<i>effectively minimise the risk of predation from dogs in both dedicated and combined crossings;</i>	Chapters 3, 4 & 5
(d)(ix)	<i>provide dry passage for dedicated fauna crossings and for combined fauna crossings to the satisfaction of EPA and DoE, at a flood immunity level determined in accordance with condition D2(c)(j);</i>	Chapter 6
(d)(x)	<i>provide habitat linkages to crossing structures from adjacent Koala habitat; and</i>	Chapter 6
(d)(xi)	<i>ensures that pathways to connectivity structures are not impeded by ancillary facilities, rest areas, service roads or local roads;</i>	Chapter 6
(e)	<i>if the mitigation measures discussed in condition D9(d) cannot be demonstrated to be effective to the satisfaction of the Secretary, in consultation with EPA and DoE, provision for the Plan to be revised to include the design and construction of a minimum of one dedicated underpass or land bridge every 500 metres. Underpass structures shall have a minimum height and width of three metres and a maximum length of 50 metres;</i>	Section 6.3.9

(f)	<i>provision for the installation and vegetation planting of fauna overpasses prior to the commencement of construction;</i>	Section 6.3.9
(g)	<i>a revegetation strategy to be implemented to increase connectivity adjacent to the SSI and leading to crossing locations, and the provision of vegetation planting on land bridges, to ensure the establishment of the vegetation prior to the commencement of construction;</i>	Section 6.3.11
(h)	<i>details of the proposed monitoring methodology to ensure the effectiveness of the mitigation measures and the ongoing survival of the Coolgardie/Bagotville, Broadwater and Woombah/Iluka Koala populations. Monitoring shall:</i>	Chapter 8
(h)(i)	<i>include goals that demonstrate the mitigation measures are effective, including clear objectives, milestones, performance measures, corrective actions, and thresholds for corrective actions, and timeframes for completion;</i>	Section 8.6
(h)(ii)	<i>occur until such time as the mitigation measures are demonstrated to be effective for three consecutive monitoring periods, or as agreed by the Secretary, to the satisfaction of the independent ecologist and OEH; and</i>	Chapter 8
(h)(iii)	<i>for the purposes of the Coolgardie/Bagotville population, consider the results of the surveys undertaken in the Koala habitat and population assessment: Ballina Shire Council LGA (Biolink Ecological Consultants Pty Ltd, November 2013) in determining the baseline population;</i>	Chapter 3, 6 & 7
(i)	<i>where the results of monitoring undertaken in accordance with condition D9(h) suggests that the mitigation measures are ineffective or changes to the population have occurred, the Applicant shall provide the Secretary, within one month of recording the changes, the corrective actions that have been implemented and/or proposed to be implemented, or a procedure for demonstrating that this change is not a result of the SSI. Should the Applicant be unable to demonstrate to the satisfaction of the Secretary that any change to the population is not attributable to the SSI, the SSI shall be deemed as the cause of the impact and the Applicant shall, within one month of these findings, provide, to the satisfaction of the Secretary, in consultation with the EPA and DoE, the proposed corrective actions to address the impacts of the SSI. Any required corrective actions shall include, but not necessarily be limited to:</i>	Chapter 8
(i)(i)	<i>installation of further crossings or modifications to existing crossings and the provision of evidence of the complete, safe crossing of these fauna crossings by the Koala. Any additional crossings shall be provided at a sufficient frequency to ensure that habitat connectivity is maintained or improved from pre-construction conditions, within two years of their installation; and</i>	Chapter 8
(i)(ii)	<i>reassessment of all revegetation areas and frequent reporting and maintenance including addressing failures;</i>	Chapter 8

(j)	<i>if the measures in condition D9(i) cannot be demonstrated to be successful within one year of their implementation, procedure for the submission of further offsets in accordance with conditions D5 and D6(j), to be provided within one year of these findings. Further offsets may include:</i>	Chapter 8
(j)(i)	<i>the legal protection and conservation management of additional areas of existing habitat that actively regenerated and secured into conservation management; and/or</i>	Chapter 3
(j)(ii)	<i>strategic revegetation of cleared areas to improve connectivity; and/or</i>	Chapter 6
(j)(iii)	<i>development of a supplementary feeding program and/or breeding program; and/or</i>	na
(j)(iv)	<i>development of a long term predator control program; and</i>	Chapter 7 and 8
(k)	<i>evidence of consultation with species experts, EPA and DoE in addressing the requirements of this condition, and demonstration of how comments provided by the species experts, EPA and DoE, as a result of this consultation, have been addressed.</i>	Chapter 2 and Appendix D
	<i>The Koala Management Plan shall be submitted and approved by the Secretary prior to the commencement of construction of the relevant stages of the SSI. The approved Koala Management Plan shall be implemented prior to the commencement of construction of the relevant stages.</i>	
EPBC-5	<i>In order to ensure the long-term viability of the Ballina Koala population, the approval holder must engage a suitably qualified expert to undertake population viability modelling of the Ballina Koala population over a time period of no less than 50 years, taking into account the impacts resulting from the road upgrade in Section 10. This modelling should consider the current proposed route and any proposed avoidance or mitigation measures as appropriate.</i>	Ballina Koala Plan (Niche 2016)
EPBC-6	<i>The approval holder must have the modelling required by Condition 5 peer reviewed by a second suitably qualified expert.</i>	Ballina Koala Plan (Niche 2016)
EPBC-7	<i>In addition to the Koala Management Plan(s) required by NSW approval conditions D8 and D9, to ensure that an unacceptable impact will not occur to the Ballina Koala population, the approval holder must submit for the Minister's approval, a Ballina Koala Plan no less than 3 months prior to commencement of Section 10 of the action, if the impacts to the Ballina Koala population are demonstrated to be acceptable within the Ballina Koala Plan. The Ballina Koala Plan must include:</i> <ol style="list-style-type: none"> a. <i>the modelling required by Condition 5 and the results of this modelling, and the peer review required by Condition 6;</i> b. <i>discussion of the future viability of the Ballina Koala population;</i> 	Ballina Koala Plan (Niche 2016)

	<p>c. <i>in the context of relevant environmental social and economic considerations, and additional avoidance, mitigation or offsets, beyond those required by the NSW approval conditions, proposed to minimise the impacts to the Ballina Koala population; and</i></p> <p>d. <i>evidence that any additional avoidance and mitigation measures proposed have been considered in the modelling required in Condition 5.</i></p> <p><i>The approval holder must not commence Section 10 unless the Ballina Koala Plan has been approved by the Minister. The approved Plan must be implemented.</i></p>	
EPBC-8	<p><i>The approval holder must develop a Koala Management Plan(s) pursuant to the requirements of NSW approval conditions D8 and D9 for each relevant stage(s). The Koala Management Plan must minimise impacts to the Koala to the satisfaction of the Minister and must be submitted to the Minister for approval. The relevant stage(s) cannot commence until the Koala Management Plan for that stage is approved by the Minister. The approved Plan(s) must be implemented.</i></p>	This Plan
EPBC-9	<p>The Koala Management Plan, relevant to Section 10, must be consistent with the approved Ballina Koala Plan and can only be submitted to the Minister for approval after the Ballina Koala Plan has been approved by the Minister.</p>	This Plan
EPBC-10	<p>Should further offsets be required in accordance with NSW approval condition D9(d) or be proposed as part of the Ballina Koala Plan, these must be in accordance with the EPBC Offsets Policy.</p>	Chapter 8
S/PIR Environmental management measure		
EMM-B11	<p><i>The threatened species management plans prepared for the project will be finalised, as relevant to the element of the project to be constructed. Development of the plans will include responding, where feasible and reasonable to:</i></p> <ul style="list-style-type: none"> <i>Recommendations from expert review undertaken as part of the Submissions / Preferred Infrastructure Report (and detailed in section 1.4 of the management plans).</i> <i>Any conditions of approval.</i> <i>Results from baseline monitoring undertaken.</i> <p><i>The threatened species management plans will be finalised in consultation with the relevant State and Federal government agencies</i></p>	This Plan

This Plan identifies the potential impacts of the Pacific Highway upgrade on the Koala (*Phascolarctos cinereus*) populations and areas of potential Koala habitat between Woolgoolga and Ballina. The Plan outlines existing knowledge of Koala populations, their habitat and distribution, the proposed mitigation measures to be implemented for the Koala, and a program for monitoring the effectiveness of these measures and the viability of identified key populations.

The objectives of the Koala Management Plan include providing:

- An effective process for ensuring the long-term conservation of the Koala in the region, including consideration of the concerns of key stakeholders, and expert review.

- A summary of the locations where Koala populations and their habitat occur, together with those areas which would likely be impacted by the project.
- Management and mitigation measures that would be implemented during the pre-construction, construction and operational phases of the highway upgrade to minimise impacts on Koala populations.
- A monitoring program to be implemented during pre-construction, construction and operation of the project to assess the effectiveness of the mitigation measures and to assess any changes to the status of the Koala population in the region.

2.3 Management structure and plan updates

2.3.1 Management structure

This Koala Management Plan provides a monitoring and management framework for all parts of the proposed upgrade between Woolgoolga to Ballina (Sections 1-11).

This Plan informs future monitoring and reporting, identifies the locations proposed for conducting monitoring and the methods, variables and timing of the proposed monitoring program.

General responsibilities for environmental management are outlined in the Construction Environmental Management Plan (CEMP) and the Construction Flora and Fauna Management Plan (FFMP). Responsibilities for implementation of the Koala Management Plan have been described throughout this Plan and are summarised in Chapter 9. This plan operates in conjunction with the (CEMP) and project-specific flora and fauna management plans (FFMP), and will be incorporated into a wider framework that includes such plans.

Following approval of the Plan, the construction contractor and the ecologists engaged for the relevant project sections will implement the Plan during the construction phase with oversight and responsibility for its implementation by the Roads and Maritime Services, including all operational phase and management measures associated with this Plan.

2.3.2 Plan updates

Development of this Plan has been an iterative and consultative process. It has included input from relevant experts and agencies as well as data from specifically designed scientific studies to fill identified knowledge gaps with respect to Koala populations and habitat within the Project area. This Management Plan has been updated as required to meet the mitigation and management measures committed to in the Environmental Impact Statement (EIS) and Submission/Preferred Infrastructure (SPIR) reports, and complies with the relevant Conditions of Approval (CoA) for the project. Closely associated with this Plan is the Ballina Koala Plan (Niche 2016) which details a Population Viability Analysis (PVA) of the Koala population within the locality of Section 10 of the Upgrade, near Wardell. The PVA was undertaken in accordance with Australian Government condition No. 5 to determine the potential impact of the proposed Highway Upgrade on the population of Koalas occurring specifically within the northern Sections of the Upgrade (Section 10). This Plan draws on the information from the PVA with management actions for Section 10 consistent with the outcomes of that assessment. The Ballina Koala Plan (BKP) is included in Appendix A.

This Plan (Version 4.1) has been updated following independent expert review and review by DoE, EPA and DP&E (see Appendix C and Appendix D) so that it addresses the changes arising from those reviews. Version 4.1 also addresses the Conditions of Approval set down by the NSW State Government and the Australian Government (Table 2-1).

Version 5 included an Addendum to Appendix I the Koala Revegetation Strategy as at February 2019. Version 6 (this Plan) updates section 8.6 Koala Revegetation Monitoring and replaces plot-based koala faecal pellet surveys with the application of various accepted methods to survey the plantation area. Tables 2-2, 6-3, 8-4 and 9-1 have also been updated to reflect the change in method.

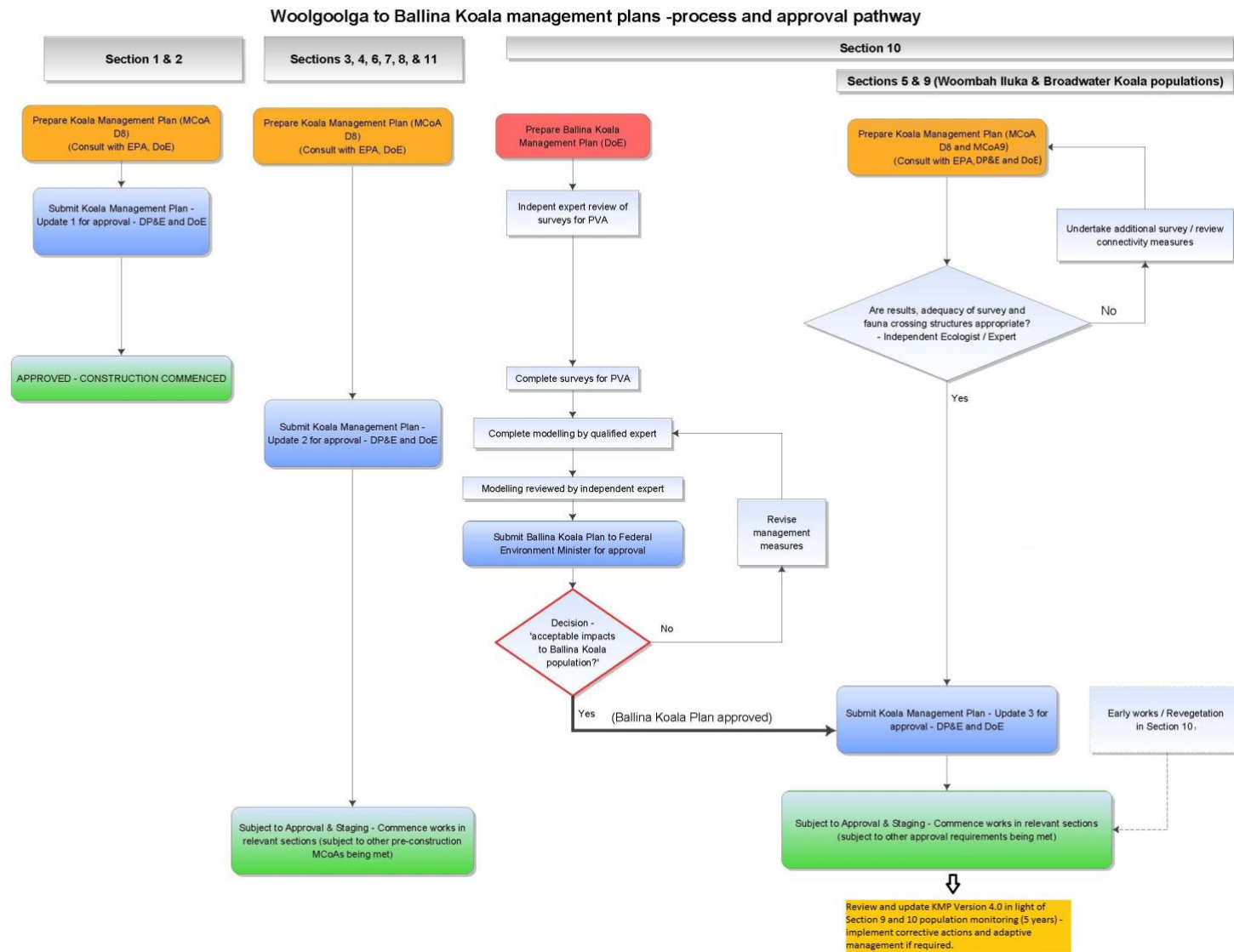
A summary of the process for updating the Plan is illustrated below in Figure 2-1.

NSW CoA D8 and D9 requires the Plan to be submitted and approved by the Secretary of the NSW Department of Planning and Environment (DP&E) prior to commencement of construction of the relevant stages of the action and implemented prior to commencement of construction of the relevant stages, unless otherwise agreed by the Secretary.

The Australian Government (EPBC Act) Project Approval Condition 8 requires that a Koala Management Plan be developed pursuant to the requirements of the NSW approval conditions D8 and D9 for each relevant stage. The Plan must minimise impacts to the Koala to the satisfaction of the federal Minister and must be submitted to the Minister for approval. The relevant stage cannot commence until the Koala Management Plan for that stage is approved by the Minister (Table 2-1).

The Australian Government Condition 23 states that any activity not in accordance with this Plan requires that the Plan be revised and submitted to the Department of Environment for the Minister's written approval. The varied activity shall not commence until the Minister has approved the revised Plan or agreement in writing.

Figure 2-1 Process to develop management plan



2.4 Plan authors and expert review

2.4.1 Authors

Table 2-2 details the qualifications and experience of authors of this Koala Management Plan. The first three authors prepared Version 1 of the Plan, Drs Kavanagh and McLean prepared Version 2, and Dr Kavanagh prepared Versions 3 and 4 of this Plan. Preparation of Version 4 was assisted by Dr Griffith.

Table 2-2. Author qualifications and experience

Personnel	Qualifications	Experience
Chris Thomson	Bachelor of Applied Science and Graduate Certificate in Natural Resources	Chris is a SKMs practice leader for terrestrial fauna and has a Bachelor of Applied Science and Graduate Certificate in Natural Resources and seventeen years professional experience managing biodiversity assessments and scientific reporting. He is a highly experienced field ecologist with extensive experience on major road projects with the Roads and Maritime, having worked widely throughout NSW as the technical lead on a range of environmental assessments including several Pacific Highway upgrades, in addition to the Hume Highway, Great Western Highway, Princes Highway and New England Highway along with numerous large and small arterial road projects including the M5, M4, Westlink M7 and Westconnex. Chris has comprehensive knowledge of Commonwealth and NSW threatened species legislation, policies and guidelines and has extensive experience in the design of avoidance and mitigation measures for minimising impacts on threatened species with a high level of experience on infrastructure projects including the development of compensatory habitat and offset strategies, biodiversity connectivity strategies, mitigation and monitoring strategies and threatened species management plans.
Valerie Hagger	Bachelor of Applied Science (Environmental Science) with Honours in Ecology (First Class), University of Queensland (2001) Masters of Science (Conservation Biology), University of Queensland (2011)	Valerie is a Senior Ecologist and has ten years environmental consulting experience specialising in environmental impact assessment (EIA), ecological survey and monitoring, ecological assessment, management and approvals, and project management. She has successfully managed numerous environmental and ecological projects for Defence and mining clients, and has been the ecology technical lead on many EIA projects for water supply infrastructure and mining. Valerie is competent in conducting baseline flora and fauna surveys, vegetation (regional ecosystem) surveys and mapping, assessing impacts on ecological values, developing management plans and monitoring strategies for threatened species, ecological communities, weeds and pest animals and rehabilitation, and developing offsets strategies. She is also accomplished in climate change vulnerability assessments on biodiversity
Dr Chris Schell	BAppSc (Hons), PhD	Fourteen years consulting experience and 24 years research experience (flora and fauna). Chris assisted with updating the plan following the initial agency review.
Dr Rod Kavanagh	Dip.Appl.Sc.(Agriculture), Grad.Dip.Nat.Res.(Wildlife Management)-University of New England, M.Sc. (Forest Ecology)-Australian National University, Ph.D (Conservation Biology)-University of Sydney.	35 years as a senior wildlife research scientist with State Forests of NSW and the NSW Department of Primary Industries, and three years as an ecological consultant with Niche Environment and Heritage. Rod has published more than 80 peer-reviewed papers in scientific journals about Australian forest fauna. His research and consulting work has included numerous studies investigating the distribution, habitat and ecology of the Koala in NSW, as well as the response of this species to logging, drought, high temperatures and habitat restoration.
Dr Amanda Griffith	BSc (Hons), PhD – University of NSW	Amanda Griffith is an ecological consultant with over 15 years' experience and a strong background in mammalian ecology, research and management. She has a PhD in behavioural ecology of Red Kangaroos (focussing on population dynamics and reproduction) and a sound understanding of the application of scientifically rigorous, field-based studies. Amanda has had recent experience with four Koala management plans in addition to the W2B KPoM.

Personnel	Qualifications	Experience
Dr Chris McLean	BEnSc (Hons) – University of Newcastle, PhD – University of Wollongong.	10 years experience in undertaking ecological management and research projects, including four years as an ecological consultant. Chris has undertaken research both as the lead researcher and as a supervisor of research students on a range of Australian mammals, including the Koala.
Dr David Rohweder	B.App.Sc (hons) & PhD – Southern Cross University	28 years' experience undertaking ecological surveys, and monitoring populations of threatened fauna. David is the principal ecologist at Sandpiper Ecological Surveys and has completed over 200 projects. David primary focus is monitoring threatened species populations and the effectiveness of impact mitigation measures. He has 20 peer reviewed Journal articles in the fields of road ecology and behavioural ecology.

2.4.2 Expert review

An expert review of Version 1 of the plan was undertaken in August 2013 by Associate Professor Robert Close from the University of Western Sydney and Australian Museum Business Services. Robert's principal field of interest is marsupial biology, which includes cytogenetics, formation of new species, hybridisation of existing species, fertility of hybrids, and ecology. Robert has conducted a study of Koalas in the Campbelltown region since 1990 that has included supervision of graduated PhD students. The Campbelltown study has largely been ecological and genetic but has become a community-associated research program, with feedback from the community leading to increased sightings of Koalas. Since October 1995, Robert and his colleagues have published a weekly column in the Macarthur Advertiser principally describing their Koala research. The project has provided long-term family data for Koalas that include four generations of Koalas.

In 1999 Robert joined the Australian Museum Consulting team to conduct research on the effects of the Pacific Highway upgrades at Yelgun to Chindera and at Bonville on the respective local Koala populations. Robert has published over 50 articles on mammals and marsupials, nine of these have been specifically on the Koala.

A curriculum vitae for Associate Professor Robert Close is provided in Appendix B, and a copy of his review is provided as Appendix C. The recommendations provided in this review, and the responses by TfNSW to the recommendations, are summarised in Appendix C.

An expert review of Version 4 of the plan was undertaken by Associate Professor Jonathan Rhodes from the University of Queensland. Jonathan is based in the School of Geography, Planning and Environmental Management at The University of Queensland (UQ), and a member of the Centre for Biodiversity and Conservation Science at UQ. He is an ecologist with a broad range of interests in conservation biology, spatial modelling, and environmental decision making. Jonathan is a part of the Koala Expert Advisory Committee (KEAC) for the Project and has also provided advice on the population viability analysis modelling and mitigation measures for the Ballina Koala population. A copy of his review is provided in Appendix K.

2.4.3 Agency review

Version 2 of the Plan was reviewed in February 2015 by NSW Department of Planning and Environment (DP&E), NSW Environment Protection Authority (EPA) and the Commonwealth Department of Environment (DoE). Version 3 of the Plan was reviewed in September 2015 and in December 2015 by DP&E, EPA and DoE. Version 4 of the plan was reviewed in June 2016 by DP&E, EPA and DoE. The comments and requirements of the three Agencies are listed in Appendix D, together with the responses by TfNSW to them.

3. Koala populations

Figure 3-1 to Figure 3-11, at the end of this chapter show the distribution of Koala records, habitat quality classes for the species, and the distribution of vegetation types containing preferred Koala food tree species.

3.1 Existing knowledge

3.1.1 Conservation status

The Koala (*Phascolarctos cinereus*) is listed as a vulnerable species under the New South Wales *Threatened Species Conservation Act 1995* (TSC Act).

The Koala (*Phascolarctos cinereus*) (combined population in Queensland, New South Wales and the Australian Capital Territory) is listed as a vulnerable species under the Australian Government *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

3.1.2 Habitat requirements

The Koala inhabits a range of *Eucalyptus*-dominated forest and woodland communities where favoured food trees are present (Hindell and Lee 1990, DECC 2008), which may also include isolated paddock trees (White 1999). The quality of the habitat for Koalas is influenced by a range of factors (Reed *et al.* 1990, DECC 2008), such as:

- Species and size of trees present.
- Structural diversity of the vegetation.
- Soil nutrients.
- Climate and rainfall.
- Size and disturbance history of the habitat patch.

The Koala is a folivore with a diet restricted primarily to the foliage of *Eucalyptus* species, however the species is also known to consume the foliage of related genera, including *Corymbia*, *Angophora* and *Lophostemon* species. *Leptospermum* and *Melaleuca* species have also been identified as a source of fodder for the Koala (DSEWPac 2013).

A list of Koala food trees, categorised as primary, secondary and supplementary food trees, for the NSW North Coast is provided in Appendix 2 of the NSW Koala Recovery Plan (DEC 2008). The presence of these tree species as either canopy dominants or main associated species in each of the BioMetric Vegetation Types known to be present along the highway upgrade are shown in Table 3-1 (see Vegetation Types Database at:

http://www.environment.nsw.gov.au/resources/nature/BioMetric_Vegetation_Type_CMA.xls).

Table 3-1. Occurrences of Koala food tree species on the NSW north coast listed according to the BioMetric Vegetation Types known to be present along the highway upgrade.

BioMetric vegetation types showing the dominant or associated tree species known to be food trees for the Koala	Koala food tree species		
	Primary	Secondary	Supplementary
Angophora paludosa shrubby forest and woodland on sandstone or sands of the North Coast (NR101)	Forest Red Gum (<i>E. tereticornis</i>)	Red Mahogany (<i>E. resinifera</i>)	-
Angophora robur shrubby forest and woodland on sandstones of the North Coast (NR102)	Orange gum (<i>E. bancroftii</i>)	-	Tindal's Stringybark (<i>E. tindaliae</i>)
Black Bean-Weeping Lilly Pilly riparian rainforest of the North Coast (NR110)	-	-	-
Blackbutt - bloodwood dry heathy open forest on sandstones of the northern North Coast (NR115)	-	Red mahogany (<i>E. resinifera</i>)	-
Blackbutt-Tallowwood dry grassy open forest of the central parts North Coast (NR119)	Tallowwood (<i>E. microcorys</i>)	-	-
Blackbutt grassy open forest of the lower Clarence Valley of the North Coast (NR125)	Tallowwood (<i>E. microcorys</i>)	Red mahogany (<i>E. resinifera</i>)	-
Brush Box - Tallowwood shrubby open forest of the northern ranges of the North Coast (NR140)	Tallowwood (<i>E. microcorys</i>)		
Coast Cypress Pine shrubby open forest of the North Coast Bioregion (NR148)	-	-	-
Coastal floodplain sedgelands, rushlands, and forblands (NR149)	-	-	-
Coastal heath on sands of the North Coast (NR152)	-	-	-
Flooded Gum - Tallowwood - Brush Box moist open forest of the coastal ranges of the North Coast (NR159)	Tallowwood (<i>E. microcorys</i>)	-	-
Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the North Coast (NR161)	Forest red gum (<i>E. tereticornis</i>)	-	-
Forest Red Gum grassy open forest of the coastal ranges of the North Coast (NR162)	Forest red gum (<i>E. tereticornis</i>)		
Grey Gum - Grey Ironbark open forest of the Clarence lowlands of the North Coast (NR173)	-	Small-fruited grey gum (<i>E. propinqua</i>)	-
Hoop Pine-Yellow Tulipwood dry rainforest of the North Coast (NR179)	-	-	-
Mangrove-Grey Mangrove low closed forest of the NSW Coastal Bioregions (NR182)	-	-	-
Narrow-leaved Ironbark dry open forest of the North Coast (NR193)	Forest red gum (<i>E. tereticornis</i>)		
Narrow-leaved Red Gum woodlands of the lowlands of the North Coast (NR197)	Cabbage gum (<i>E. amplifolia</i>)	Narrow-leaved red gum (<i>E. seeana</i>)	-
Needlebark Stringybark - Red Bloodwood heathy woodland on sandstones of the lower Clarence of the North Coast (NR200)	-	-	-
Orange Gum (<i>Eucalyptus bancroftii</i>) open forest of the North Coast (NR216)	Orange gum (<i>E. bancroftii</i>)	-	-
Paperbark swamp forest of the coastal lowlands of the North Coast (NR217)	Swamp mahogany (<i>E. robusta</i>) Forest red gum (<i>E. tereticornis</i>)	-	-
Pink Bloodwood - Tallowwood moist open forest of the far northern ranges of the North Coast (NR219)	Tallowwood (<i>E. microcorys</i>)	Small-fruited grey gum (<i>E. propinqua</i>)	
Red Mahogany open forest of the coastal lowlands of the North Coast (NR222)	-	Red mahogany (<i>E. resinifera</i>)	-
Scribbly Gum - Needlebark Stringybark heathy open forest of coastal lowlands of the northern North Coast (NR227)	-	-	-
Scribbly Gum - Red Bloodwood heathy open forest of the coastal lowlands of the North Coast (NR228)	-	-	-
Spotted Gum - Grey Box - Grey Ironbark dry open forest of the Clarence Valley lowlands of the North Coast (NR244)	Forest red gum (<i>E. tereticornis</i>)	Grey box (<i>E. moluccana</i>)	Thin-leaved Stringybark (<i>E. eugenoides</i>)

BioMetric vegetation types showing the dominant or associated tree species known to be food trees for the Koala	Koala food tree species		
	Primary	Secondary	Supplementary
Spotted Gum - Grey Ironbark - Pink Bloodwood open forest of the Clarence Valley lowlands of the North Coast (NR246)	-	Small-fruited grey gum (<i>E. propinqua</i>)	-
Swamp Box swamp forest of the coastal lowlands of the North Coast (NR253)	Swamp mahogany (<i>E. robusta</i>) Cabbage gum (<i>E. amplifolia</i>)	-	-
Swamp Mahogany swamp forest of the coastal lowlands of the North Coast (NR254)	Swamp mahogany (<i>E. robusta</i>) Forest red gum (<i>E. tereticornis</i>)	Red mahogany (<i>E. resinifera</i>)	-
Swamp Oak swamp forest of the coastal lowlands of the North Coast (NR255)	Forest red gum (<i>E. tereticornis</i>)	-	-
Tallowwood dry grassy forest of the far northern ranges of the North Coast (NR267)	Tallowwood (<i>E. microcorys</i>)	Small-fruited grey gum (<i>E. propinqua</i>)	-
Tuckeroo-Riberry-Yellow Tulipwood littoral rainforest of the North Coast (NR273)	-	-	-
Turpentine moist open forest of the coastal hills and ranges of the North Coast (NR274)	Tallowwood (<i>E. microcorys</i>)	Red mahogany (<i>E. resinifera</i>) Small-fruited grey gum (<i>E. propinqua</i>)	-
Wet heathland and shrubland of coastal lowlands of the North Coast (NR278)	-	-	-
White Booyong-Fig subtropical rainforest of the North Coast (NR280)	-	-	-

Koalas exhibit strong feeding preferences for individual trees within a species. This variability creates a nutritional patchiness such that species-based assessments of habitat may result in overestimates of the availability of high quality habitat, as Koalas selectively utilise only a portion of the habitat perceived to be of a high quality (DSEWPac 2013). In addition, many other unrelated factors (e.g. predation, disease, human impacts) could increase Koala mortality and thus explain low abundance of this species in its preferred habitat.

The list of tree species known to be important as food for the Koala is large and expanding as more information becomes available. Table 3-2 provides a list of Koala food trees from the Australian Koala Foundation (Mitchell 2012) for the local government areas Coffs Harbour, Grafton and Ballina.

Table 3-2. Koala food tree species in Coffs Harbour, Clarence Valley and Ballina LGAs (source: Mitchell 2012)

LGA	Scientific name and/or subspecies	Common name and ecology
Clarence Valley	<i>E. amplifolia</i> ssp. <i>sessiliflora</i>	Cabbage gum; by streams or in lower moisture sites, in deeper loamy soils
	<i>E. bancroftii</i>	Orange Gum; infertile, sandy lowland sites
	<i>E. biturbinata</i>	Grey Gum; slopes on soils of medium fertility, annual rainfall >1000 mm
	<i>E. crebra</i>	Narrow-leaved red ironbark, Ironbark, Narrow-leaved ironbark; well-drained shallower or sandy/sandy clay soils of medium fertility, >550 mm rainfall
	<i>E. glaucina</i>	Slaty Red Gum; deep, moderately fertile moist soils
	<i>E. grandis</i>	Flooded Gum, Rose Gum; moist, fertile, well-drained, deep, loamy soils of alluvial or volcanic origin, 725-3500 mm
	<i>E. laevopinea</i>	Silvertop stringybark; hills and eastern escarpments, medium to high fertility basalt soils in wetter areas
	<i>E. melanophloia</i>	Silver-leaved ironbark; moderately fertile silts, loams, sandy clays on foothills

LGA	Scientific name and/or subspecies	Common name and ecology
	<i>E. microcorys</i>	Tallowwood; on slopes in deeper moderate to fertile soils, well-drained but moist
	<i>E. moluccana</i>	Coastal Grey Box, Grey box, Gum-topped box; loam soils of moderate to high fertility on coastal plains and ranges, tolerates saline soils
	<i>E. obliqua</i>	Messmate Stringybark; fertile acidic well-drained loams, > 600 mm rainfall, drought tolerant
	<i>E. planchoniana</i>	Bastard Tallowwood, Needlebark stringybark; dry sclerophyll forest or woodland on sandy soils or coastal sand
	<i>E. propinqua</i>	Small-fruited Grey Gum; wet coastal forest on soils of low to medium fertility, drought and frost tolerant
	<i>E. racemosa ssp. racemosa</i>	Scribbly Gum; shallow infertile sandy soil, coastal areas or over sandstone
	<i>E. resinifera ssp. hemilampra</i>	Red mahogany; sandy or well drained fertile soils, drought and frost tolerant
	<i>E. robusta</i>	Swamp Mahogany; swampy, seasonally waterlogged soils, very moist fertile soils, heavy clay, sandy clay, alluvial sand soils
	<i>E. seeana</i>	Narrow-leaved Red Gum; poorly drained shallow soils, swampy sandy soils
	<i>E. siderophloia</i>	Ironbark, Broken Back Ironbark; wet forest on soils of moderate fertility
	<i>E. tereticornis ssp. tereticornis</i>	Forest red gum, Blue gum, Red Iron-gum; alluvial soils, 600-2500 mm, tolerates salt-laden coastal winds, tolerates saline soils, medium-heavy clays, does not tolerate waterlogged soils
	<i>E. tindaliae</i>	Tindal's Stringybark; poorer soils in high rainfall areas, often derived from granite
Coffs Harbour	<i>E. bancroftii</i>	Orange Gum; infertile, sandy lowland sites
	<i>E. biturbinata</i>	Grey Gum; slopes on soils of medium fertility, annual rainfall>1000 mm
	<i>E. crebra</i>	Narrow-leaved red ironbark, Ironbark, Narrow-leaved ironbark; well-drained shallower or sandy/sandy clay soils of medium fertility, >550 mm rainfall
	<i>E. globoidea</i>	White Stringybark; moist well drained soils in foothills
	<i>E. grandis</i>	Flooded Gum, Rose Gum; moist, fertile, well-drained, deep, loamy soils of alluvial or volcanic origin, 725-3500 mm
	<i>E. microcorys</i>	Tallowwood; on slopes in deeper moderate to fertile soils, well-drained but moist
	<i>E. moluccana</i>	Coastal Grey Box, Grey box, Gum-topped box; loam soils of moderate to high fertility on coastal plains and ranges, tolerates saline soils
	<i>E. planchoniana</i>	Bastard Tallowwood, Needlebark stringybark; dry sclerophyll forest or woodland on sandy soils or coastal sand
	<i>E. propinqua</i>	Small-fruited Grey Gum; wet coastal forest on soils of low to medium fertility, drought and frost tolerant
	<i>E. racemosa ssp. racemosa</i>	Scribbly Gum; shallow infertile sandy soil, coastal areas or over sandstone
	<i>E. resinifera ssp. hemilampra</i>	Red mahogany; sandy or well drained fertile soils, drought and frost tolerant
	<i>E. robusta</i>	Swamp Mahogany; swampy, seasonally waterlogged soils, very moist fertile soils, heavy clay, sandy clay, alluvial sand soils
	<i>E. seeana</i>	Narrow-leaved Red Gum; poorly drained shallow soils, swampy sandy soils
	<i>E. siderophloia</i> Ironbark,	Broken Back Ironbark; wet forest on soils of moderate fertility
	<i>E. tereticornis ssp. tereticornis</i>	Forest red gum, Blue gum, Red Iron-gum; alluvial soils, 600-2500 mm, tolerates salt-laden coastal winds, tolerates saline soils, medium-heavy clays, does not tolerate waterlogged soils
	<i>E. tindaliae</i>	Tindal's Stringybark; poorer soils in high rainfall areas, often derived from granite
Ballina	<i>E. bancroftii</i>	Orange Gum; infertile, sandy lowland sites
	<i>E. grandis</i>	Flooded Gum, Rose Gum; moist, fertile, well-drained, deep, loamy soils of alluvial or volcanic origin, 725-3500 mm
	<i>E. microcorys</i>	Tallowwood; on slopes in deeper moderate to fertile soils, well-drained but moist
	<i>E. moluccana</i>	Coastal Grey Box, Grey box, Gum-topped box; loam soils of moderate to high fertility on coastal plains and ranges, tolerates saline soils
	<i>E. propinqua</i>	Small-fruited Grey Gum; wet coastal forest on soils of low to medium fertility, drought and frost tolerant
	<i>E. racemosa ssp. racemosa</i>	Scribbly Gum; shallow infertile sandy soil, coastal areas or over sandstone

LGA	Scientific name and/or subspecies	Common name and ecology
	<i>E. resinifera</i> ssp. <i>hemilampra</i>	Red mahogany; sandy or well drained fertile soils, drought and frost tolerant
	<i>E. robusta</i>	Swamp Mahogany; swampy, seasonally waterlogged soils, very moist fertile soils, heavy clay, sandy clay, alluvial sand soils
	<i>E. seeana</i>	Narrow-leaved Red Gum; poorly drained shallow soils, swampy sandy soils
	<i>E. siderophloia</i>	Ironbark, Broken Back Ironbark; wet forest on soils of moderate fertility
	<i>E. tereticornis</i> ssp. <i>tereticornis</i>	Forest red gum, Blue gum, Red Iron-gum; alluvial soils, 600-2500 mm, tolerates salt-laden coastal winds, tolerates saline soils, medium-heavy clays, does not tolerate waterlogged soils
	<i>E. tindaliae</i>	Tindal's Stringybark; poorer soils in high rainfall areas, often derived from granite

The Koala resides in a specific home-range, however the home-ranges of individual animals are not mutually exclusive, often overlapping extensively (Kavanagh *et al.* 2007). Individuals tend to use the same set of trees, but generally not at the same time, and social interactions are uncommon outside of the breeding season. Koalas tend to move relatively short distances under most conditions, changing trees only a few times each day (DSEWPac 2013).

Home ranges for the Koala are variable depending on the location, with Koalas occurring in "poorer" habitats having larger home ranges than individuals established in higher quality habitats (DSEWPac 2013). On average, male Koalas have larger home ranges than females (Kavanagh *et al.* 2007, Goldingay and Dobner 2014, de Oliveira *et al.* 2014). For example, at Bonville on the NSW North Coast, approximately 40 kilometres south of Woolgoolga, male home ranges were estimated at approximately 20 hectares and female home ranges were approximately 10 hectares (Lassau *et al.* 2008).

Recent genetic research identified major roads as a barrier to gene flow for Koalas (Lee *et al.* 2010 and Dudaniec *et al.* 2013). The Project will fragment habitat links for Koalas seeking to access preferred habitats either side of the highway, particularly where these animals are most abundant (e.g. along Section 10, between Bagotville and Wardell and the southern parts of Coolgardie, and Section 9, between Broadwater National Park and Rileys Hill, of this Project).

Koala movements are expected to be more frequent and extensive during the breeding season (September to February) with the peak dispersal period (July to August) due to expansion of home ranges and movement of juveniles away from natal areas (Lassau *et al.* 2008). Therefore, these periods would be likely to represent peaks in Koala movement, resulting in potentially greater incidence of road mortality, but also higher rates of usage of connectivity structures and thus higher detection rates.

3.2 Distribution of the Koala and its habitat

The distribution of potential habitat for the Koala throughout the footprint area of the Pacific Highway upgrade between Woolgoolga and Ballina was assessed by means of vegetation assessments, identification of the presence of known Koala food trees, assessments of habitat connectivity, patch area and evidence of Koala presence using assessments of the presence of faecal pellets. The Spot Assessment Technique (SAT) (scat-search method) of Phillips and Callaghan (2011), which involves inspection of the ground below 30 trees greater than 10 cm diameter at breast height within 0.1-0.2 ha plots, was used to identify Koala presence and relative use of different vegetation types. A total of 212 scat-search plots was sampled along the length of the Pacific Highway upgrade, and evidence of Koala presence was found at 16 of these plots.

Each vegetation polygon was also assessed and ranked from 0 (lowest) to 10 (highest) in terms of its habitat suitability for the Koala (based on the above criteria), and in terms of the likelihood of each vegetation type to contain preferred (primary and secondary) Koala food trees. The methodology was in accordance with the EPBC Act's Environmental Offset Policy (October 2012) and Offsets Assessment Guide. These assessments were undertaken for each of the eleven sections of the highway upgrade, the results of which are mapped in Figs 2-1 to 2-11. In addition, the locations of all NSW Wildlife Atlas records of the Koala are indicated on these maps. References to previously cleared land noted below refer to land cleared historically (for grazing or other purposes) prior to the project.

3.2.1 Section 1: Woolgoolga to Halfway Creek

Koala habitat quality (HQ) was scored in 181 vegetation polygons encompassing a total of 199.20 ha (including 74.16 ha previously cleared) along the 17 km stretch of Section 1. The median HQ score was 7 (average 6.4, range 3-7; Biosis 2014), indicating that potential Koala habitat was widespread along this section of the highway upgrade (Figure 3-1; Table 4-1). These relatively high scores may be due to the large continuous areas of State Forest and National Park near the highway footprint area, leading to higher weightings for patch size and connectivity. Figure 3-1 indicates that habitat suitable for the Koala is widespread along Section 1 of the highway upgrade. However, only few records of the Koala were obtained during vegetation assessments, faecal pellet searches, other surveys, and from the NSW Wildlife Atlas (EIS 2011, S/PIR 2013, Biosis 2014). A total of 30 scat-search plots were surveyed in Section 1 across nine vegetation types, but no Koala faecal pellets were observed. A small number of Koala faecal pellets were observed at one additional site in August 2012 during opportunistic searches near the Range Road Interchange (GeoLink 2012). Studies during the early 1990s also found that the Koala was very uncommon in the State Forests that adjoin Section 1 (and Section 2) of the highway (Kavanagh *et al.* 1995). Others have reported similar findings of low Koala population densities in these forests during the past decade (Brian Tolhurst, *personal communication November 2014*; previously Regional Forest Ecologist, Forestry Corporation of NSW). It was concluded that Koalas occur at very low population densities along Section 1 of the Pacific Highway Upgrade, despite the existence of potentially suitable habitat.

3.2.2 Section 2: Halfway Creek to Glenugie

Sixty-four mapped vegetation polygons totalling 129.81 ha (including 37.66 ha previously cleared) were assessed along the 15 km stretch of Section 2. The median Koala HQ score was 8 (average 7.4, range 5-9; Ecosure 2014), indicating that potential Koala habitat was widespread along this section of the highway upgrade (Figure 3-2; Table 4-1). A total of 24 scat-search plots was surveyed in Section 2 across eight vegetation types, and Koala faecal pellets were observed at only one plot. This plot was located in vegetation type NR217 (Paperbark swamp forest of the coastal lowlands of the North Coast). Overall, vegetation floristics and condition were very good for Koalas, with good connectivity to State Forest, particularly at the northern end of the Section. However, while there were several records of the Koala in or near Section 2 of the project area, Koalas appear to occur at very low population densities in this area, and these findings were also supported by those of Kavanagh *et al.* (1995) and B. Tolhurst (*personal communication*). It was concluded that Koalas occur at very low population densities along Section 2 of the Pacific Highway Upgrade, despite the existence of potentially suitable habitat.

3.2.3 Section 3: Glenugie to Tyndale

Ninety-five mapped vegetation polygons totalling 364.09 ha (including 56.52 ha previously cleared) were assessed along the 35 km stretch of Section 3. The median Koala HQ score was 5 (average 5, range 3-8; Geolink 2015), which was relatively low compared to other sections (Figure 3-3; Table 4-1).

However, a number of communities within this section support primary Koala food trees, including Swamp Mahogany swamp forest and Forest Red Gum- Swamp Box forest (Geolink 2015). Many older (> 10 years) and few recent Bionet records of the Koala occur along the southern parts of Section 3, particularly within nearby Glenugie, Bom Bom and Devines State Forests which maintain good connectivity. Much of the northern part of this Section has been cleared for agriculture, with minimal vegetation connectivity between the east and the west. However, Pine Brush State Forest occurs in the east which maintains good north-south connectivity to larger tracts of native vegetation. It was concluded that Koalas occur at low population densities along Section 3 of the Pacific Highway Upgrade, despite the existence of potentially suitable habitat.

3.2.4 Section 4: Tyndale to Maclean

Forty mapped vegetation polygons totalling 161.35 ha were assessed along the 13.2 km of Section 4. The median Koala HQ score was 5 (average 5.1, ranging from 3-6; Geolink 2015). Some of the vegetation communities contain primary Koala habitat, including Flooded Gum-Tallowwood-Brush Box moist open forest and Grey Gum-Grey Ironbark forest (Figure 3-4; Table 4-1). This Section consists predominantly of land used for intensive agriculture (sugar cane) in low-lying areas, with remnant native vegetation located mainly to the east. Limited connectivity exists to the west of the project area due to agricultural lands and the Clarence River. It was concluded that Koalas occur at very low population densities along Section 4 of the Pacific Highway Upgrade, despite the existence of potentially suitable habitat.

3.2.5 Section 5: Maclean to Iluka Road

Section 5 includes part of the identified Woombah- Iluka Koala Population (Clarence Valley Council Draft Comprehensive Koala Plan of Management) that is located near the Iluka Road intersection with the Pacific Highway. The approximate distribution of this population, in relation to the Highway Upgrade, is from chainage 94000 (near the Clarence River bridge) to chainage 102000 (in Section 6). Further discussion of this population will be deferred until the next two sections (Sections 3.3 and 3.4) of this Koala Management Plan.

Thirty three mapped vegetation polygons totalling 212.54 ha were assessed along the 14.4 km stretch of Section 5. The median Koala HQ score was 5 (average 5, range 3-7; Geolink 2015) (Figure 3-5; Table 4-1). A further six sites were surveyed using the Spot Assessment Technique (SAT) to determine Koala habitat utilisation within the area (Ecosure 2014). The highest value Koala habitat consists of Flooded Gum-Tallowwood Brush Box moist open forest and Grey Gum-Grey Ironbark forest, which are located on both sides of the Highway. The landscape is predominantly cleared for intensive agriculture along the Clarence River but substantial forest areas occur to the north (e.g. Mororo Creek Nature Reserve, Bundjalung National Park), albeit with limited connectivity.

3.2.6 Section 6: Iluka Road to Devils Pulpit upgrade

Sixty-eight mapped vegetation polygons totalling 113.37 ha (including 43.67 ha previously cleared) were assessed along the 9.2 km stretch of Section 6. The median Koala HQ score was 7 (average 6, range 3-8; AECOM 2014). Eight vegetation communities were mapped, all of which have the potential to be used by Koalas (Figure 3-6; Table 4-1). In general, most communities contained primary Koala feed trees, such as Swamp Mahogany, Tallowwood and Forest Red Gum. A number of Bionet Koala records occur within adjacent State Forests, which are often attributed to Forestry Corporation pre harvest surveys. A high degree of connectivity occurs both to the north and south, and east to west, via State Forests in the area. It was concluded that Koalas occur at very low population densities along Section 6 of the Pacific Highway Upgrade, despite the existence of potentially suitable habitat.

3.2.7 Section 7: Devils Pulpit upgrade to Trustums Hill

Section 7 is 15.3 km long and 85 mapped vegetation polygons totalling 172.34 ha (including 69.19 ha previously cleared) were assessed (Biosis 2014). The median Koala HQ score was 6 (average 6, range 3-7) and the Section includes a number of vegetation types that contain primary Koala feed trees including Red Mahogany Open Forest and Narrow-leaf Redgum woodland (Figure 3-7; Table 4-1). This Section has some Koala records within adjacent native vegetation, suggesting a low density Koala population. Connectivity is less than some Sections, however moderate sized corridors occur in both north-south and east-west directions. It was concluded that Koalas occur at very low population densities along Section 7 of the Pacific Highway Upgrade, despite the existence of potentially suitable habitat.

3.2.8 Section 8: Trustums Hill to Broadwater National Park

Koala habitat quality was scored in 57 vegetation polygons encompassing a total of 122.30 ha (including 88.98 ha previously cleared) along the 11.1 km stretch of Section 8. The median Koala HQ score was 4 (average 4.1, range 3-9; Ecosure 2014) (Figure 3-8, Table 4-1). This Section includes native vegetation around Trustums Hill in the south and Broadwater National Park in the north. In the centre of the Section, the predominant land use is intensive agriculture for sugar cane. Koala records occur within the south and north of the Section. Connectivity in the north of the section is moderate through Broadwater National Park. It was concluded that Koalas occur at very low population densities along Section 8 of the Pacific Highway Upgrade, despite the existence of potentially suitable habitat.

3.2.9 Section 9: Broadwater National Park to Richmond River

Section 9 includes most of the identified Broadwater Koala Population, which also extends into the northern part of Section 8. The approximate distribution of this population in relation to the highway upgrade, is from chainage 137000 to chainage 145000.

One hundred and forty-seven vegetation polygons totalling 85.36 ha (including approximately 51.67 ha of previously cleared vegetation) were assessed within Section 9 (Melaleuca Group 2014). The average HQ score was 4.13 (out of 10; range 3-9, Figure 3-9) for Koala habitat, noting that primary feed trees, including Swamp Mahogany, Forest Red Gum and Tallowwood, were present. The Melaleuca Group (2014) considered that Koalas were highly likely to occur in many areas assessed, and noted Koala scats and climbing marks on trees within several vegetation types, including Swamp Mahogany-Swamp Forest, Grey Gum- Grey Ironbark Open Forest, Forest Red Gum Grassy Open Forest and Brush Box-Tallowwood Shrubby Open Forest. Table 3-3 summarises the location of the scat and Koala records.

Surveys of the Broadwater population were conducted in 2014 and 2015 (Ecosure 2014 and 2015 respectively). These reports are provided in Appendix E and Appendix F respectively. A total of 20 SAT sites were surveyed in 2014 and a further 54 SAT sites were surveyed on 2015. These surveys indicated that the Broadwater Koala Population is located mainly around the perimeter of the Broadwater National Park, especially along the forested fringe and fragmented woodlands outside of the Park. Broadwater National Park is dominated by heathland and, as such, is largely unsuitable for Koalas. The most important areas for Koalas were considered to be between Riley's Hill and the eastern side of the township of Broadwater.

3.2.10 Section 10: Richmond River to Coolgardie Road

Section 10 includes the Coolgardie-Bagotville Koala Population. The Koala population located in Section 10, extends 13.5 km north of the Richmond River and includes the localities of Bagotville and Coolgardie west of Wardell. More Koalas have been recorded in this Section compared to all other

Sections of the Upgrade. Recent population estimates indicate 196 (± 65 ,SD) Koalas occur within the area through which Section 10 is located (Phillips 2015).

As part of the Minister's Conditions of Approval, a population viability analysis (PVA) has been undertaken for this population (Niche 2016). The aim of the PVA was to estimate the likely impact of the proposed highway upgrade in Section 10 on Koala population viability over a 50 year period and investigate the relative benefits of a range of plausible management scenarios that could be implemented by TfNSW to minimise any potential impacts of the proposed highway upgrade. A more detailed discussion of this population is detailed in the next two sections of this Plan.

The approximate distribution of the population in Section 10, in relation to the Highway Upgrade, is from chainage 146000 (at the Richmond River) to chainage 158500 (in Section 11).

108 mapped vegetation polygons totalling 220.54 ha were assessed along the 13.5 km stretch of Section 10. This included 116.09 ha of previously cleared land. The median Koala HQ score was 5 (average 5, range 3-10; Geolink 2015) (Figure 3-10; Table 4-1). Two recent studies have been undertaken to determine Koala population densities and habitat use within this and the broader area, the information in which has been used to inform this Plan. Ecosure (2014) undertook 30 SAT plots to determine Koala habitat utilisation across the area. Ecosure-Biolink (2015) undertook direct counts (46 transects) and SAT plots (53 primary and 23 supplementary) to determine Koala population estimates and habitat utilisation across the area. Good quality Koala habitat is primarily located within the northern and southern sections of the alignment in this Section, the highest value Koala habitat occurring within the Swamp Sclerophyll Forests to the immediate north of the Richmond River in the south of the Section 10.

3.2.11 Section 11: Coolgardie Road to Ballina bypass

Section 11 is 5.4 km in length and runs north from Coolgardie Road and is proposed to tie in with the Pimlico to Teven project. This section is heavily cleared, consisting predominantly of cane fields. Twenty-nine polygons were mapped, of which 22 contained potential Koala habitat, across an area of 43.28 ha (including 29.61 ha previously cleared) (AMBS 2015). The median habitat quality score was four, with a range of 3-8 and average of 3.65 (AMBS 2015, Figure 3-11). Known Koala records occur within the vegetated areas of this section, in particular within Swamp Sclerophyll Forest (Ecosure 2014). It was concluded that Koalas occur at very low population densities along Section 11 of the Pacific Highway Upgrade, despite the existence of potentially suitable habitat.

3.2.12 Summary

It is evident from the distribution of Koala records in the NSW Wildlife Atlas (BioNet) for the North Coast Bioregion, the results of Koala scat-search plots presented above, and the vegetation community mapping undertaken for this Project, that Koalas could occur in all Sections of the Project and in a range of environments that will be impacted by the Project. The areas with the greatest number of Koala records in relation to the Project occur in the Richmond Valley LGA between Woodburn and the Richmond River including Rileys Hill and Broadwater National Park (Sections 9) and the Ballina LGA particularly around Wardell, Coolgardie and Bagotville (Section 10). These northern populations are considered key populations within the Project area.

Other key Koala populations in the project area have been identified in the western regions of the Clarence Valley LGA (Clarence Valley Council 2010), northern regions of the Coffs Harbour LGA (Coffs Harbour City Council 1999) and to the west of Woodburn in the larger State Forests of the Richmond LGA (Australian Koala Foundation 2008).

3.3 Key populations in the project area

There are more than 14,600 recorded Koala sightings in the NSW Wildlife Atlas for the NSW North Coast Bioregion (data accessed 20 November 2014). These records are spread over all local government areas (LGA) in a wide range of topographies and vegetation types, including in conservation reserves, State Forests and private land. The data indicate that Koalas occur in all project Sections of the highway upgrade area and in a range of vegetation types that will be impacted by the project. Field data collected during the EIS and subsequent SPIR support this assertion. These documents report a total of 160 Koala habitat and faecal assessment plots, and a further 52 Koala faecal-pellet search plots (total 212) being undertaken. Koala faecal pellets were found at sixteen of these plots, with the greatest proportion of plots with pellets occurring in Sections 9 and 10 (Table 3-3).

Three key populations have been identified along the proposed Upgrade. These include: Section 5: Woombah-Iluka population, Section 8 (northern part) and 9: Broadwater population and Section 10: Coolgardie-Bagotville Population.

3.3.1 Section 5: The Woombah- Iluka population

The Woombah Koala population is defined as the animals, and their habitat, contained within a 5 km radius of the intersection between the Pacific Highway and Iluka Road. The Iluka Koala population is located east of the Esk River, more than eight kilometres away, and considered unlikely to be affected directly by the planned upgrading of Sections 5 and 6 the Pacific Highway. Previous surveys for the species within the area including Koala habitat assessments, faecal pellet searches, spotlighting/call playback searches and direct surveys have revealed little evidence of Koala activity.

Information from all available sources suggests that the Woombah Koala population is present, but that it may be represented by only few individuals. The Comprehensive Koala Plan of Management for the Ashby, Woombah and Iluka localities in the Clarence Valley LGA (draft), September 2010, and updated in March 2015, indicates “The Woombah Koala population is in imminent danger of extinction and it is highly likely that the Iluka Koala population is already extinct. However, recent observations, from a range of sources, indicate that some Koalas are still present in both the Woombah and Iluka areas”.

The area supports large patches of preferred Koala habitat that are currently unoccupied by Koalas and thus the area has the potential to support Koalas should there be any future population increases (Biolink Ecological Consultants 2012). The Iluka Road area is considered to provide an important area of connectivity for Koalas moving between the coast and the Maclean area (GeoLink 2014).

3.3.2 Section 8 (part) and 9: The Broadwater population

The Broadwater Koala population includes the animals, and their habitat, contained within an area 3-5 km either side of an 11.0 km portion of the Pacific Highway Upgrade from Lang Hill (northern part of Section 8) north to the Richmond River (including all of Section 9). These Sections (part 8-9) are one of two areas of the entire Upgrade (along with Section 10) where the greatest numbers of Koala records were encountered in surveys. These two areas were previously considered by the authors of the Highway Upgrade Environmental Impact Statement and Supplementary Biodiversity Assessment (SPIR) to contain “important populations” according to the guidelines for assessment described in the *Interim Koala referral advice for proponents* (DSEWPoC 2012). The Richmond River forms a major barrier to the west and north, restricting the movements of the Broadwater Koala population.

Surveys (Ecosure 2014) indicated that the Broadwater Koala Population is located mainly around the perimeter of the Broadwater National Park, especially along the forested fringe and fragmented woodlands outside of the Park. Broadwater National Park is dominated by heathland and, as such, is largely unsuitable for Koalas. The most important areas for Koalas were considered to be between

Riley's Hill and the eastern side of the township of Broadwater, and a number of connectivity structures are proposed throughout the fragmented woodlands along the Highway alignment to permit Koala dispersal. The northern and southern exit points of the Highway at the edges of Broadwater National Park were also regarded as crucial areas requiring connectivity structures to permit Koala movements throughout the area.

3.3.3 Section 10: The Coolgardie-Bagotville population

The Koala population located in Section 10 extends 13.5 km north of the Richmond River and includes the localities of Bagotville and Coolgardie west of Wardell. One-hundred and forty-seven records for the Koala occur within approximately two km of the upgrade alignment within this Section. Recent studies (Ecosure 2014, Ecosure-Biolink 2015 and Biolink 2013) have revealed the relatively high numbers of Koalas within this Section compared to the other Sections and also other areas within the region. As with the Broadwater population, previous assessments have considered that this population may be regarded as an "important population" under the EPBC Act assessment guideline (Phillips and Chang 2013).

The resident populations, predominantly occur in the southern and central portions of the Section. They appear to persist in two large contiguous forest patches associated with the Blackwall Range and areas to the east that are separated predominately by farmland. The considerable number of resident Koala populations in this area coincides with larger areas of intact Koala habitat, as well as a high availability of preferred Koala food trees; including *E. microcorys*, *E. tereticornis*, *E. robusta* and *E. propinqua* (Ecosure 2014).

As mentioned above, the Coolgardie-Bagotville population was the subject of a PVA to determine the potential impacts of the Highway Upgrade on the population. The area nominated as enclosing this population was approximately 8,250 ha. The general landscape context within the study area constitutes a predominantly-cleared, sometimes waterlogged, fertile valley surrounded to the west by mostly tall forested lands on slopes and ridges along the Blackwall Range, and to the east by low slopes covered mostly by drier forests and woodlands with large areas of tall heathland growing on less fertile soils. The valley and lower slopes have been used extensively for grazing and sugar cane production, although significant areas of remnant or regrowth native vegetation still remain, particularly along watercourses. The proposed route of the highway upgrade in Section 10 traverses through the eastern side of the valley and will result in the loss of 34 ha of native vegetation, half of which (17 ha) is recognised as good habitat for Koalas.

Additional Koala surveys using the faecal pellet search (SAT) method were conducted throughout target areas in Sections 5, 7, 9 and 10 (Ecosure 2014). Supplementary sites were also surveyed by targeting known preferred Koala food trees for the presence of scats. Data collected were used to further inform areas of habitat use by Koalas, including two additional sites where a Koala was observed in Section 8 and Section 11 that were not part of the original project scope. Evidence of Koala faecal pellets varied between project Sections, and included one positive site in Section 5 (six sites surveyed), none in Section 7 (8 sites surveyed), one in Section 9 (20 sites surveyed), and six in Section 10 (30 sites surveyed). In addition, Koala habitat use was confirmed at 24 supplementary sites. Five Koalas were confirmed by Ecosure during field surveys (four in Section 9 and one in Section 10), while eight anecdotal sightings were reported by local landholders (one in Section 9 and seven in Section 10), and three by Roads and Maritime Services contractors (one in each in Sections 8, 9 and 10).

Table 3-3. Locations where evidence of Koalas was reported from scat search surveys

Project section	No. of scat-search plots	No. of plots with scats	Location description	Distribution of Koala records
1	30	0	No records of Koala faecal pellets found in Section 1. (NB. One opportunistic record located in Section 1 near the Range Road intersection on the eastern side of the current Pacific Highway (GeoLink 2012).	Only one record from BioNet of the Koala along Section 1 (in Newfoundland State Forest). No evidence of a local population centred near the road corridor.
2	24	1	One plot with Koala faecal pellets in Section 2, located just south of Halfway Creek near Yuraygir State Recreation Area.	Only two records from BioNet of the Koala along Section 2 (both in Yuraygir SCA). No evidence of a local population centred near the road corridor.
3	64	4	Four plots recorded Koala scats in the Brushgrove area. This occurred in three different vegetation types (Scribbly Gum woodland, Turpentine forest and Tallowwood forest).	Many older BioNet records from within the broader landscape, including within nearby State Forests (Bom Bom, Devines, Glenugie SFs). One record from 2012 adjacent to Pine Brush State Forest within 1 km of road corridor.
4	5	0	No records were recorded during field surveys within this section.	Three BioNet records in the broader landscape, all occurring within ~1 km of the road alignment.
5	6	1 of 6 (Ecosure2014) 2 of 13 (EIS/SPIR)	1 plot recorded scats within vegetation to the NW of Iluka Road approximately 150m west chainage 96000 (Ecosure 2014).	Numerous (>100) records in the broader landscape, focused around the townships of Ashby and Iluka. Around 10 records occurring within 1 km of road alignment. One Koala was directly observed in Mororo Creek Nature Reserve. Scats were also found at 4 of 18 sites in the Woombah area (north-east of the Iluka Road intersection) for a study used to inform the Comprehensive Koala Plan of Management for the Ashby, Woombah and Iluka localities in the Clarence Valley LGA (Biolink Consulting Services 2015).
6	18	0	No records of Koala faecal pellets were made during field surveys in this Section.	Nine records occur within 5 km of the road alignment, including recent (2012) records within 1 km of the road alignment.
7	32	1	Koala scats observed at one site near Tabbimoble Swamp Nature Reserve and Doubleduke State Forest.	Four records within 1 km of the road alignment and about 20 within 5 km. None of the records are recent.
8	10	0	No records were recorded during field surveys within this section.	Numerous records within the broader landscape and around 12 records within 5 km of the road alignment. However, none of these records is recent.
9	30	1 of 20 (Ecosure 2014) 5 of 10 (EIS/SPIR)	Pellets recorded within 5 of 10 sites (EIS and SPIR). Pellets in 1 of 20 plots surveyed by Ecosure 2014 but also recorded in 5 additional supplementary sites.	36 BioNet records within 3-5km of section. No direct observations during scat/habitat and daytime canopy surveys by Ecosure (2014), Melaleuca (2014) and for the EIS/SPIR. Six direct, anecdotal observations were made during the study by Ecosure 2014, including three within close proximity to the road alignment, one in areas of connecting habitat between Riley's Hill and Broadwater, and one recent sighting by a landholder in the northern

Project section	No. of scat-search plots	No. of plots with scats	Location description	Distribution of Koala records
				portion of Section 9. Most important areas for Koalas were considered to be between Riley's Hill and the eastern side of the township of Broadwater (Ecosure 2014). During surveys Ecosure (2015) recorded 8 individuals (including two with back young) during population surveys of 54 sites within the vicinity of the alignment. Koalas were highly likely to occur in many areas assessed, and Melaleuca (2014) noted Koala scats and climbing marks on trees within several vegetation types, including Swamp Mahogany-Swamp Forest, Grey Gum- Grey Ironbark Open Forest, Forest Red Gum Grassy Open Forest and Brush Box-Tallowood Shrubby Open Forest. 12/28 of sites between the Evans and Richmond Rivers in Richmond Valley LGA showed evidence of Koala activity (Biolink Ecological Consultants 2015), only one Koala directly observed.
10	30	8 of 13 (EIS/SPIR) 6 of 30 (Ecosure 2014) 29 of 53 (Ecosure-Biolink 2015)	EIS/SPIR – One positive SAT site along existing highway south of Coolgardie Road, and six sites between the Richmond River and Old Bagotville Road, including Thurgates Road and Old Bagotville Road. Also in vegetation to the east of the alignment and in open country to the west of the alignment immediately north of the Richmond River; and to the east and west of the intersection of the alignment with Wardell Rd (Ecosure 2014).	148 BioNet records within approximately 2 km of the alignment. 9 Koalas were sighted/anecdotally recorded during the pre-construction surveys (Ecosure 2014) the majority (6) being within 300m of the alignment including 3 within the alignment. The majority of these were located to the north of the Richmond River including two in the vicinity of Wardell Road. 11 Koalas were observed during direct count surveys of 46 sites within the vicinity of the alignment (Ecosure-Biolink (2015). This survey included 53 SAT plots, 55% of which had scats (1 Koala was observed at one of these sites) and 23 supplementary SAT sites to the east of the alignment.
11	11	0	Anecdotal records of the Koala were reported from landholders during field surveys. Contains a number of stands of Swamp Mahogany, thus some areas contain important Koala habitat.	Approximately 15 BioNet Koala records occur within 2 km of the road alignment, with a random distribution.

Additional Koala surveys, undertaken as a requirement to inform this Plan (Ecosure 2015) included direct surveys for Koalas at 54 sites within Section 9 and the northern portion of Section 8 to encompass the Broadwater population. A total of eight adult Koalas were observed including two with back young. Within Section 10, a total of 11 Koalas were observed during population surveys within this Section (Ecosure-Biolink 2015), which included direct counts at 46 sites. This assessment also found evidence of Koala activity at 55% of primary SAT sites surveyed (total of 53 sites).

Sections 1 and 2 are not considered to support key Koala populations, although the species is present. The initial preferred route studies surveyed 16 scat search sites across Sections 1 and 2 (Ecotone 2007). An additional 32 scat search plots were conducted in Sections 1 and 2 for the EIS (2011) followed by an additional 32 plots surveyed in February 2013. This included plots specifically positioned along Range Road to the east of the project to assess presence of a Koala population. Scat searches were conducted at Range Road as reported in Geolink (2012) and involved a series of plots and random searches between plots. As a result of the accumulated survey effort for Koala across Woolgoolga to Wells Crossing (Sections 1 and 2) and including Range Road, Koala populations in these locations were considered to occur in low densities relative to the amount of habitat available in the locality. There were five records of Koalas within 10 kilometres either side of the project reported in the NSW Wildlife Atlas database between 1992 and 2006. Based on the Wildlife Atlas records and communication with local residents during field surveys, occasional road deaths do occur in the area. This is consistent with only two scats being found despite the level of survey effort.

Sections 3 and 4 are not considered to support key Koala populations, even though the species is present. Sparse BioNet records occur throughout the broader landscape, such as within Bom Bom and Pine Brush State Forests, despite the considerable survey effort that has been undertaken there as part of Forests NSW pre-harvest surveys. A total of four out of 64 faecal pellet search plots completed within Section 3 contained Koala scats and no records occurred from the five plots completed within Section 4. Within Section 4 there are sparse BioNet records.

In Section 5, the Woombah population appears to be represented by only few individuals and little detailed information is available about its distribution and status. The most significant Koala survey effort within 5 km of the Iluka Road intersection was conducted by Phillips and Forsman (2002) and Biolink Ecological Consultants (2012), both of which informed the preparation of the Draft Clarence Valley CKPOM (2010, 2015). These surveys recorded Koala faecal pellets at only two of the 19 plots surveyed (separated in time by several years). The TfNSW surveys described above recorded Koala faecal pellets at one of six plots surveyed, together with an opportunistic record of a live animal on the north-eastern edge of Mororo Creek Nature Reserve. Information from all available sources suggests that the Woombah Koala population is present, but that it may be represented by only few individuals. The Woombah Koala population is likely to extend north into Section 6.

Within Section 6, none of the 18 faecal pellet search plots surveyed contained Koala scats. Nine BioNet Koala records occur within five kilometres of Section 6, suggesting a sparse population that is not considered to be an important Koala population. Within Section 7, one of the 32 faecal pellet search plots surveyed contained Koala scats and approximately 20 BioNet records occur within five kilometres of the Upgrade. None of the surveyed SAT plots within Section 8 contained Koala scats but approximately 12 BioNet Koala records occurred within five kilometres of Section 8. Similarly, none of the three Koala faecal pellet search plots surveyed in Section 11 contained evidence of Koala presence. Koalas are likely to occur at low population densities along Section 11 due to the limited area of suitable habitat (Table 4-1).

Sections 9 and 10 had the highest number of Koala records, scats and direct sightings within the Project area (Table 3-3). These populations have been studied in some detail (see Table 3-3 for summary of results and locations). Due to the relatively high numbers of Koalas occurring within these Sections, as detailed in Section 3.3, the animals within these areas are considered to represent key populations within the Project area. As such, Sections 9 and 10 will be targeted for additional mitigation and management measures to minimise the potential impacts of the Project to these populations.

3.4 Survey adequacy of existing reports informing the Koala Management Plan

Roads and Maritime engaged Dr Rod Kavanagh to conduct a detailed assessment of the adequacy of the surveys of the Koala populations at Coolgardie-Bagotville, Broadwater and Woombah-Iluka informing this KMP. This was conducted to ensure that the Ministers Condition of Approval D9a were met, namely:

- Condition D9 (a) (i) requires that surveys be adequate to determine “the **population status** of theBroadwater Koala population”.
- Condition D9 (a) (ii) requires that surveys be adequate to determine “**habitat use and movement patterns** of Koala populations within five kilometres of the proposed upgrade, or such area as determined by the independent ecologist;”
- Condition D9 (a) (iii) requires that surveys be adequate to determine “**habitat areas likely to be fragmented** by the SSI;”

The adequacy reviews are provided in Appendix G and summarised below.

3.4.1 Woombah- Iluka population

It was determined that the Ministerial Conditions of Approval for D9 (a) were not technically met for parts (i), (ii) or (iii).

In relation to part (i), the survey effort to date was determined to be inadequate to understand and document details of the status of the Woombah Koala population (i.e. its size, its distribution and trend), other than that the population is very small and sparsely distributed, likely in danger of local extinction from a range of existing and recent factors that are independent of the proposed highway upgrade.

Based on review of the available material regarding the potential impacts of the Upgrade, and consultation with the relevant regulatory authorities (DoE and DP&E, 15 June 2015), it was determined that, there was a low risk that the Woombah- Iluka and Ashby Koala population would be impacted by section 5 of the Woolgoolga to Ballina upgrade project.

Thus, while Condition D9 (a) (i) was not technically met, the review determined that no additional baseline Koala surveys were required for Section 5 for the Woombah- Iluka Koala populations.

It was similarly determined (15 June 2015) in consultation with DoE and DP&E that surveys undertaken to date for Section 5 (Woombah- Iluka area) satisfy MCoA D9(a) ii and (iii). The reasons for this are detailed below.

In relation to part (ii), available information was considered inadequate to understand and document details of habitat use and movement patterns for the Woombah Koala population. For part (iii), the survey effort was also determined to be inadequate to understand and document details of the habitat areas that are likely to be fragmented by the SSI. However, In relation to part (iii), considerable efforts have been made to document and map areas of high quality habitat for Koalas that are proposed for clearing along the highway footprint.

It was determined that the intent of Conditions D9 (a) (ii) and (iii) is primarily to understand where connectivity structures should be placed to minimise impacts of the SSI on the Woombah Koala population. The existing Pacific Highway has already fragmented the habitat of this Koala population into east and west portions, both of which include vegetation types comprised of important food tree species for the Koala. At this location (Section 5), the alignment of the proposed Highway Upgrade sits largely within the existing highway footprint. The forested landscape context within 5 km of the Iluka Road intersection is such that there are obvious locations where connectivity structures and habitat restoration/revegetation should be located to minimise habitat fragmentation and to provide safe passage for Koalas. Recommendations for the placement of connectivity structures to achieve this have been described in the pre-construction survey report by Ecosure (2014).

Thus, while Conditions D9 (a) (ii) and D9 (a) (iii) were not technically met, the regulating agencies decided that sufficient information was available to satisfy these two Conditions, in terms of the locations of connectivity structures required to minimise impacts on the Woombah Koala population.

3.4.2 Broadwater population

It was determined that the Ministerial Conditions of Approval for D9 (a) were not technically met for parts (i), (ii) or (iii).

In relation to part (i), it was determined that survey effort was inadequate to understand and document details of the status of the Broadwater Koala population (i.e. its size, its distribution and trend), other than that the population is small and sparsely distributed.

Consultation and review of this assessment with the regulatory authorities resulted in implementation of additional surveys, to address this. A new baseline survey (fully reviewed and endorsed by Dr Rod Kavanagh and Dr Jonathan Rhodes), was undertaken by Ecosure (2015) covering Section 8 (part) and Section 9 in Spring 2015 and is included in Appendix F.

In relation to part (ii), the survey effort was assessed as inadequate to understand and document details of habitat use and movement patterns for the Broadwater Koala population. For part (iii), the survey effort was also assessed as inadequate to understand and document details of the habitat areas that are likely to be fragmented by the SSI. However, In relation to part (iii), considerable efforts have been made to document and map areas of high quality habitat for Koalas that are proposed for clearing along the highway footprint.

It was determined that the intent of Conditions D9 (a) (ii) and (iii) was primarily to understand where connectivity structures should be placed to minimise impacts of the SSI on the Broadwater Koala population. The existing Pacific Highway has already fragmented the habitat of this Koala population into east and west portions, both of which include vegetation types comprised of important food tree species for the Koala. At this location (Section 9), the alignment of the proposed Highway Upgrade sits partially within the existing highway footprint. The forested landscape context, including the largely heathland-dominated Broadwater National Park and surrounding agricultural matrix, is such that there are obvious locations where connectivity structures and habitat restoration/revegetation should be located to minimise habitat fragmentation and to provide safe passage for Koalas. Recommendations for the placement of connectivity structures to achieve this have been described in the pre-construction survey report by Ecosure 2014.

It was concluded that Conditions D9 (a) (ii) and D9 (a) (iii) were not technically met. However, it was concluded that there was sufficient information available to address the intent of Conditions D9 (a) (ii) and (iii) such that the number and location of connectivity structures required to minimise impacts on the Broadwater Koala population was available. The available information was thus considered sufficient to satisfy these two Conditions.

3.4.3 Section 10: Coolgardie-Bagotville population

In recognition of the importance of the Coolgardie-Bagotville population and the requirement to undertake a population viability analysis (PVA), the Koalas in the Coolgardie-Bagotville area were the subject of a major field study and two laboratory studies (Neaves *et al.* 2015, Norman *et al.* 2015, Phillips *et al.* 2015) to better understand the demographics and genetics of the population and provide the appropriate inputs into the PVA model. These studies were developed to ensure survey adequacy requirements of CoA9 were met.

All population size, distribution, demographic and stochastic inputs to the PVA model, as well as the frequency of likely catastrophic events (i.e. the “baseline” model), were provided by the authors of the local Koala field study, which included details for 50 captured animals (Phillips *et al.* 2015). It is unknown whether the “baseline” demographic parameters, collected from the once-only snapshot sample, are truly representative of the population, and this is an inherent limitation of the PVA for which there are no alternatives. Accordingly, uncertainty around modelled or predicted population estimates must be considered in relation to interpreting or assessing future trends in the Koala population. This Plan includes the provision of long-term population monitoring that will be used to assess actual population trends against the PVA predictions (see Section 8.3 for details).

Under the scenarios modelled, the PVA findings indicated that, due to the relatively low density and declining population, there were not enough Koalas to effectively utilise the new habitat that would be provided if the highway upgrade was constructed. Although there is considerable uncertainty in the PVA, this is the best available information on trends in the population and indicates an ongoing decline. Hence it was determined that management attention needs to focus strongly on measures that will either increase population fecundity, and/or reduce population mortality. Population modelling incorporating reductions in mortality by 4 or 8 young animals per year revealed that efforts to reduce Koala mortality in the region has the potential to substantially improve Koala population viability.

This Koala Management Plan has been developed with the aim of implementing a management strategy that will decrease Koala mortality across the region and increase the viability of the population.

3.5 Key threats

The key threats to Koala populations include:

- Loss of foraging, sheltering and breeding habitat.
- Habitat fragmentation and impacts on habitat connectivity (movement of individual Koalas to different populations and home-ranges allows important genetic exchange which is essential for Koala population viability).
- Vehicle strike (Koala injury or death).
- Domestic dog attacks (Koala injury or death).
- Possible increased prevalence of disease (increased susceptibility to disease due to stress caused by the above mentioned threats) (DEHP 2012 and DSEWPaC 2013).

Drought and incidences of extreme heat are also known to cause very significant mortality, and post-drought recovery may be substantially impaired by a range of other threatening factors (Gordon *et al.* 1988, Seabrook *et al.* 2001, Lunney *et al.* 2012, TSSC 2012).

Koala injuries or death have been reported during the clearing phases of road projects from the removal of habitat trees and have been demonstrated from collisions with vehicles during the operation of these projects (AMBS 2011).

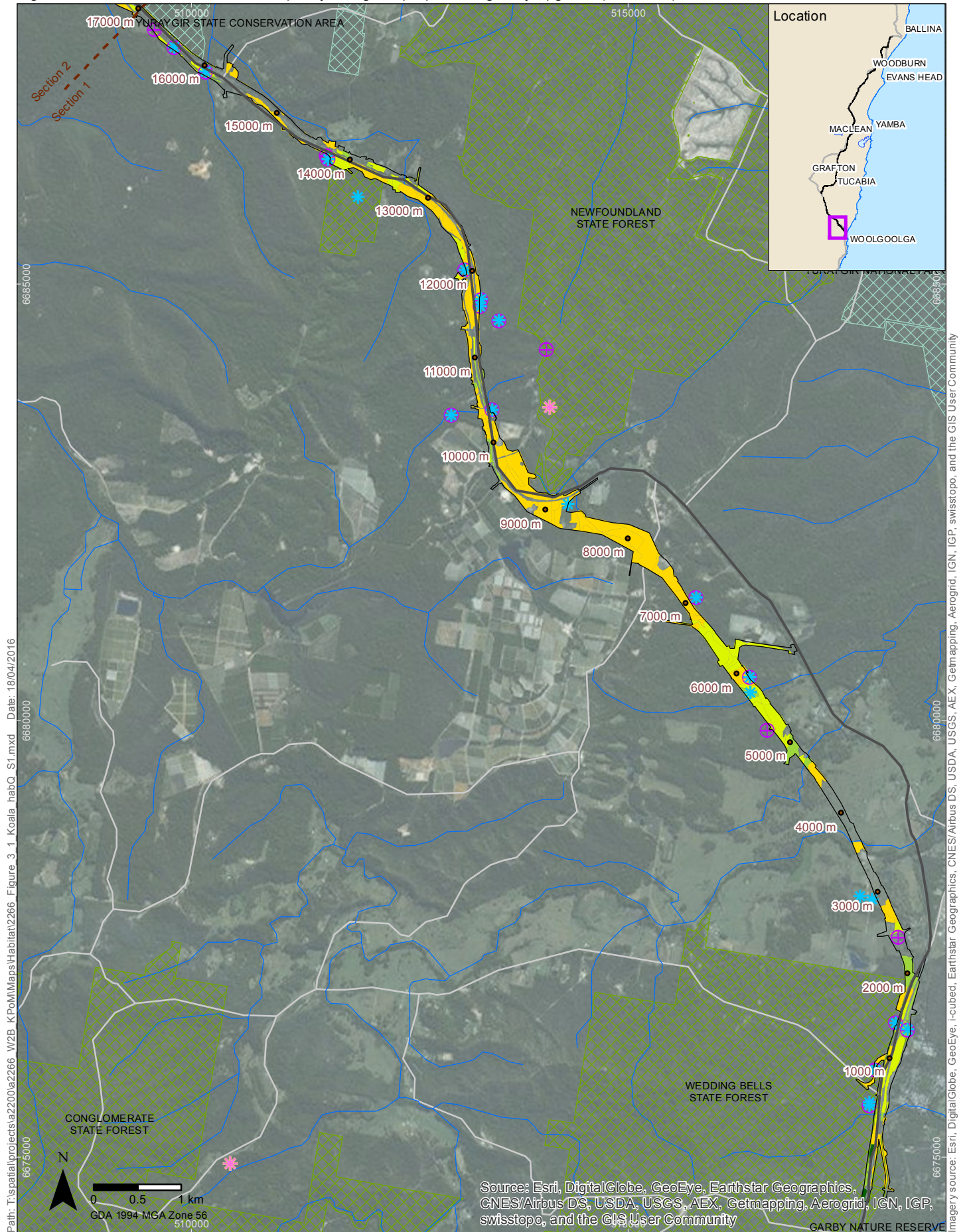
Mortality due to vehicle strike has the potential to significantly affect local Koala populations particularly where individual home-ranges abut or overlap the project corridor (AMBS 2011). These impacts are likely to be most significant in areas where the highway upgrade passes through high quality habitat for Koalas and those areas which are extensively forested. However, the presence of the proposed underpass structures and temporary and permanent fauna exclusion fencing will reduce this risk, including current road-kill events on the existing highway.

Crossing structures (underpasses and overpasses) have been shown to be effective for Koalas provided they are large enough, not too long, and are combined with fencing and revegetation (Taylor and Goldingay 2003, AMBS 2011, RMS unpublished data). However, research is lacking on the extent to which mitigation measures reduce the risk of local extinction, given the overall context of the major linear infrastructure (Taylor and Goldingay 2010, Van der Ree *et al.* 2011). Most Koalas killed by vehicle collisions on the highway are not the local roadside residents but appear to be sub-adults dispersing and perhaps old, weak animals displaced from their former home-ranges away from the highway (Dique *et al.* 2003a, AMBS 2011). Consequently the impact of road mortality may affect populations more widely.

In a radio-tracking study of Koalas on the Pacific Highway at Bonville (AMBS 2011) construction activities in two study areas led directly to only one known death, suggesting that the direct impacts of clearing and construction are relatively minor at a population scale (when appropriate mitigation strategies are in place). Construction activities (in particular habitat removal) indirectly affected individual Koalas, including the mortality of at least one animal through stress, the alteration of home-ranges and behaviour of others, and possibly mortality as a result of home-range adjustments (AMBS 2011).

Habitat restoration using plantings of Koala food trees has been shown to be very successful, with Koalas utilising young plantings within seven years, both as feeding and shelter habitat (Kavanagh and Stanton 2012).

Figure 3-1 Koala records and habitat quality along the proposed highway upgrade (Section 1)

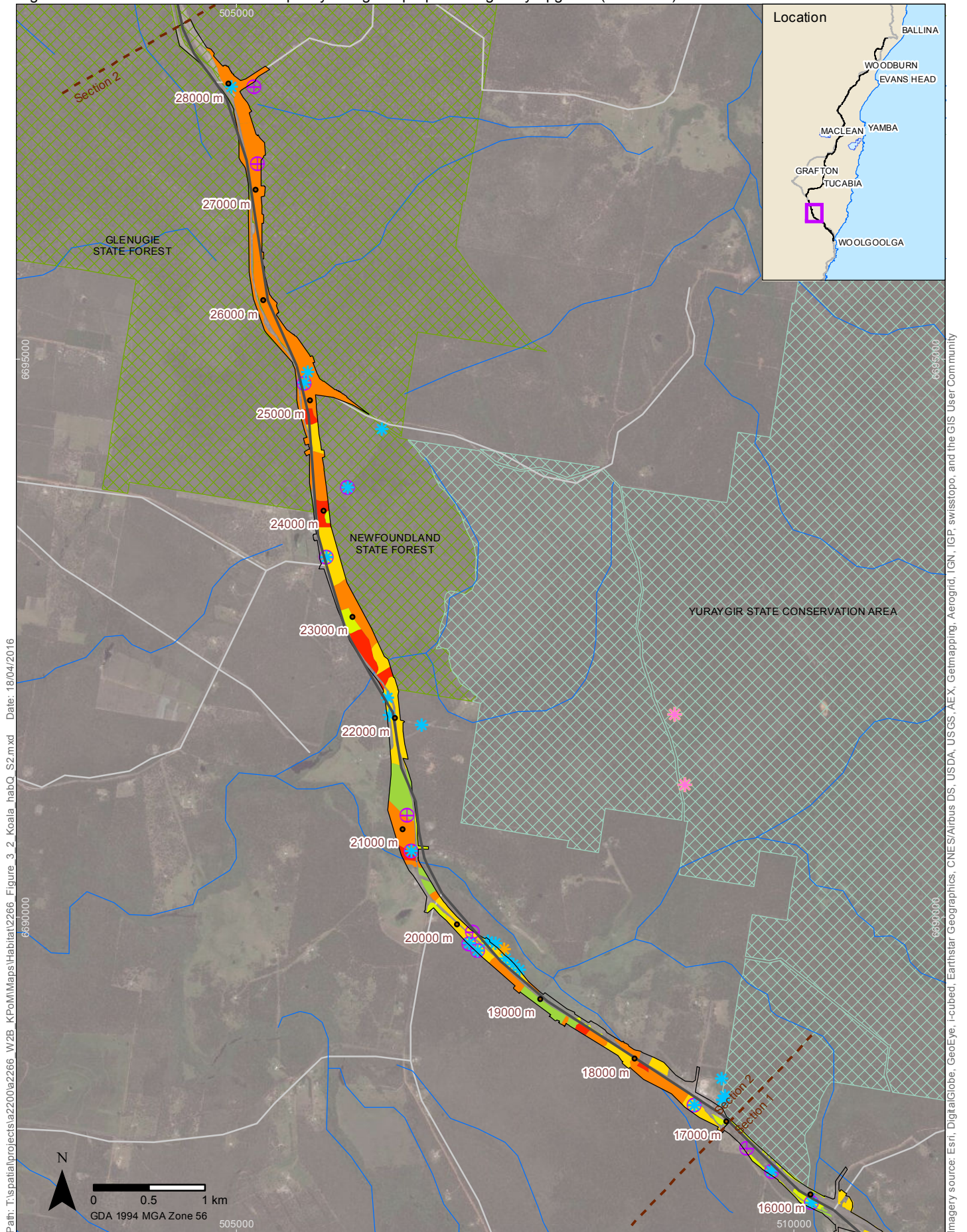


- Pacific Highway
- Project Boundary
- * Koala Atlas sightings
- ⊕ Koala habitat assessment plots

- Koala scat search plots
- * No scats

- Koala habitat quality values
- 3
- 5
- 6
- 7

Figure 3-2 Koala records and habitat quality along the proposed highway upgrade (Section 2)



- Pacific Highway
- Project Boundary
- ★ Koala Atlas sightings
- ⊕ Koala habitat assessment plots

- Koala scat search plots
- ★ Scats
- ★ No scats

- Koala habitat quality values
- 3
- 5
- 6
- 7
- 8
- 9

Figure 3-3 Koala records and habitat quality along the proposed highway upgrade (Section 3)

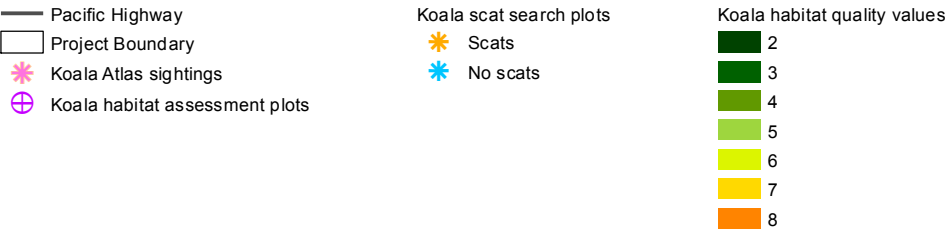
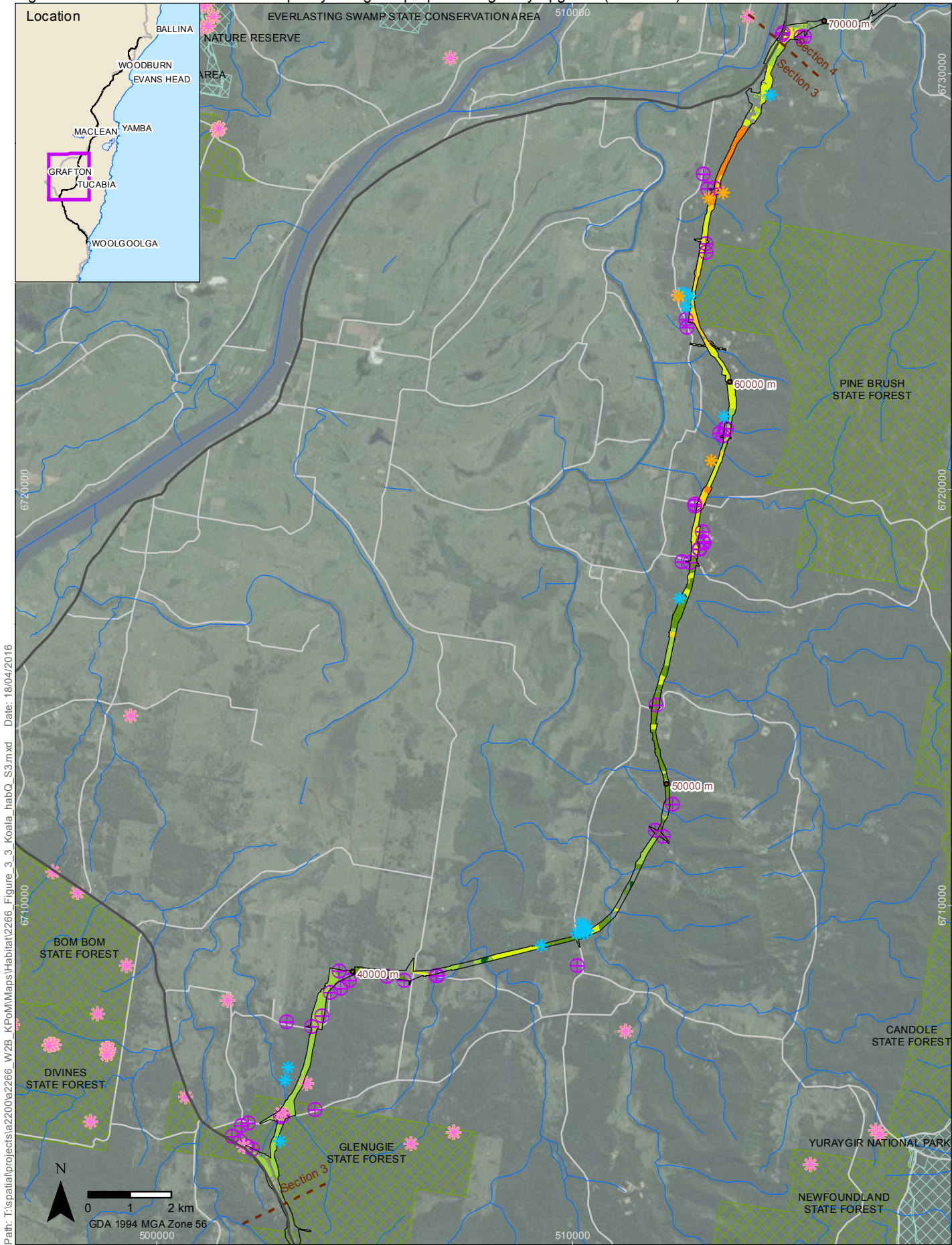


Figure 3-4 Koala records and habitat quality along the proposed highway upgrade (Section 4)

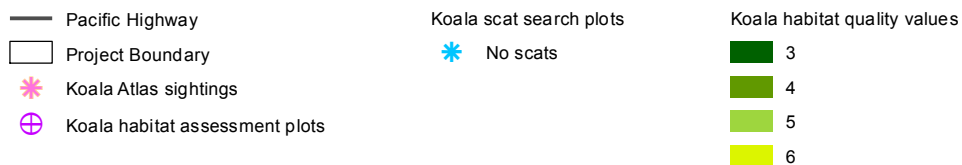
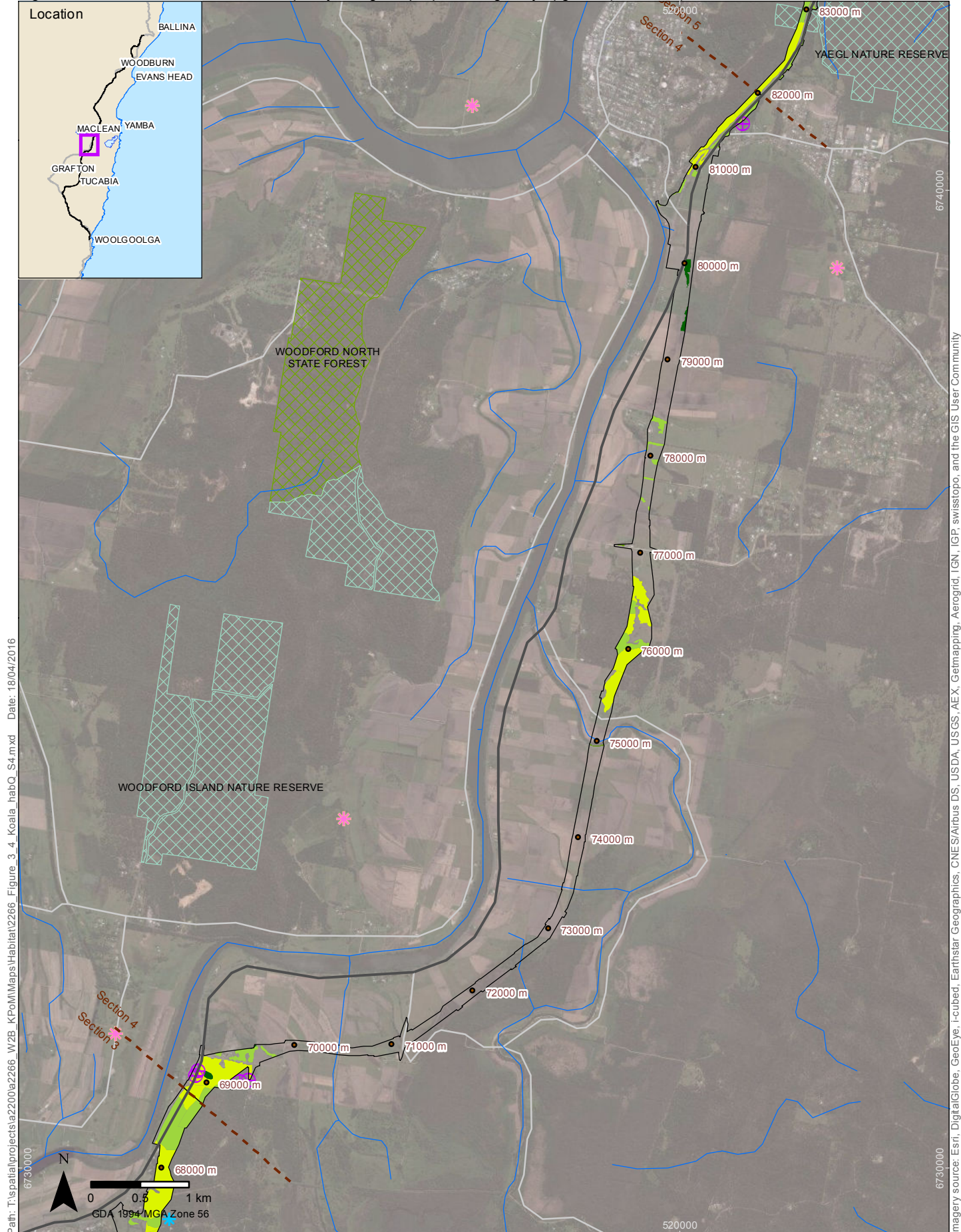


Figure 3-5 Koala records and habitat quality along the proposed highway upgrade (Section 5)

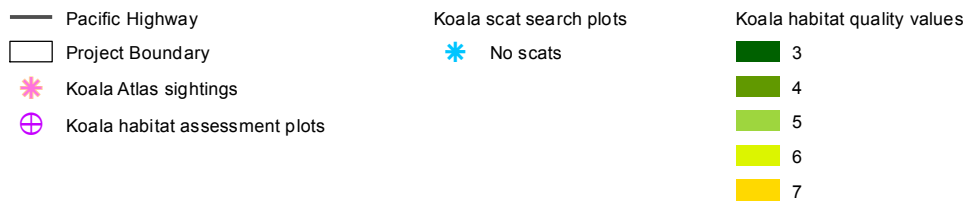
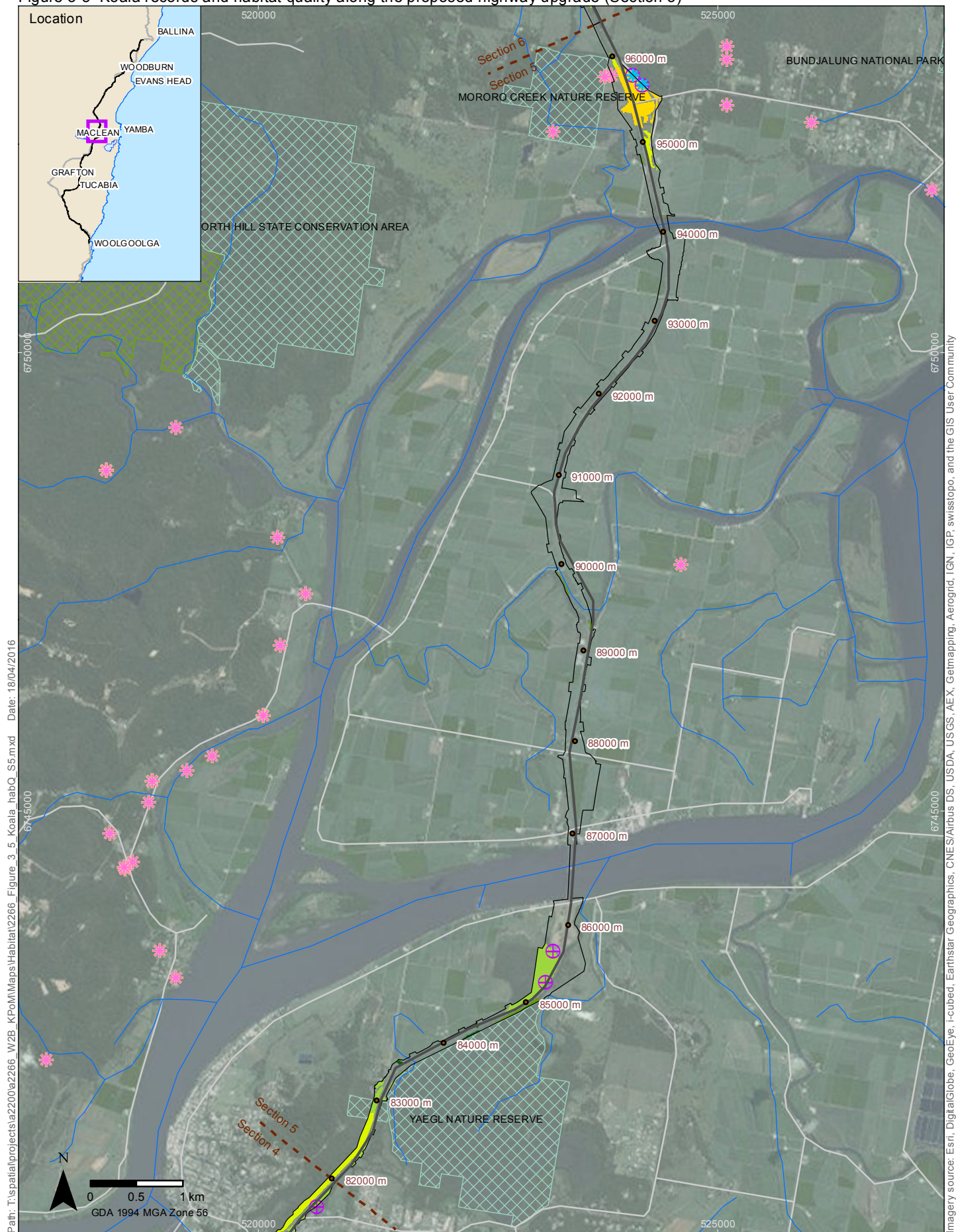
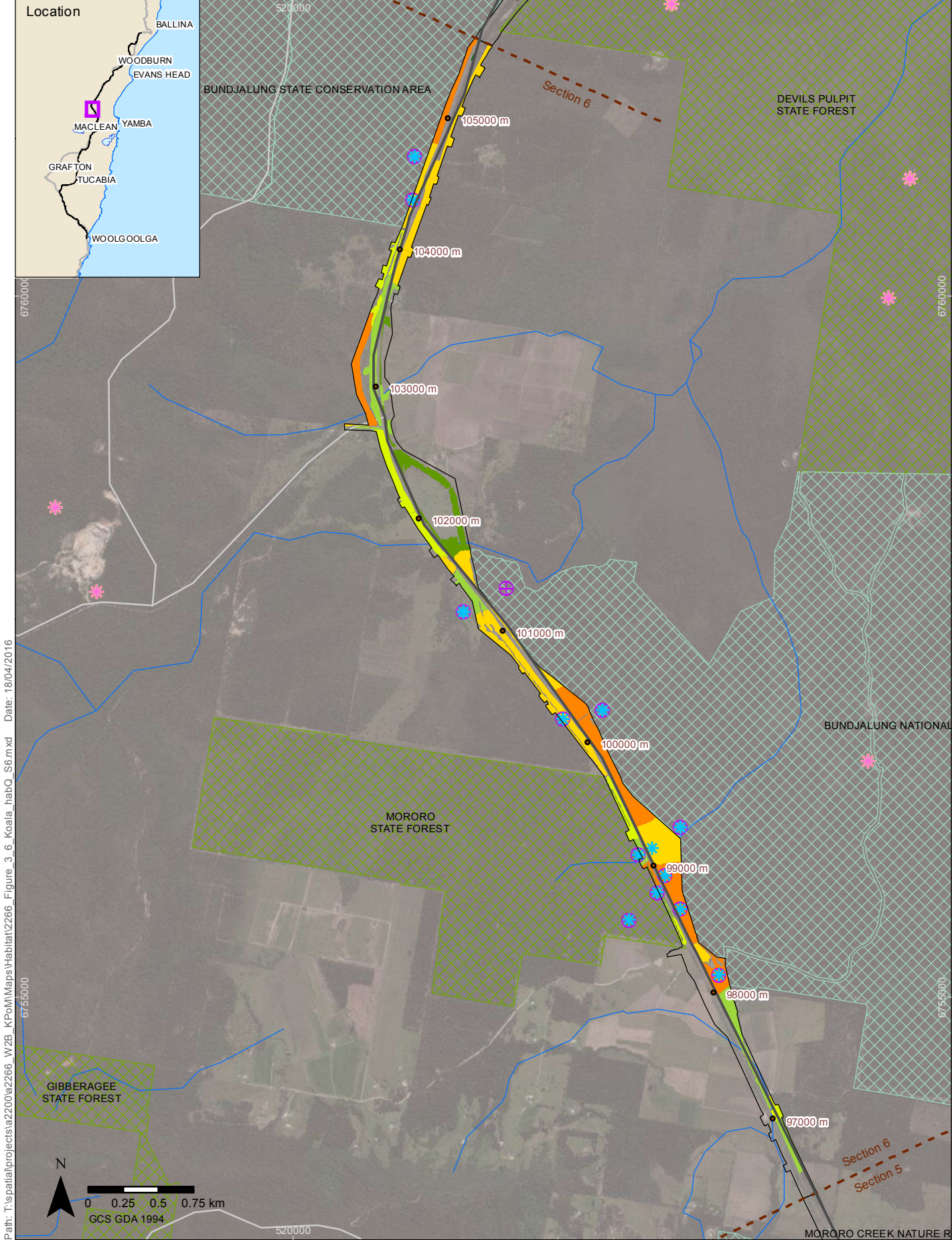


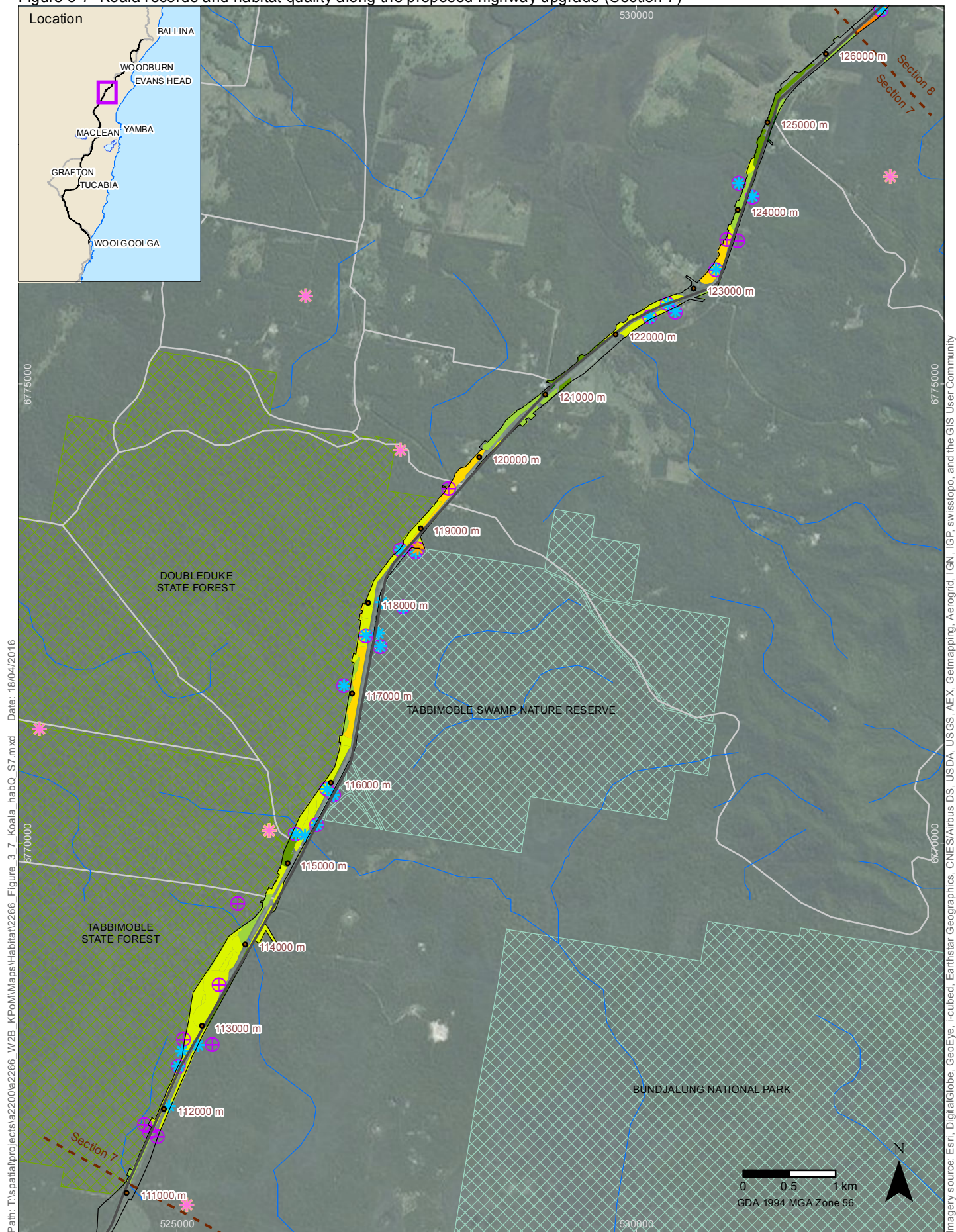
Figure 3-6 Koala records and habitat quality along the proposed highway upgrade (Section 6)



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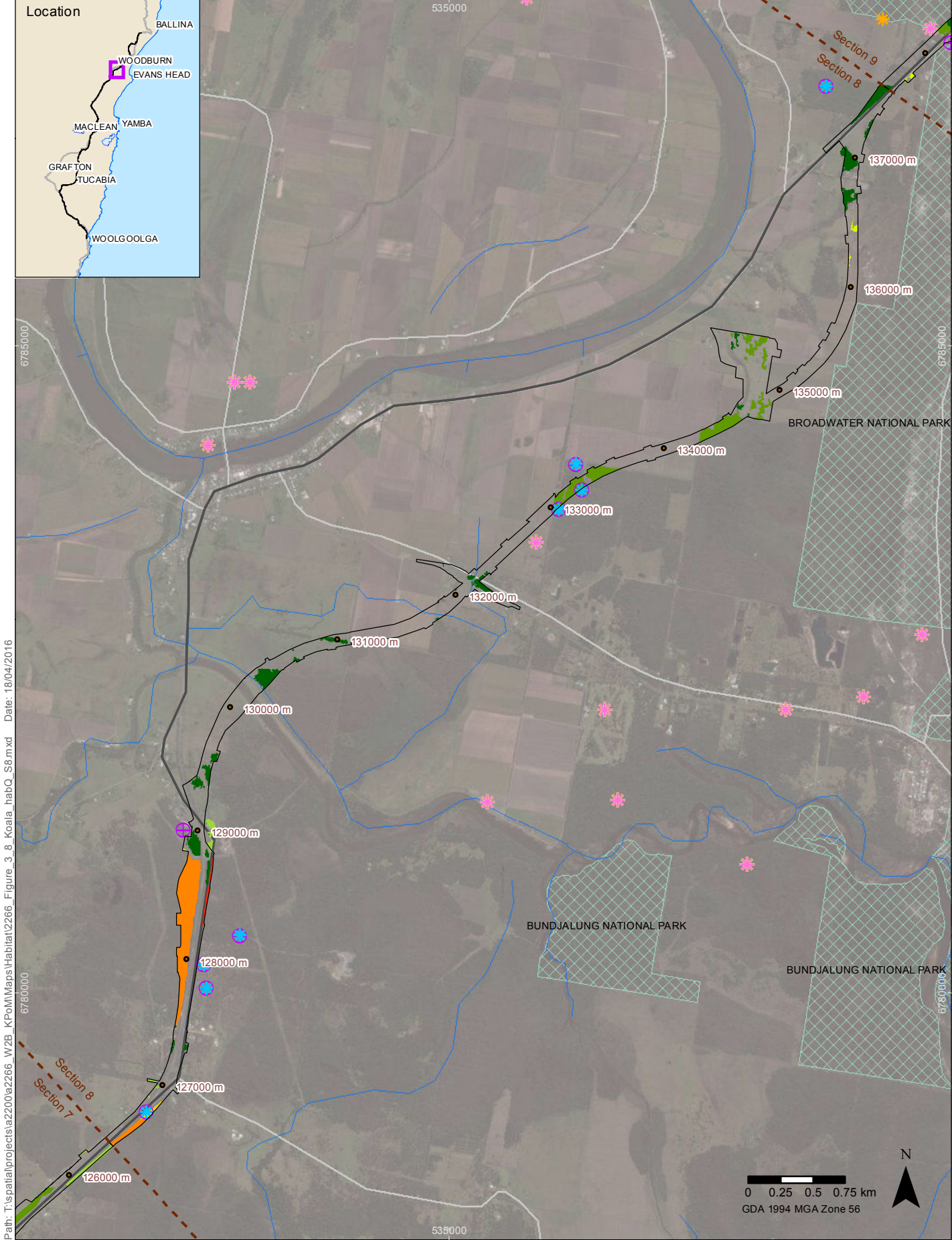
Imagery source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Figure 3-7 Koala records and habitat quality along the proposed highway upgrade (Section 7)



- | | | |
|----------------------------------|-------------------------|------------------------------|
| — Pacific Highway | Koala scat search plots | Koala habitat quality values |
| □ Project Boundary | ★ Scats | 3 |
| ✱ Koala Atlas sightings | ★ No scats | 4 |
| ⊕ Koala habitat assessment plots | | 5 |
| | | 6 |
| | | 7 |
| | | 8 |

Figure 3-8 Koala records and habitat quality along the proposed highway upgrade (Section 8)



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Imagery source: Esri, DigitalGlobe, GeoEye, I-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, IGP, swisstopo, and the GIS User Community

Figure 3-9 Koala records and habitat quality along the proposed highway upgrade (Section 9)

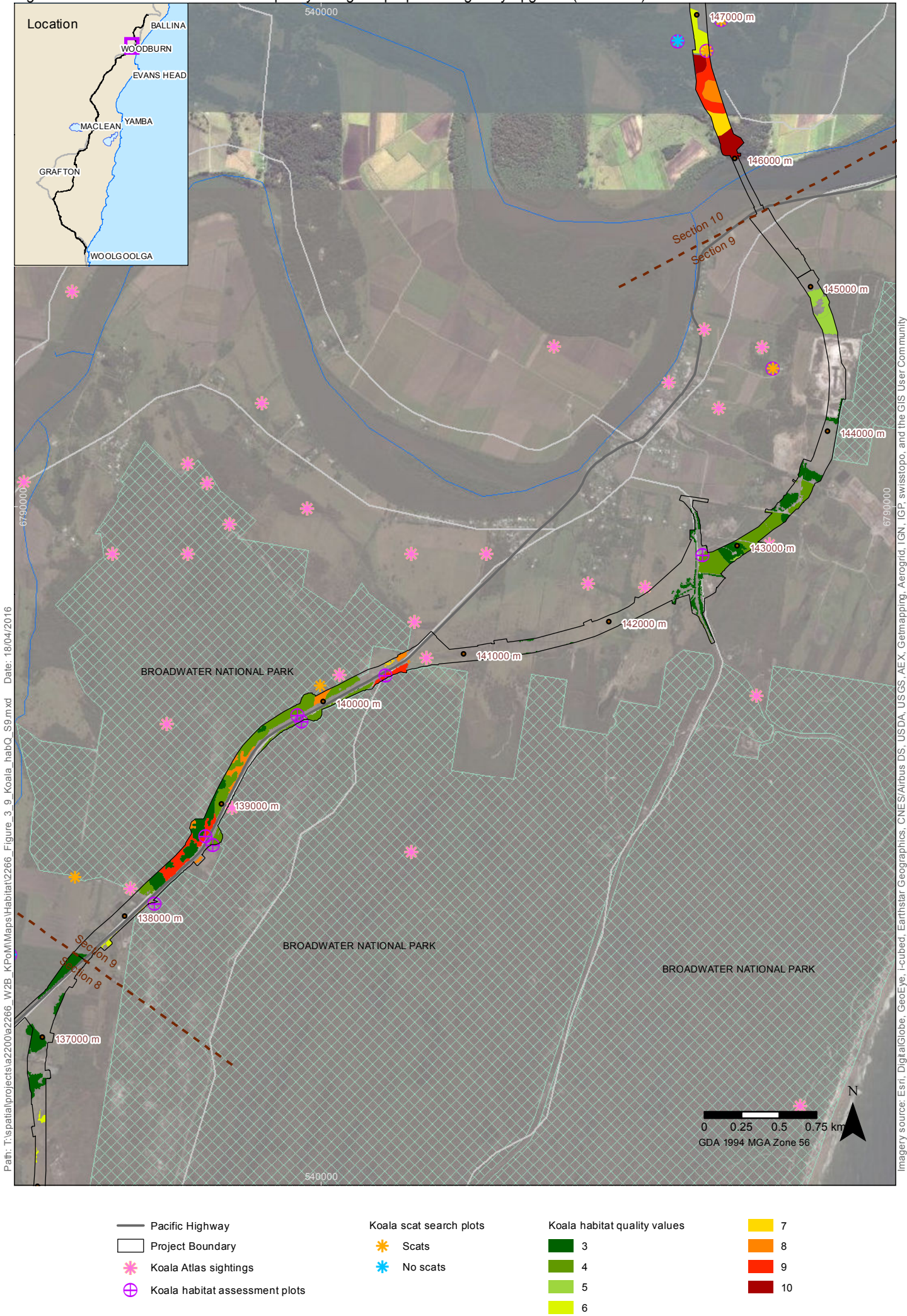


Figure 3-10 Koala records and habitat quality along the proposed highway upgrade (Section 10)

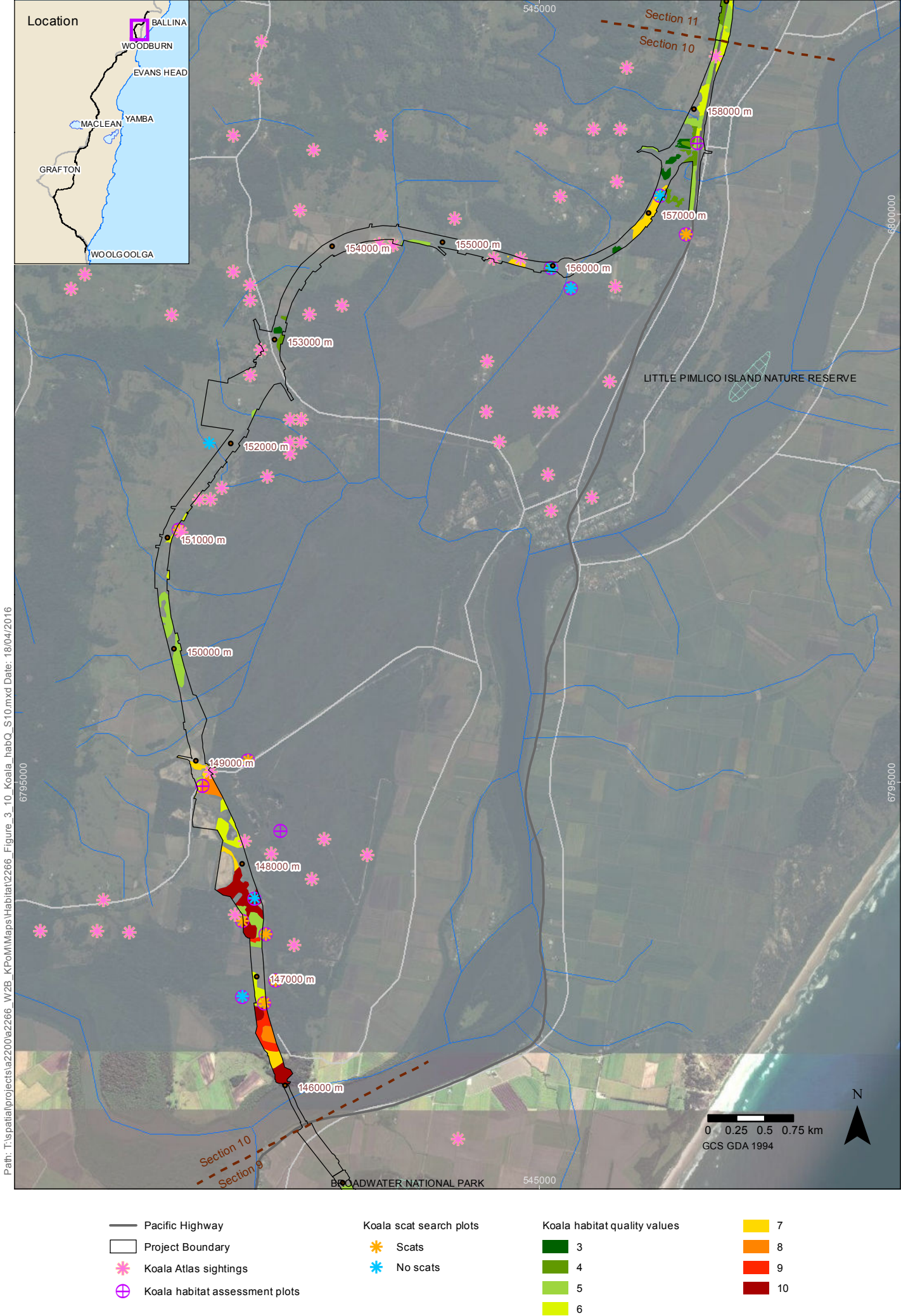
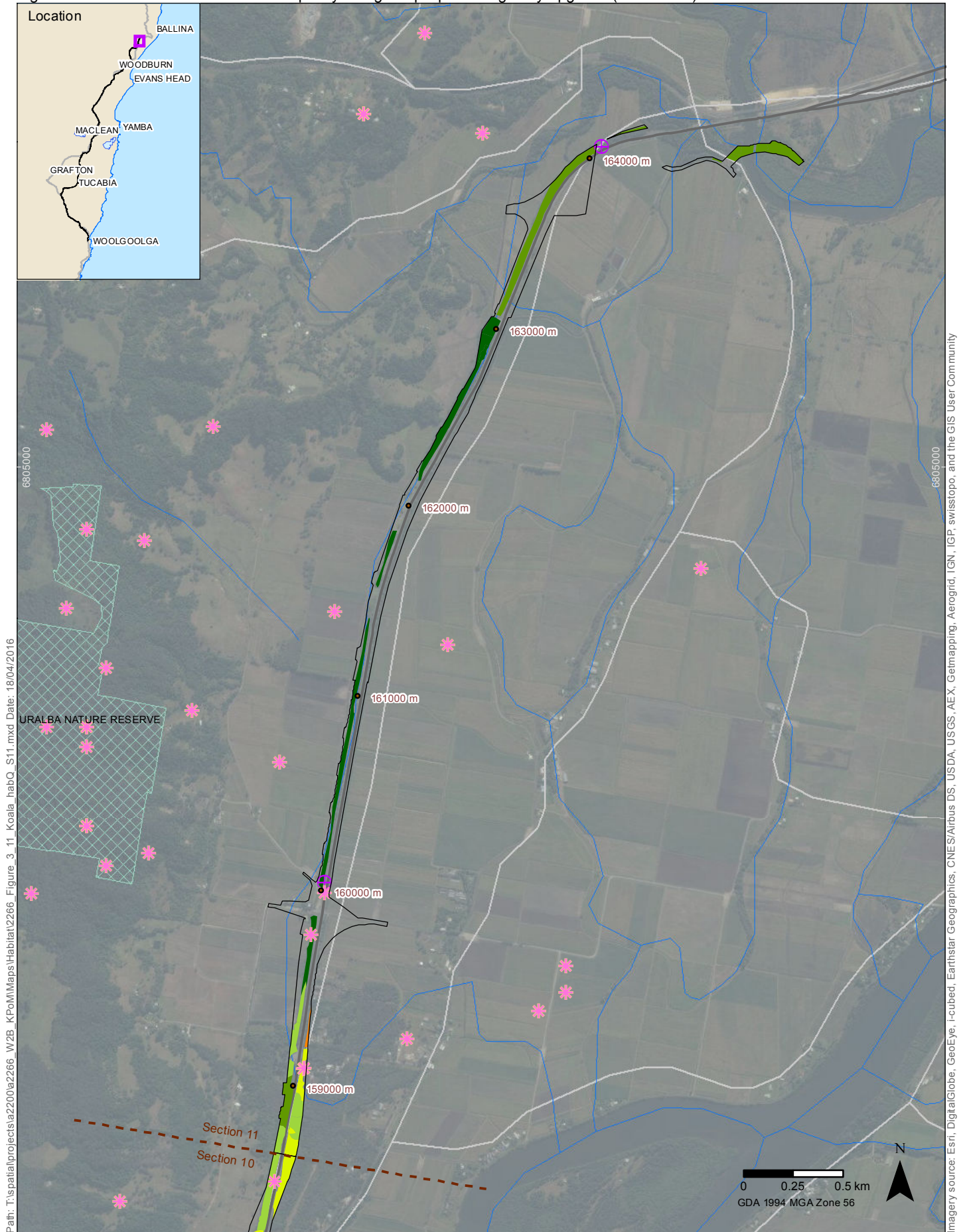


Figure 3-11 Koala records and habitat quality along the proposed highway upgrade (Section 11)



- Pacific Highway
 - Project Boundary
 - * Koala Atlas sightings
 - ⊕ Koala habitat assessment plots
- Koala habitat quality values
- 3
 - 4
 - 5
 - 6
 - 8

4. Potential impacts and management approach

This chapter provides a brief overview of the potential impacts to Koala populations with reference to the more detailed impact assessment presented in the Section 4.3.2 (pp. 298-300, 306 and 314-315) of the Biodiversity Working Paper (Roads and Maritime 2012) and Section 4.5.6 (pp. 136-155) of the Supplementary Biodiversity Assessment (Roads and Maritime 2013). It also provides an overview of the effectiveness of mitigation measures proposed for this project which have been based on previous experience with Koalas on upgrade projects for the Pacific Highway

4.1 Potential impacts associated with the project

The main potential impacts to Koala populations from the project include:

- Loss of foraging, sheltering and breeding habitat (leading to a reduction in Koala population size).
- Habitat fragmentation and impacts on habitat connectivity (leading to disrupted movements of individual Koalas to different populations and areas of suitable habitat, thus reducing opportunities for genetic exchange and increasing the chances of predation or collision with motor vehicles, both of which are important factors affecting Koala population viability).
- Increased mortality due to vehicle strikes.

The Woolgoolga to Ballina project will directly impact 885 hectares of Koala habitat within the clearing footprint (Sections 1-11). This is based on Koala Habitat Quality Scores ranging from 3-10, and includes 126.85 ha in Section 1, 92.52 ha in Section 2, 306.80 ha in Section 3, 37.90 ha in Section 4, 31.67 ha in Section 5, 69.70 ha in Section 6, 103.15 ha in Section 7, 33.55 ha in Section 8, 23.56 ha in Section 9, 34.96 ha in Section 10 and 13.94 ha in Section 11. (Table 4-1). The Koala habitat score methodology was in accordance with the EPBC Act's Environmental Offset Policy (October 2012) and Offsets Assessment Guide (see Section 3.2 of this Plan). The area of Koala habitat to be removed, as estimated using this method, is larger than the 557 ha and 375 ha originally estimated as 'habitat critical to the survival of the Koala' (DSEWPaC 2012) in the EIS and SPIR, respectively. This is because Roads and Maritime Services decided to take a more conservative approach to estimating the area of Koala habitat that would be removed as part of the Project. TfNSW assumed that all Biometric Vegetation Types that nominally contain Koala food tree species (see Table 3-1), regardless of their actual occurrence on the ground (as required under the definition of 'habitat critical to the survival of the Koala'), would be treated as requiring offsets under the EPBC Act Biodiversity Offsets Policy. The SPIR estimated that 375 ha of primary and secondary 'habitat critical to the survival of Koala' habitat would be cleared throughout the Project footprint. This figure was derived from 160 habitat assessment plots, each 0.1 ha in size and distributed throughout a similar number of vegetation polygons, in which absence of the required percentage composition (30% and 50%) of primary and secondary Koala food trees was interpreted as absence of primary and secondary Koala habitat within the entire vegetation polygon. This methodology was based on Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) (2012) *Interim Koala referral advice for proponents*.

All Biometric Vegetation Types nominally containing primary, secondary and supplementary Koala food tree species will be recognised as requiring offsets. Primary food tree species in these vegetation types include Swamp Mahogany (*Eucalyptus robusta*), Forest Red Gum (*E. tereticornis*), Tallowwood (*E. microcorys*), Cabbage Gum (*E. amplifolia*) and Orange Gum (*E. bancroftii*). Secondary food tree species are represented by Red Mahogany (*E. resinifera*), Small fruited Grey-Gum (*E. propinqua*), Grey Box (*E. moluccana*) and Narrow-leaved Red Gum (*E. seeana*). Supplementary tree species include the stringy-barks (*E. eugenoides* and *E. tindaliae*).

Table 4-1. Area (ha) of each Biometric Vegetation Type proposed for clearing in relation to Koala habitat score ranking.

Biometric vegetation type	Koala Habitat Quality scores										
	0	2	3	4	5	6	7	8	9	10	Grand total
Section 1											
Cleared	72.86						0.11				72.97
Forest Red Gum - Swamp Box of the Clarence Valley Lowlands of the North Coast						0.26	2.27				2.54
Needlebark Stringybark - Red Bloodwood Heathy Woodland on Sandstones of the Lower Clarence of the North Coast							13.82				13.82
Paperbark Swamp Forest of the Coastal Lowlands of the North Coast	0.03				7.88	3.01	1.18				12.09
Spotted Gum - Grey Ironbark - Pink Bloodwood Open Forest of the Clarence Valley Lowlands of the North Coast	0.33				0.99	3.58	12.94				17.83
Swamp Box Swamp Forest of the Coastal Lowlands of the North Coast						5.23	5.69				10.91
Swamp Mahogany Swamp Forest of the Coastal Lowlands of the North Coast	0.28		0.60		1.49	5.77	4.26				12.40
Swamp Oak Forest of the Coastal Lowlands of the North Coast	0.95										0.95
Total Section 1	74.97		0.60		11.52	32.00	80.11				199.20
Section 2											
Black Bean - Weeping Lilly Pilly Riparian Rainforest of the North Coast			0.00								0.00
Blackbutt - Tallowwood Dry Grassy Open Forest of the Central Parts North Coast						0.26	0.24				0.50
Blackbutt Grassy Open Forest of the Lower Clarence Valley of the North Coast					3.97						3.97
Cleared	37.66										37.66

WOOLGOOLGA TO BALLINA | PACIFIC HIGHWAY UPGRADE: SECTIONS 1–11

Biometric vegetation type	Koala Habitat Quality scores										
	0	2	3	4	5	6	7	8	9	10	Grand total
Narrow-Leaved Red Gum Woodlands of the Lowlands of the North Coast						1.05		4.51			5.56
Needlebark Stringybark - Red Bloodwood Heathy Woodland on Sandstones of the Lower Clarence of the North Coast						1.61	0.63				2.24
Orange Gum (<i>Eucalyptus bancroftii</i>) Open Forest of the North Coast								4.84	4.38		9.22
Paperbark Swamp Forest of the Coastal Lowlands of the North Coast					3.34						3.34
Scribbly Gum - Needlebark Stringybark Heathy Open Forest of Coastal Lowlands of the Northern North Coast							6.35				6.35
Scribbly Gum - Red Bloodwood Heathy Open Forest of the Coastal Lowlands of the North Coast							14.12	4.34			18.47
Spotted Gum - Grey Box - Grey Ironbark Dry Open Forest of the Clarence Valley Lowlands of the North Coast								8.61			8.61
Spotted Gum - Grey Ironbark - Pink Bloodwood Open Forest of the Clarence Valley Lowlands of the North Coast							2.10	27.59			29.70
Swamp Box Swamp Forest of the Coastal Lowlands of the North Coast							0.09				0.09
Swamp Mahogany Swamp Forest of the Coastal Lowlands of the North Coast								2.23	1.87		4.10
Total Section 2	37.66		0.00		7.31	2.92	23.53	52.14	6.25		129.81
Section 3											
<i>Angophora robur</i> shrubby forest and woodland on sandstones on the north coast					3.69		2.58				6.26
Black Bean - Weeping Lilly Pilly riparian rainforest of the North Coast					0.70						0.70

WOOLGOOLGA TO BALLINA | PACIFIC HIGHWAY UPGRADE: SECTIONS 1-11

Biometric vegetation type	Koala Habitat Quality scores										
	0	2	3	4	5	6	7	8	9	10	Grand total
Blackbutt - bloodwood dry heathy open forest on sandstones of the northern North Coast				7.00	5.88						12.88
Cleared	56.72										56.72
Coastal floodplain sedgelands, rushlands, and forblands	0.49		0.84								1.33
Coastal freshwater meadows and forblands of lagoons and wetlands						0.31					0.31
Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the North Coast					0.86	12.94	3.05	1.33			18.18
Narrow-leaved Ironbark dry open forest of the North Coast					5.47						5.47
Paperbark swamp forest of the coastal lowlands of the North Coast					4.72	0.74	6.39				11.84
Pink Bloodwood- Tallowwood moist open forest of the far northern ranges of the North Coast						15.56		15.44			31.00
Scribbly Gum - Needlebark Stringybark heathy open forest of coastal lowlands of the northern North Coast			0.39	28.34	10.45	5.59					44.77
Scribbly Gum - Red Bloodwood heathy open forest of the coastal lowlands of the North Coast			0.62	9.93	5.84						16.40
Spotted Gum - Grey Ironbark - Pink Bloodwood open forest of the Clarence Valley lowlands of the North Coast				15.94	65.27						81.21
Swamp Box swamp forest of the coastal lowlands of the North Coast						1.64	2.15				3.79
Swamp Mahogany swamp forest of the coastal lowlands of the North Coast					0.87	10.79	1.30				12.96
Swamp Oak swamp forest of the coastal lowlands of the North Coast				4.24	4.30	9.02					17.55
Turpentine moist open forest of the coastal hills and ranges of the North Coast						31.09	11.55				42.63
Total Section 3	57.21		1.85	65.45	108.04	87.67	27.02	16.77			364.09

WOOLGOOLGA TO BALLINA | PACIFIC HIGHWAY UPGRADE: SECTIONS 1–11

Biometric vegetation type	Koala Habitat Quality scores										
	0	2	3	4	5	6	7	8	9	10	Grand total
Section 4											
<i>Angophora robur</i> shrubby forest and woodland on sandstones on the north coast					1.13						1.13
Cleared	115.86										
Coastal floodplain sedgelands, rushlands and forblands	2.20										2.20
Flooded Gum - Tallowood - Brush Box moist open forest of the coastal lowlands of the north coast					0.38	0.83					1.21
Forest Red Gum - Swamp Box of the Clarence Valley lowlands				0.05	2.72	10.84					13.61
Grey Gum - Grey Ironbark open forest of the Clarence lowlands of the north coast	0.31			0.10	2.82	14.64					17.87
Paperbark swamp forest of the coastal lowlands	0		1.17								1.17
Spotted Gum - Grey Ironbark open forest at the Clarence lowlands of the north coast					2.72						2.72
Swamp Mahogany swamp forest of coastal lowlands of the north coast						0.51					0.51
Swamp Oak forest of the coastal lowlands of the north coast	5.07										5.07
Total Section 4	123.45		1.17	0.15	9.77	26.81					161.35
Section 5											
Cleared	171.66										171.66
Flooded Gum - Tallowood - Brush Box moist open forest of the coastal lowlands of the north coast					1.56	4.32					5.88
Forest Red Gum - Swamp Box of the Clarence Valley lowlands				0.32	0.10						0.43
Grey Gum - Grey Ironbark open forest of the Clarence Valley lowlands of the north coast					2.08	2.29	10.52				14.88

WOOLGOOLGA TO BALLINA | PACIFIC HIGHWAY UPGRADE: SECTIONS 1-11

Biometric vegetation type	Koala Habitat Quality scores										
	0	2	3	4	5	6	7	8	9	10	Grand total
Grey Mangrove low closed forest	0.96										0.96
Paperbark swamp forest of the coastal lowlands			0.56	1.20	5.16	0.48					7.40
Swamp Oak forest of the coastal lowlands of the north coast	7.73				3.08						10.81
White Booyong-fig subtropical rainforest of the north coast	0.52										0.52
Total for Section 5	180.87		0.56	1.52	11.99	7.08	10.52				212.54
Section 6											
Blackbutt - Bloodwood Dry Heathy Open Forest on Sandstones of the Northern North Coast				0.03	0.12	2.10	2.56	4.32			9.12
Cleared	43.67										43.67
Forest Red Gum - Swamp Box of the Clarence Valley Lowlands of the North Coast				0.27	2.29	2.53	1.03	4.68			10.81
Grey Gum - Grey Ironbark Open Forest of the Clarence Lowlands of the North Coast					2.71	0.39	15.26	9.62			27.97
Narrow-Leaved Red Gum Woodlands of the Lowlands of the North Coast							3.13	1.45			4.58
Paperbark Swamp Forest of the Coastal Lowlands of the North Coast				1.93	4.68	5.19	0.32				12.11
Red Mahogany Open Forest of the Coastal Lowlands of the North Coast					1.76		1.37				3.13
Spotted Gum - Grey Ironbark - Pink Bloodwood Open Forest of the Clarence Valley Lowlands of the North Coast			0.04					0.51			0.55
Tallowood Dry Grassy Forest of the Far Northern Ranges of the North Coast					1.42						1.42
Total Section 6	43.67		0.04	2.22	12.97	10.21	23.67	20.58			113.37
Section 7											

WOOLGOOLGA TO BALLINA | PACIFIC HIGHWAY UPGRADE: SECTIONS 1–11

Biometric vegetation type	Koala Habitat Quality scores										
	0	2	3	4	5	6	7	8	9	10	Grand total
Blackbutt - Bloodwood Dry Heathy Open Forest on Sandstones of the Northern North Coast					6.80	6.60	3.47				16.87
Cleared	69.19										69.19
Grey Gum - Grey Ironbark Open Forest of the Clarence Lowlands of the North Coast						1.44					1.44
Narrow-Leaved Red Gum Woodlands of the Lowlands of the North Coast				0.81		5.93					6.75
Needlebark Stringybark - Red Bloodwood Heathy Woodland on Sandstones of the Lower Clarence of the North Coast						1.03					1.03
Paperbark Swamp Forest of the Coastal Lowlands of the North Coast					2.14	13.30					15.44
Red Mahogany Open Forest of the Coastal Lowlands of the North Coast			0.53	10.23	11.30	2.32	9.78				34.17
Scribbly Gum - Needlebark Stringybark Heathy Open Forest of Coastal Lowlands of the Northern North Coast						13.92					13.92
Spotted Gum - Grey Ironbark - Pink Bloodwood Open Forest of the Clarence Valley Lowlands of the North Coast						10.03	3.51				13.54
Total Section 7	69.19		0.53	11.04	20.25	54.56	16.76				172.34
Section 8											
<i>Angophora paludosa</i> Shrubby Forest and Woodland on Sandstone or Sands of the North Coast								0.61			0.61
Cleared	88.75					0.23					88.98
Forest Red Gum grassy open forest of the coastal ranges of the North Coast			0.89	2.67	0.28	0.05	0.51	10.67			15.07
Grey Gum - Grey Ironbark Open Forest of the Clarence Lowlands of the North Coast					0.08				0.48		0.56

WOOLGOOLGA TO BALLINA | PACIFIC HIGHWAY UPGRADE: SECTIONS 1-11

Biometric vegetation type	Koala Habitat Quality scores										
	0	2	3	4	5	6	7	8	9	10	Grand total
Paperbark Swamp Forest of the Coastal Lowlands of the North Coast			3.41	5.34				1.03			9.78
Red Mahogany Open Forest of the Coastal Lowlands of the North Coast								0.48			0.48
Swamp Box Swamp Forest of the Coastal Lowlands of the North Coast			3.05								3.05
Swamp Mahogany Swamp Forest of the Coastal Lowlands of the North Coast						0.02					0.02
Swamp Oak Forest of the Coastal Lowlands of the North Coast			3.72	0.03							3.75
Total Section 8	88.75		11.07	8.03	0.35	0.29	0.51	12.80	0.48		122.30
Section 9											
Blackbutt - Bloodwood Dry Heathy Open Forest on Sandstones of the Northern North Coast			0.61		0.60						1.20
Brushbox – Tallowwood Shrubby Open Forest of the Northern Ranges of the North Coast					0.55						0.55
Cleared	51.67										51.67
Coast Cypress Pine Shrubby Open Forest of the North Coast			0.60	0.56	0.88						2.04
Coastal Heath on Sands of the North Coast			6.10	13.70	0.13						19.93
Paperbark Swamp Forest of the Coastal Lowlands of the North Coast			2.82	1.30	0.08			0.25			4.46
Swamp Mahogany Swamp Forest of the Coastal Lowlands of the North Coast					0.00	0.20	0.17	1.79	3.35		5.50
Total Section 9	51.67		10.13	15.56	2.24	0.20	0.17	2.04	3.35		85.36
Section 10											

WOOLGOOLGA TO BALLINA | PACIFIC HIGHWAY UPGRADE: SECTIONS 1–11

Biometric vegetation type	Koala Habitat Quality scores										
	0	2	3	4	5	6	7	8	9	10	Grand total
Blackbutt – Pink Bloodwood Shrubby Open Forest of the Coastal Lowlands of the North Coast				0.05	2.21	0.14	2.97				5.38
Blackbutt Grassy Open Forest of the lower Clarence Valley of the North Coast						0.23	0.93	0.91		1.53	3.60
<i>Cinnamomum camphora</i> (Camphor Laurel)			1.44								1.44
Cleared	115.02			0.14			0.93				116.09
Mangrove - Grey Mangrove Low Closed Forest of the NSW Coastal Bioregions	0.17										1.44
Narrow-Leaved Red Gum Woodlands of the Lowlands of the North Coast					1.06	2.01	0.70		1.26	3.92	8.94
Paperbark Swamp Forest of the Coastal Lowlands of the North Coast	0.00		0.41	0.88	1.61	2.17			0.25	0.64	5.96
Scribbly Gum - Needlebark Stringybark Heathy Open Forest of Coastal Lowlands of the Northern North Coast					1.98	1.47					3.45
Swamp Mahogany Swamp Forest of the Coastal Lowlands of the North Coast					0.63	0.27		1.23			2.12
Tuckeroo – Riberry – Yellow Tulipwood Littoral Rainforest of the North Coast	0.01			0.19	0.89						1.09
White Booyong – Fig Subtropical Rainforest of the North Coast			0.39	0.52	0.47		0.53				1.92
Total Section 10	115.20		2.24	1.78	8.85	6.29	6.06	2.14	1.51	6.09	150.16
Section 11											
Cleared	29.30			0.31							29.61
Mangrove - Grey Mangrove Low Closed Forest of the NSW Coastal Bioregions	0.05			0.09							0.13
Paperbark Swamp Forest of the Coastal Lowlands of the North Coast			2.35	0.91	0.73	0.63		0.16			4.78

WOOLGOOLGA TO BALLINA | PACIFIC HIGHWAY UPGRADE: SECTIONS 1-11

Biometric vegetation type	Koala Habitat Quality scores										
	0	2	3	4	5	6	7	8	9	10	Grand total
Scribbly Gum - Needlebark Stringybark Heathy Open Forest of Coastal Lowlands of the Northern North Coast					0.68	0.55					1.23
Swamp Mahogany Swamp Forest of the Coastal Lowlands of the North Coast			3.76	2.36	0.52						6.63
Swamp Oak Forest of the Coastal Lowlands of the North Coast				0.89							0.89
Tuckeroo - Riberry - Yellow Tulipwood Littoral Rainforest of the North Coast					0.00						0.00
Total Section 11	29.34		6.10	4.56	1.93	1.18		0.16			43.28

Koalas may also be impacted by fragmentation and the barrier effect of the highway. It has been identified that Koalas are regularly struck by cars where high-density populations occur in fragmented urban habitats (Canfield 1987, Dique *et al.* 2003b, Taylor and Goldingay 2010, DSEWPac 2013). Recent genetic research has identified that major roads can act as a barrier to gene flow for Koalas (Lee *et al.* 2010). Vehicle strike (Koala injury or death) during road construction and operation presents one of the key potential impacts of the Project.

The project will fragment habitat links for Koalas seeking access to preferred habitats either side of the highway, and this is particularly of concern for the key populations located between Bagotville and Wardell and the southern parts of Coolgardie (Section 10 of the project), and also between Broadwater National Park and Rileys Hill (Section 9 of the project). However, any potential barrier effects of the highway upgrade within Sections 1-8 (excluding the Woombah population) and 11 are of less concern due to the very low population density of Koalas inhabiting these areas.

Potential indirect impacts would result from:

- Greater likelihood of local extinction due to small population size as a result of fragmentation.
- Reduced opportunities for effective and safe dispersal due to fragmentation, and potentially reduced breeding success.
- Disease and stress.
- Potential for increased predation risk within and adjacent to fauna underpasses where Koala movements may be concentrated.

The low-density populations of Koalas occurring within most Sections (1-8 and 11) are likely to suffer a reduced level of impact by the Project, compared to other Sections (9 and 10) where this species is more abundant or of greater significance as determined by pre-construction surveys and according to local planning documents. Accordingly, the management response by TfNSW will differ between Sections.

To quantify the potential impact on the individual Koalas located within the known hotspots of Section 10 (Wardell Road and Laws Point) the number of food trees present in the locality (area over which Koalas who utilise food trees within the alignment are likely to forage) and those to be removed has been determined (see Figure 6-7). These are shown in Table 4-2 and demonstrate that 23% of the total number of identified food trees present within these areas would be removed for the Project. In general, not all trees within the project boundary will be removed – only those that occur within the proposed construction footprint.

Table 4-2. Number of Koala food trees to be removed within Section 10 Koala ‘hot spot’ locations.

Location	No. of key food trees present within and directly adjacent to the road corridor. (Dr. S Phillips, unpublished data).	No. of identified trees removed	
		SPiR	Current SMEC Design
Laws Point	70	14	12
Wardell Road	43	17	14

4.2 Detailed design considerations

Several factors were considered in identifying the key connectivity zones for Koalas and the types of crossing structures likely to be used by this species have been included in the detailed design of the Project. The factors considered in locating and sizing of connectivity structures included:

- Known and potential Koala habitat and connectivity areas.
- Consideration of local Koala population density

- Previous experience from monitoring programs which investigated the effectiveness of structures for Koalas. These experiences included the need to make underpasses as large as possible in profile, but as short as possible in total length (< 50 m).

4.3 Mitigation and monitoring

A number of measures to mitigate and monitor the impact of the project on Koalas during construction and operation for the entire project were suggested in the EIS (Biodiversity Working Paper, Roads and Maritime 2012). In general these measures related to:

- Installation of dedicated and combined connectivity structures, including overpasses and underpasses, in combination with strategic revegetation and fencing to encourage use of these facilities/areas.
- Development of a Koala Fencing Strategy.
- Provision of Koala fauna exclusion fencing, including fencing of escape points and strategic areas of preferred vegetation.
- Additional targeted Koala surveys as part of a comprehensive monitoring program.
- Pre-clearing surveys to identify Koalas within the construction corridor.
- Identification of exclusion zones and fencing to prevent damage to native vegetation and Koala habitat.
- Siting of ancillary facilities to avoid impacts to known and potential Koala habitat.
- Implementation of a dog policy to ensure that no domestic dogs are brought onto the site.
- Induction and training of construction staff to make them aware of Koala habitat requirements, clearing extents and no-go areas.
- A licensed wildlife carer/ecologist would be present on site during all vegetation clearing.

4.4 Effectiveness of mitigation measures

A summary of the proposed Koala-specific mitigation measures for the entire Pacific Highway upgrade, and evaluation of their effectiveness based on past experience with other highway upgrades, is described in Table 4-3.

Table 4-3. Mitigation measures and evaluation of their effectiveness

WOOLGOOLGA TO BALLINA | PACIFIC HIGHWAY UPGRADE: SECTIONS 1–11

Issue	Mitigation measure	History of success	Effectiveness rating
Impact to Koala habitat outside the construction zone.	<p>Identification of exclusion zones and limits of clearing.</p> <p>Revegetation of lands adjacent to the corridor post construction.</p>	<p>A standard procedure has been developed by Roads and Maritime and documented in the Biodiversity Guidelines for Construction (RTA 2011). The guidelines were developed in consultation with the NSW Office of Environment and Heritage (OEH) and subsequently by the NSW Environmental Protection Authority (EPA), NSW Department of Primary Industries (DPI) (Fisheries), biodiversity specialists and Roads and Maritime staff including project managers, construction personnel and designers. Consultation was facilitated through a number of workshops carried out in 2009. These procedures have been developed using knowledge gained from a long history of upgrades on the Pacific highway and other road projects in NSW.</p> <p>Temporary fencing around important fauna habitats (exclusion zones) has been used by Roads and Maritime on multiple highway upgrades including the Pacific Highway and Hume Highway for the past 20 years. It has become a standard procedure as part of the Construction Environment Management Plan (CEMP) and is inspected during construction. When combined with standard training of contractors it has become a highly effective measure at avoiding impacts to important habitats adjacent to construction areas.</p> <p>Landscape designs are a standard procedure used on all upgrades and have developed over the last three decades to include the use of locally indigenous plant species and a targeted approach to revegetation where required. This includes the provision of specific keystone species for fauna including Koala feed trees. It is particularly useful at crossing zones, to encourage fauna use of underpass and overpass structures.</p>	High
Potential impacts to Koalas within the project during clearing works.	<p>Pre-clearing and clearing procedures.</p> <p>Installation of temporary barrier fencing during construction including placement of escape points</p> <p>Koala relocation protocol.</p> <p>Managing Koala construction vehicle collisions during construction.</p>	<p>Guide 1: Pre-clearing procedures of the Roads and Maritime Biodiversity Guidelines (RTA 2011) outline the process to be followed prior to clearing works. The objective of this guide is to provide guidance for the pre-clearing process that would be conducted before any clearing takes place to minimise the impact on native flora and fauna. If fauna is within the identified limits of clearing an ecologist would capture and/or remove the fauna that have the potential to be disturbed, injured or killed as a result of clearing activities. Guide 8: Fauna handling would be followed for the capture and release of fauna.</p> <p>Specifically for the Koalas refer to Section 6.3.6 in this plan for a description of the Koala relocation protocol.</p> <p>The use of ecologists and licensed wildlife carers has been used on Pacific Highway projects over the last 10 years to successfully capture and relocate fauna. Temporary exclusion fencing has also been used on all Pacific Highway upgrade over the last 10 years to exclude fauna from the construction works along the highway upgrade.</p>	Moderate – High. Monitor success and implement corrective actions
Domestic dogs brought on site by contractor could lead to dog attack	CEMP to document dog policy.	A prohibition of dog's policy is implemented as a standard procedure part of the CEMP process and has been used on multiple upgrades on the Pacific Highway including the Bonville and Kempsey upgrade where Koalas were important issues. This policy has ensured that no domestic dogs are brought onto the site by construction contractors and is monitored throughout the construction period with consequences for contractors who bring dogs to the site.	High
Potential impact to Koala habitat when siting ancillary facilities.	Locate ancillary facilities and access roads in disturbed and cleared areas.	<p>Roads and Maritime <i>Stockpile Site Management Procedures</i> (RTA 2011).</p> <p>The siting of temporary construction related infrastructure is to be sited where possible within existing cleared or disturbed areas. This approach can substantially reduce the overall area of impact to vegetation and fauna habitat, while also reducing the area required to be rehabilitated at the end of construction.</p>	High

<p>Disruption to Koala movements and gene flow.</p> <p>Koala vehicle collisions on the highway.</p>	<p>Fauna crossing structures – underpasses, including refuge poles and furniture</p> <p>Fauna crossing structures – overpasses (land bridges), including refuge poles.</p> <p>Installation of permanent fauna exclusion fencing.</p> <p>Maintenance of fauna exclusion fencing.</p>	<p>Targeted crossing structures for Koalas have been used on multiple projects in Australia with high level of success. Roads and Maritime undertook monitoring of the vegetated median and rope bridge for the Bonville underpass in 2010 (SES 2010). This monitoring found that the underpasses were being used by Koalas, but only rarely during the first few years of the project (AMBS 2011).</p> <p>A review of the usage of fauna passage structures was undertaken for Roads and Maritime in 2009 (Roads and Maritime 2009). This report found that Koalas have been recorded in fauna tunnels and box culverts. Specifically this study found that:</p> <ul style="list-style-type: none"> • Koalas were using box culverts within the Yelgun to Chinderah and Brunswick Heads sections. • Within the Yelgun to Chinderah section the purpose-built fauna tunnel in the Taree section was also being used. • The culverts successful in attracting Koalas were united by their close proximity to quality vegetation. • The Koala may require time to acclimatise to the presence of the road and the underpass structures (AMBS 2011). Alternatively, it may be necessary for vegetation to regenerate before a Koala is comfortable moving over land. • Koalas were recorded in culverts with and without internal poles and logs. Although the sample sizes were too small to comment on whether culverts with poles were more successful than those without. <p>Permanent fauna exclusion fencing has been used on multiple sections of the Pacific Highway to exclude fauna and direct to crossing points. An investigation of the impact of roads on Koalas was undertaken in 2011 for Roads and Maritime (AMBS 2011). Some of the findings from the study include that:</p> <ul style="list-style-type: none"> • Most Koalas killed by vehicle collisions on the highway are not the local roadside residents but appear to be sub-adults dispersing and perhaps old, weak animals displaced from their former home-ranges away from the highway. Consequently the impact of road-kill affects a wider section of the population. • The genetic variation in roadside Koalas in the Yelgun to Chinderah and Bonville study areas prior to the upgrades was relatively high and had apparently not been impacted by the long existence of the Pacific Highway • Construction activities in the two study areas directly led to only one known death, suggesting that the direct impacts of clearing and construction are relatively minor at a population scale (when appropriate mitigation strategies are in place). • Floppy-top' fauna exclusion fencing can be very effective at reducing the rate of road-killed Koalas, but gaps and other weaknesses (including side-roads) have to be eliminated, and fences that end at the forest edge are likely to be not as effective as those that extend beyond the forest. • Underpasses (both constructed culverts and 'natural' underpasses such as gullies) can work in providing safe dispersal routes for Koalas to cross the highway. Other studies have recorded Koalas using underpasses in NSW including at the Brunswick Heads bypass, Bulahdelah to Coolongolook section of the Pacific Highway, Taree section of the Pacific Highway upgrade and a culvert near Brunswick Heads (Taylor and Goldingay 2003). • Recommended that clearing activities be undertaken outside the Koala breeding and dispersal period during future road constructions. • Other sources of mortality (e.g. <i>Chlamydia</i>) can be much higher in roadside Koalas than road mortality <p>Roads and Maritime routinely conducts maintenance on exclusion fencing along the Pacific Highway both as a standard procedure and in response to a breach in the fence or the discovery of significant numbers of fauna road kills.</p>	<p>Moderate – High, monitor success and implement corrective actions</p>
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WOOLGOOLGA TO BALLINA | PACIFIC HIGHWAY UPGRADE: SECTIONS 1–11

Increased noise and dust during construction impacting on Koala movements and behaviours.	Dust and noise managed in accordance with procedures in the CEMP	Roads and Maritime have developed standard procedures for dust and noise management on construction sites as part of the CEMP process with a long history of success as reported in auditing reports.	High
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4.5 Section 10

As mentioned previously, the population of Koalas within Section 10 was the subject of a PVA. The PVA thoroughly investigated the potential impact of the road on the population, also taking into account implementation of a number of mitigation/management measures. The outcomes of the PVA have been used to guide the management measures contained within this Plan for the animals within this Section and are summarised below.

4.5.1 PVA results

Population projections from the PVA within the Ballina Koala Plan (BKP) showed a gradual decline in the Koala population over 50 years, with or without the proposed highway upgrade. With no road, the model predicted an approximately 41% decline in the population over the first 15 years. This population decline was a result of births not being adequate to offset deaths, regardless of the presence of the highway upgrade. The impact of the road was minimal and estimated to range between no effect and up to a 9.7% decline in the projected population size after 50 years.

It was shown that population projections could be improved substantially through management intervention, including through the provision of supplementary habitat (leading to a 0.5% increase in population size) and by a combination of approaches that result in reduced mortality (by four or eight animals per year, with diminishing benefit over time) and increased fecundity (by 20%), all of which could potentially increase the projected population by 257-404% over 50 years. Management measures aimed at increasing population fecundity, and/or reducing population mortality were identified as having the greatest potential to arrest the current steep decline in this population.

A key mitigation measure of the PVA included reducing the annual mortality of Koalas by an initial four (or up to eight) animals per year. This information was based on long-term road-kill data collected by the Lismore Friends of the Koala, which indicates that an average of 1.23 animals per year are killed on roads within the study area, although annual mortalities of 4-6 animals were considered more likely (Phillips *et al.* 2015). These authors observed six Koala mortalities caused by vehicle-strike during the six months of their field study, and at least 10 mortalities in 2015 (S. Phillips, *pers. comm.*

14/12/2015). Four main road-kill “hot-spots” were identified within the Project study area; the Pacific Highway, the Bruxner Highway, Wardell Road and Old Bagotville Road. The same long-term data set also showed that at least 1.64 Koalas were killed annually by predation by domestic dogs. This information suggested that there may be opportunities for management to reduce the numbers of “avoidable” Koala mortalities by four, or possibly up to eight, animals per year within the study area. These two scenarios of reducing annual mortality by four or eight were included because they represented likely achievable objectives that could be achieved by fencing known road-kill hotspots and by controlling local wild dog numbers. Implementation of management measures to address improving population-level fecundity would prove more challenging.

Figure 4-1 shows the PVA population projections for a number of the modelled scenarios. These scenarios are based on the Ballina Koala Plan and an addendum to the Ballina Koala Plan that was prepared by Dr Kavanagh, the author of the Ballina Koala Plan, at the request of the Department of Environment following submissions made to the Department of Environment by Dr Steve Philips and Dr Phillip Miller (Appendix L).

The six scenarios represented in Figure 4-1 are summarised as follows:

- Scenario 1 – base case – projected population with no road.
- Scenario 2 – projected population with impact from the road with mitigation measures such as connectivity structures, fully fenced highway and koala revegetation, but no additional population

wide mitigation that reduce mortality, and accounting for an initial loss of carrying capacity for five animals.

- Scenario 3 - projected population with impact from the road with mitigation measures such as connectivity structures, fully fenced highway, but no revegetation and no population wide mitigation measures, an initial (and lasting) loss of carrying capacity for 14 animals, and an immediate loss of 14 animals from the population.
- Scenario 4 – projected population with impact from the road with mitigation measures and population wide mitigation measures that result in reduced mortality of four Koalas per year every year.
- Scenario 5 – projected population with impact from the road with mitigation measures and population wide mitigation measures that result in reduced mortality of eight Koalas per year every year.
- Scenario 6 - projected population with impact from the road with mitigation measures such as connectivity structures, fully fenced highway and koala revegetation, population wide mitigation measures that result in a reduced mortality of four Koalas per year initially (Year 0), but where the reduced mortality decreases proportional to population size in subsequent years. Scenario 6 was considered to be the most accurate representation for the model as although it is agreed that the proposed mitigation measures can reduce mortality by at least four animals per year based on the current population size, as the population declines the number of individuals saved per year through the mitigation measures will decline proportional to the population size.

The predicted outcome for the population is approximately the same in each scenario resulting in a Koala population within the study area of approximately 40 animals by the end of 50 years. Scenarios 4, 5 and 6, including various assumptions regarding reducing mortality, and show a marked increase in the projected year 50 population size to at least 65.5 (Scenario 6) compared with scenarios that don't consider reduced mortality. Scenario 6 is based on a diminishing benefit compared with Scenarios 4 and 5 as it reduces mortality rates proportional to population size. Scenario 4 is based on the same reduction in mortality as Scenario 6 (four individuals a year through reduced road and dog kill), but the number each year is constant, and results in a population of 109 individuals in year 50. Scenario 6 is the counterfactual against which the population counts will be measured, that being that a measure of failure is a population that falls below the lower range estimate from Scenario 6 (195 in Year 5) (see Table 4-4).

These results led to the development of a management framework where TfNSW has committed to ensuring that no Koala road-kills occur as a result of this Project, and in doing so has committed to a fully-closed (fenced) highway along the corridor, integration of additional and enhanced connectivity structures, and the establishment of 130 ha of new habitat for the Koala adjacent to and within the vicinity of the Upgrade. In addition, TfNSW will undertake further work, such as fencing and installation of connectivity structures, at two known Koala hot-spots that occur on other roads that are adjacent to and interact with this Project (i.e. part of Wardell Road in the vicinity of the new highway, and part of the existing Pacific Highway north of Wardell to Coolgardie). The aim of these management measures is to achieve a reduction in Koala mortality in the order of 4-8 animals/year to arrest population decline as predicted by the PVA models. Scenario 6 is based on reducing mortality by four animals in the first year and then proportionally to population size in future years.

Long-term population monitoring has been included as an integral part of the management of the Koalas within this Section. The selection of specific monitoring objectives and targets was required to enable the success or otherwise of the monitoring and management mitigation measures to be determined. Population projections predicted by Scenario 6 were selected for this purpose. This was based on its consideration of an annual proportional benefit from reducing mortality by an initial four animals/year (which would be the case in a declining population); and it's more conservative estimate of reducing mortality by an initial four, rather than eight animals/year. This Scenario represents the minimum acceptable outcome of the PVA.

Extensive investigations into the type, location and frequency of Koala population monitoring have been undertaken as part of development of this Plan. These included a power analysis to determine the survey effort required to reliably produce population estimates that could detect the projected population declines (see Section 8.3 for details). Initial results indicated that the ability to detect the projected population decline only achieved a reasonable level of confidence (70%) after surveying approximately 50 sites, every six months for 15 years (the ability to reliably detect the projected decline in the population increases over time as data accrues). There was no capacity to increase survey effort above this level. While it is recognised that there are limitations to interpretation of population monitoring data prior to 15 years, it is also considered important to be able to assess (within a known order of magnitude) population changes prior to this time in order to implement adaptive management measures should they be required. As such, it was determined that the PVA population predictions for Scenario 6 at years 5, 10 and 15, and their associated confidence intervals would be used as the goals for population monitoring and management within Section 10 (Table 4-4).

Table 4-4. PVA projected population size at various time intervals for Scenario 6.

Year	Population size (number of Koalas)	Confidence interval (90%)
0	236	236- 236
5	234	195 - 276
10	219	147 – 272
15	207	104 - 262
50	66	24 - 135

Data from the systematic long term population monitoring will be used to determine whether recovery efforts and mitigation measures have been successful in arresting population decline and also assess how the Koala population is trending relative to the PVA predictions (see Section 8.2 for details).

The specific goals for management of Koalas within Section 10 include:

- Zero Koala mortality during construction and operation of the new road.
- Maintenance of habitat connectivity for Koalas across the Upgrade
- Reducing Koala mortality by an initial 4 animals/year and thus arresting population decline such that it is greater than the lower bound of the 90% confidence interval of the PVA Scenario 6 (195 at year 5, 147 at year 10 and 104 at year 15), which equates to a 1.2% decline over five years, 13.7% decline over 10 years and 27.3% decline over 15 years.

The subsequent management and monitoring program detailed within this Plan incorporates these mitigation measures in line with the aim of improving the overall viability of the Koala population by attempting to reduce Koala mortality where possible.

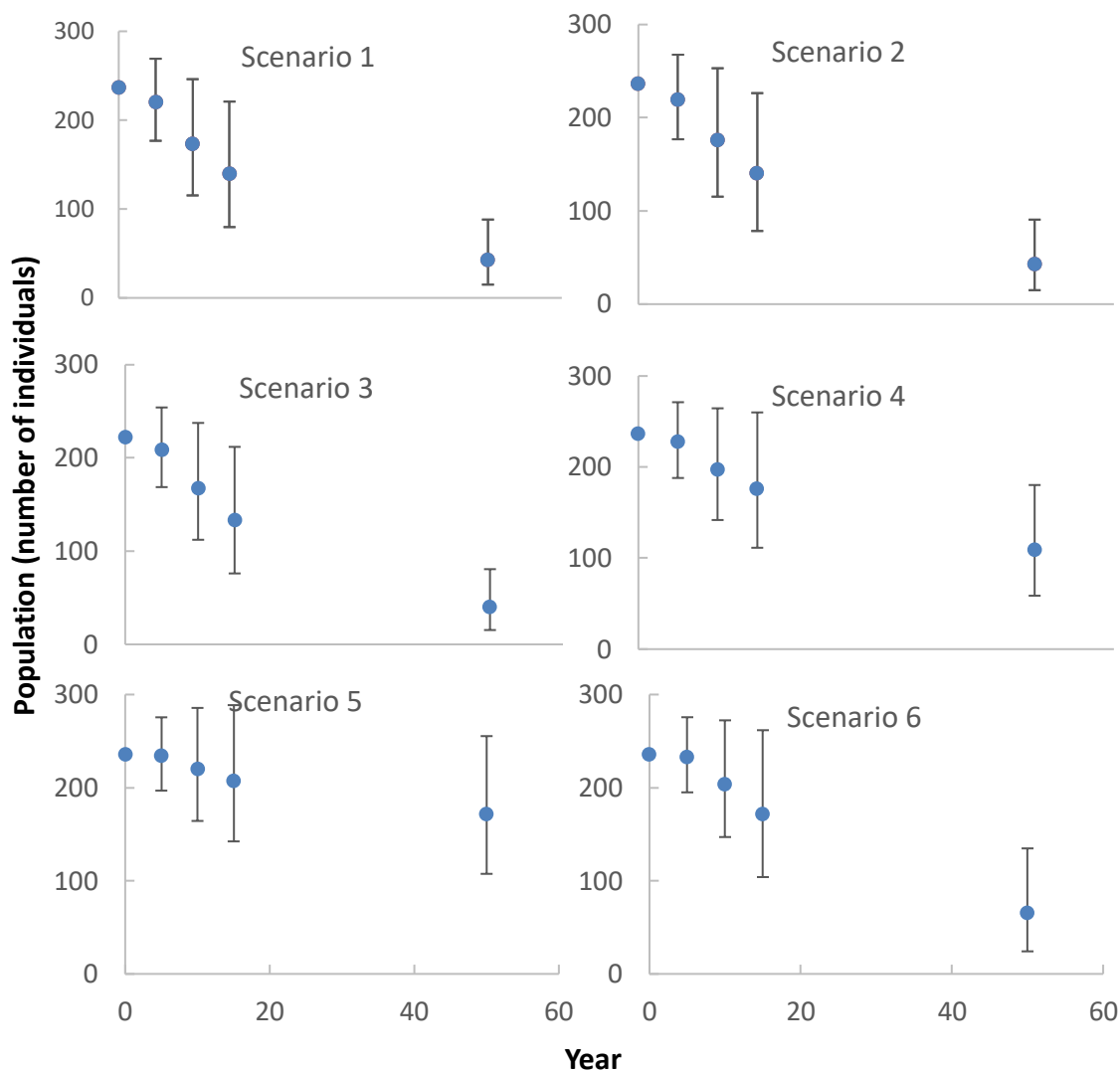


Figure 4-1. PVA population predictions for Scenarios 1-6

Error bars represent 90% confidence intervals. Scenario 6 is that against which population counts will be compared against.

4.6 Adaptive management approach

This management plan follows an adaptive management approach based on the identification of specific goals for management, implementation of management actions, followed by monitoring of the performance of these measures against the goals and identified thresholds. As a final step, the monitoring will evaluate the effectiveness of the management measures using identified thresholds for performance and implementing corrective actions to improve mitigation where required.

To ensure the success of this approach the management goals presented in the plan are based on the following SMART principles:

- **Specific.**
- **Measurable.**
- **Achievable.**
- **Results-based.**
- **Time-based.**

Details of the proposed Koala monitoring program for the entire project are described in Chapter 8 and include:

- Monitoring the use of crossing zones and crossing structures by Koalas during the construction and operational phases.
- Monitoring road-kill and thus the effectiveness of roadside fencing in excluding Koalas from the road corridor and in directing Koalas to crossing zones.
- Monitoring the success and utilisation by Koalas of habitat revegetation works (mainly in Section 10).
- A comprehensive Koala population monitoring program for Sections 8 (part), 9 and 10.

The level of monitoring intensity varies across each Section as a function of differences in animal density and potential impacts of the road. These issues are discussed in detail below.

Monitoring procedures for Koalas in Sections 1-8 and 11 of the highway upgrade are primarily limited to assessments of the effectiveness of the road crossing structures, the effectiveness of fauna exclusion fencing, the frequency and distribution of Koala road kills, and the use of restored (revegetated) habitat by Koalas. Monitoring procedures for Section 9 and 10 include all the above but include additional, long-term population monitoring.

5. Pre-construction management measures

5.1 Potential impacts during pre-construction phase

- Location of infrastructure within ancillary facility sites, including heavy vehicle access, geo-technical investigations, utility adjustments/relocation and property adjustments may impact on Koala habitat, movements, and foraging behaviour.

5.2 Main goals for management

- Koala fencing strategy as required by MCoA D2 Connectivity Strategy be completed prior to the commencement of construction (Note: does not include “floppy top” fencing in Sections 1-4 and Sections 6 (part)-8 and 11).
- Koala floppy top fencing or similar Koala specific fencing to protect the Woombah-Iluka (Section 5), Broadwater (Section 9) and Coolgardie-Bagotville (Section 10) populations.
- No impact to Koala habitat outside designated clearing areas and the project boundary.
- No Koala deaths from contractor domestic dogs on the project.

5.3 Management measures

Details on the site specific mitigation measures for Koalas to be implemented during the pre-construction phase are detailed in the following section and summarised in Table 5-2. Mitigation measures, performance measures and corrective actions - pre-construction.

5.3.1 Fauna fencing

The majority of the Woolgoolga to Ballina Pacific Highway Upgrade will be fenced on both sides to protect wildlife from collisions with motor vehicles. The Fencing Strategy, as required by MCoA D2 Connectivity, has not been finalised but there are a number of fence-types proposed for use along different sections of the road depending on the likelihood of occurrence of fauna species (Table 5-1). Fence types that are most relevant to the protection of Koalas include:

- Koala – Chain-wire floppy-top fence approximately 1.8 m high with galvanised steel posts, wire netting 1.5 m high fence with metal sheeting attached near the top, colourbond fence 1.3m high
- Mammal – Modified rabbit-proof fence 1.2 m high with 800 mm of galvanised steel wire netting and concrete or steel posts
- Emu - Modified rabbit-proof fence 1.5 m high with 1200 mm of galvanised steel wire netting and concrete or steel posts

Each fence type can be modified for Phascogales and Koalas by retro-fitting with smooth galvanised metal sheeting, 600 mm wide, placed near the top of the fence. The general mammal fence is likely to provide a barrier to the occasional Koala that may be encountered within the low density populations that occur along most of the length of the Highway Upgrade. However, if any Koala deaths or injuries are recorded, these fences will be retro-fitted with smooth metal sheeting to prevent any access by Koalas.

Sections 1 and 2

Fauna fencing type and location has been completed as part of the detailed design for Section 1 and Section 2 and is detailed in the Connectivity Strategy for these sections. “Floppy top” Koala fencing is not proposed for use in Section 1 and Section 2 because of the low population density of animals. Instead, a modified rabbit-proof fence will be installed that can be retro-fitted with smooth metal sheeting if any Koala deaths or injuries are recorded. These assessments have been undertaken following consultation with biodiversity specialists in EPA/OEH. The Connectivity Strategy provides detail on fence types and specific locations for fencing, as well as placement of escape points (for instances where fauna become trapped in the road corridor). However, recent research presented at Australian Network of Ecology and Transportation 2014 conference found that these escape points were being used by a variety of fauna groups to access the highway rather than escape from it (Taylor and Goldingay 2014). Further consultation with EPA (December 2014) recommended that “fauna drop downs” rather than “escape poles” be used in Sections 1 and 2, due to the low number of Koala records. The EPA specified that these drop downs be designed with 1200 mm clearance down the front, and that drop downs be placed close to entry nodes and less frequently (at notional 500 m intervals) further away from entry roads. The EPA acknowledged that escape points are a vital design feature of four-lane highways, and that further research is required to improve the efficiency of designs. The current Connectivity Strategy for Section 1 and 2 includes 1200 mm escape drop downs at all dedicated and combined fauna crossing culverts. The Section 2 re-use area will also include fauna drop down structures to allow for fauna to access the underpasses rather than going back across the northbound carriageway.

Details of the fauna fencing locations for Section 1 and Section 2 are shown in the Connectivity Strategy (2014).

Sections 3- 11

Detailed design of fauna fencing types has not yet been completed for Sections 3-11, but the fence-types proposed are listed in Table 5-1. Koala floppy-top fencing is not proposed for use in Sections 3-8 (excluding Woombah-Iluka Koala population area) because of the low population density of animals in these areas. Instead, a range of other fencing types will be employed along the entire length of these Sections (Table 5-1). The southern part of Section 3 (from chainage 35000 – 40000), where a large number of old Koala records occur, will be protected using ‘Phascogale’ fencing (i.e. Mammal fence with 600 mm galvanised steel panel near the top) that will also provide a barrier to Koala movement onto the road. Koala floppy-top fencing will be installed from chainage 94700 - 97200 in Sections 5-6 to protect the Woombah-Iluka population. Floppy-top fencing is also proposed for the Sections 8 (part), 9 (Broadwater), 10 (Coolgardie-Bagotville) and the southern end of Section 11 because of the greater population density of Koalas occurring there.

As described above for Sections 1 and 2, a modified rabbit-proof fence will be installed along many parts of Sections 3-4 and 6-8 and 11 that will be retro-fitted with smooth metal sheeting if any Koala deaths or injuries are recorded. Particular segments along the upgrade will also have fencing that is targeted to limit movements onto the highway by other fauna species (Table 5-1). For example, the 1.5 m high mesh fence proposed for Sections 3 and 4 targeting Emus will also act as a significant barrier for Koalas.

Table 5-1. Indicative locations of fauna fencing in Sections 3-11

Chainage (m)	Fencing type
33800 – 34200	W2G general fauna fence
34200 – 35000	Frog fence
35000 – 35200	Combined mammal/ frog /Phascogale fence
35200 – 36100	Mammal /Phascogale fence

Chainage (m)	Fencing type
36100 – 38250	Combined mammal/ frog /Phascogale fence
38250 – 38300	Combined emu/ mammal/ frog /Phascogale
38300 – 40000	Combined emu/ mammal /Phascogale fence
40000 - 47800	Combined emu / mammal fence
47800 - 52300	Combined emu/ mammal /Phascogale fence
52300 – 53500	Combined emu / mammal fence
53500 - 56300	Combined emu/ mammal /Phascogale fence
56300 - 58000	Combined emu / mammal fence
58000 - 61000	Combined emu/ mammal /Phascogale fence
61000 - 63000	Combined emu / mammal fence
63000 - 64200	Combined emu/ mammal /Phascogale fence
64200 - 65100	Combined emu/ mammal/ frog /Phascogale
65100 - 66700	Combined emu/ mammal /Phascogale fence
66700 - 74350	Combined emu / mammal fence
74350 – 75215	Shark Creek bridge
75125 - 80000	Combined emu/ mammal fence
80000 – 82000	Mammal fence
82000 – 82500	W2G general fauna fence
82500 – 85900	Mammal fence
85900 – 87260	Clarence River bridge
87260 – 89320	Standard highway fencing
89320 – 89415	Serpentine Channel
89415 – 94000	Standard highway fencing
94000 – 94190	Clarence River North Arm
94190 - 94700	Standard highway fencing
94700 – 95200	Koala fencing
95200 – 95800	Combined Koala/ frog fencing
95800 – 97900	Koala fencing
97900 – 98000	Combined Koala / mammal fencing
98000 - 101700	Combined mammal /Phascogale fence
101700 - 101900	Combined mammal /Phascogale fence
101900 - 102000	Phascogale fencing
102000 – 102100	W2G general fauna fencing
102100 – 102600	Frog fencing
102600 – 111000	W2G general fauna fencing
111000 - 111600	Phascogale fencing
111600 – 111800	Mammal / Phascogale fencing
111800 – 112100	Combined mammal/ frog fencing
112100 – 118100	Mammal fencing
118100 – 118600	Mammal Fencing
118600 – 122200	Mammal fencing
122200 - 122600	Mammal / Phascogale fencing
122600 – 123800	Mammal fencing
123800 – 124200	Mammal / Phascogale fencing
124200 - 127000	Mammal fencing

Chainage (m)	Fencing type
127000 - 128400	Mammal / Phascogale fencing
128400 - 129000	Phascogale fencing
129000 – 130100	W2G general fauna fencing
130100 – 130250	Tuckombil Canal
130250 - 134100	W2G general fauna fencing
134100 – 137800	Koala fencing
137800 – 139400	Combined Koala/ mammal fencing
139400 – 139600	Combined Koala/ mammal/ frog fencing
139600 – 139900	Combined Koala/ mammal fencing
139900 – 140100	Combined Koala/ mammal/ frog fencing
140100 – 141000	Combined Koala/ mammal fencing
141000 – 142800	Koala fencing
142800 – 145120	Combined Koala/ mammal fencing
145120 – 146100	Koala fencing
146100 – 148300	Combined Koala/ mammal fencing
148300 – 148750	Combined Koala/ mammal/ frog fencing
148750 – 159700	Combined Koala/ mammal fencing
159700 – 160700	Koala fencing
160700 – 164000	Mammal – western side of alignment
160700 - 164000	Standard highway fencing – Eastern side of alignment

5.3.2 Commence baseline surveys

No baseline surveys for Koala population size and distribution are proposed for Sections 1-8, and 11 due to the low population density of animals in these locations.

Baseline Koala surveys have focused on key Koala populations identified in Sections 8/9 and 10 of the Project and were undertaken by Ecosure (2014) for the Broadwater Population and Ecosure-Biolink for the Bagotville population (2015). These are provided in Appendix E and Appendix F respectively.

5.3.3 Identify exclusion zones

An exclusion zone is a designated 'no-go' area that is clearly identified and appropriately fenced to prevent damage to native vegetation and fauna habitat. This procedure is documented in the CEMP and conducted along the entire construction corridor for all threatened species and endangered ecological communities.

Habitat exclusion zones and limits of clearing will include consideration of Koala habitat. Habitat exclusion zones will be marked out during the on-ground survey of the road corridor and the commencement of construction to ensure that these activities, including vehicles and machinery, do not intrude or remove protected and roadside vegetation in Koala habitat areas.

The identification of exclusion zones may be staged with a priority for early works sites and then remaining areas of the construction corridor. Survey personnel will be inducted to ensure they do not encroach outside the limits of clearing.

5.3.4 Identify sensitive ancillary areas and access roads

The siting of ancillary areas including stockpiles and construction infrastructure is planned to be located within cleared areas and disturbed vegetation and undertaken in accordance with NSW CoA B73, B74 and B75. This will occur across all ancillary sites for each stage of the project and will be documented in the CEMP. The procedure will avoid direct and indirect impacts to Koala habitat. All clearing will be monitored during the construction phase. Detailed plans will be prepared showing the proposed construction activities and the location of infrastructure prior to commencement of clearing. Development of ancillary facility plans will ensure there is no impact on primary or secondary Koala habitat or vegetated areas.

5.3.5 Dog policy

The CEMP includes a policy that no domestic dogs are to be brought onto the site during pre-construction and construction activities. All project personnel will be inducted as part of the CEMP.

5.4 Performance thresholds and corrective actions

Table 5-2 summarises the pre-construction environmental planning measures for Koalas that will be completed prior to the commencement of construction.

Table 5-2. Mitigation measures, performance measures and corrective actions - pre-construction.

Main goals for mitigation	Proposed mitigation measure	Monitoring/timing frequency	Performance thresholds	Corrective actions if deviation from performance thresholds
Fencing Strategy (as part of the Connectivity Strategy) completed prior to construction commencing.	Detail location of temporary and permanent fencing, encourage use of crossing points and direct Koalas from the road corridor.	Connectivity Strategy to be completed prior to construction commencing.	Connectivity Strategy and associated fencing locations signed off as complete at end of design.	Delay construction until Connectivity Strategy has been completed.
No impact to Koala habitat outside designated clearing areas and the project boundary.	Identification and appropriate fencing/marketing of exclusion zones.	Identify clearing limits prior to clearing works. Inspection prior to clearing report in the CEMP to be signed off.	Exclusion fencing signed off at start of clearing.	Do not commence clearing, hold-off work and complete.
No impact to Koala habitat outside designated clearing areas and the project boundary.	Ancillary facilities and access roads to be planned and sited within cleared or disturbed areas within the project boundary and in accordance with NSW CoA B73, B74 and B75.	Ongoing during construction phase. Detailed plans to be prepared showing the proposed location of construction related infrastructure prior to commencement of clearing and construction activities during the construction phase.	Ancillary facility plans ensure there is no impact on primary or secondary Koala habitat and vegetated areas.	Amend locations until all known and potential Koala habitat that is not scheduled for removal is avoided.
No Koala deaths from contractor's domestic dogs on the project.	CEMP to document policy that prohibits dogs being brought onto the construction site.	Ongoing during construction.	No domestic dogs found on site belonging to construction personnel.	Any breach of the policy to be reported to Roads and Maritime and ER, with contractors warned that further breaches would require removal from the project.

6. Construction management measures

6.1 Potential impacts during construction

- Impacts during clearing of vegetation.
- Koalas entering the construction corridor and becoming trapped in the corridor.
- Koala vehicle collisions with construction traffic.
- Disturbance and degradation to adjoining Koala habitat.
- Dust and noise impacting on movements and habitat use.

6.2 Main goals for management

- No injuries to Koalas during clearing of vegetation.
- No injuries to Koalas during construction as a result of any construction related activity including Koala/construction vehicle collisions.
- No damage to Koala habitat within exclusion zones during construction.
- Dust and noise managed in accordance with the CEMP.
- Replanting of Koala habitat adjacent to the road corridor completed as per landscape design.
- Maintenance of habitat connectivity for Koalas across the Upgrade
- Section 10 - reducing Koala mortality by an initial 4 animals/year and thus arresting population decline such that it is statistically slower than the lower bound of the 90% confidence interval of the PVA Scenario 6 (195 at year 5, 147 at year 10 and 104 at year 15), which equates to a 1.2% decline over five years, 13.7% decline over 10 years and 27.3% decline over 15 years.).

6.3 Management measures

6.3.1 Construction work method statements

Construction Work Method Statements are prepared for specific activities to ensure sound environmental practices are implemented and to minimise the risk of environmental incidents or system failures.

Construction Work Method Statements will be prepared to address all construction Koala management requirements during construction in consultation with relevant agencies, Roads and Maritime Services and the relevant project environmental manager prior to the commencement of project activities considered to present risk to the Koala. Construction Work Method Statements will be prepared to ensure that all Koala management measures are implemented.

6.3.2 Construction induction and training

Induction training will be conducted 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.

6.3.3 Temporary Koala exclusion fencing

Temporary fencing will be erected along either side of the existing highway alignment that is adjacent/parallel to construction and clearing works within the locality of the key populations in Section 5, Section 8 (part), Section 9 and Section 10. This will be done to minimise the risk of Koalas being hit by highway traffic during vegetation clearing works, prior to establishment of permanent fencing along

these areas. The fence will be set back on each side of the road corridor by several metres so that if an animal becomes trapped between the fences it will not be on the road edge. Where this is not possible temporary escape structures must be used. The temporary fence should also extend past the northern and southern limits of the construction zone to funnel any Koalas away from the clearing/construction areas. Where there is a gap in the temporary fence for access off the existing highway, a Koala grid will be installed and the temporary fencing will be tied into the grid. The temporary Koala fencing will remain in place for the duration of all clearing works until the permanent Koala exclusion fencing is erected within these areas.

6.3.4 Permanent fauna exclusion fencing

Permanent fauna exclusion fencing, using a range of designs, will be installed along the majority of the length of the Woolgoolga to Ballina Pacific Highway Upgrade (Table 5-1). Sections 1-8 (excluding the Woombah-Iluka Koala population) and 11 have relatively low Koala population densities and, as such, typical floppy-top fencing used for Koalas will not be applied to these Sections. Instead, a modified rabbit proof fence (Mammal fencing; Table 5-1) has been developed which is a minimum 1200 mm high mesh fence pegged into the ground and supported with concrete posts. This fence-type is expected to act as a barrier to deter any occasional Koalas that may encounter it. In developing this fence design, extensive consultation was undertaken with biodiversity specialists from the EPA. If any Koala injuries or road kills occur during the operation of Sections 1-8 and 11, this fence, or parts thereof, will be retro-fitted with 600 mm wide smooth metal sheeting placed near the top of the fence as an additional deterrent to Koalas.


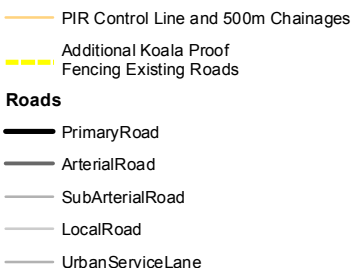



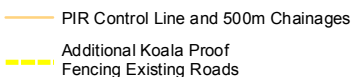
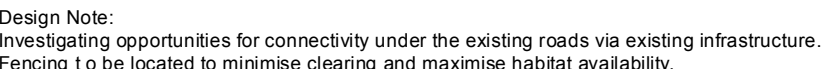
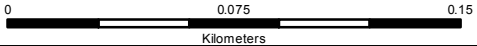
Koala “floppy-top” or similar Koala specific fauna fencing will be installed on both sides of the highway within the three key population areas occupied by the Woombah-Iluka, Broadwater and Coolgardie-Bagotville Koala populations (i.e. Sections 5, 8-9 and 10). Progressive installation of permanent Koala-proof fencing in these areas will connect to the new connectivity structures as they are built.

In addition, permanent Koala fencing will be installed on other roads within Section 10, including on parts of the existing Pacific Highway north of Wardell to Coolgardie interchange and on parts of Wardell Road either side of its crossing with the upgraded highway in Section 10, in accordance with the Ballina Koala Plan. Koala-proof fencing will be installed prior to the commencement of clearing activities adjacent to the existing highway and Wardell Road. The location of permanent Koala fencing to be installed along the existing highway and Wardell Road is shown in Figure 6-1- Figure 6-6.

Fencing along parts of Wardell Rd and the existing highway from Wardell to Coolgardie Interchange, has the potential to create a barrier effect for Koalas and other fauna. Roads and Maritime proposes to build a connectivity structure on either side of the Wardell Rd overpass, as well as an additional connectivity structure approximately 300 metres east of the new alignment along Wardell Road. This connectivity structure, located between the township of Wardell and the upgrade, will be installed in recognition of the need to provide connectivity between the heath habitat on the northern and southern sides of Wardell Road for the Koala and also the threatened Long Nosed Potoroo. The location of the connectivity structure along Wardell Road is shown in Figure 6-2. A connectivity structure already exists on the existing highway south of the Coolgardie interchange (three cell culvert x 16 metres long x 2.2 metres high x 2.8 metres wide) and Roads and Maritime propose to build a connectivity structure on the northern side of the Coolgardie interchange (see location of structure on Figure 6-6).

Figure 6-1. Location of additional permanent Koala fencing - Wardell Road



 Transport Roads & Maritime Services	Koala Management Plan Additional Fencing Wardell Road West					1:2,500 at A3
	Section 10 Chainage: 145 100 to 158 600					Print Date: 5/05/2016
	Map 1 of 6				Author: SPALDINC	

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Figure 6-2. Location of additional permanent Koala fencing – Wardell Road




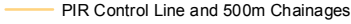
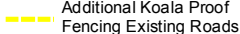



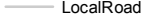
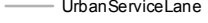
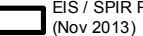

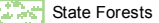



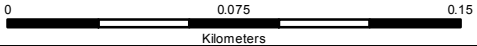



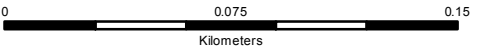
 Transport Roads & Maritime Services	Koala Management Plan Additional Fencing Wardell Road East	 PIR Control Line and 500m Chainages  Additional Koala Proof Fencing Existing Roads Roads  Primary Road  Arterial Road  Sub Arterial Road  Local Road  Urban Service Lane	 EIS / SPIR Project Boundary (Nov 2013)  Cadastral  State Forests  NPWS Reserves Design Note: Investigating opportunities for connectivity under the existing roads via existing infrastructure. Fencing to be located to minimise clearing and maximise habitat availability.		 1:2,500 at A3  0 0.075 0.15 Kilometers Print Date: 5/05/2016 Author: SPALDINC <small>Map produced by Pacific Complete in partnership with RMS Map data copyright 2015 Roads & Maritime Services, NSW. Spatial data used under licence from Land and Property Management Authority, NSW © 2015. Roads & Maritime Services makes no representations or warranties of any kind about this map product's accuracy, reliability, completeness or suitability for any particular purpose. Roads and Maritime Services disclaims all responsibility and all liability for the full amount of all expenses, losses, damages, costs and injury which may be suffered by any person in connection with, or arising out of, the use of this map product.</small>
	PACIFIC HIGHWAY UPGRADE <i>Woolgoolga to Ballina</i>	Section 10 Chainage: 145 100 to 158 600 Map 2 of 6			

Figure 6-3. Location of additional permanent Koala fencing – Wardell Road



 Transport Roads & Maritime Services	Koala Management Plan Additional Fencing Wardell Road East	<div><div><div>— PIR Control Line and 500m Chainages</div><div>— Additional Koala Proof Fencing Existing Roads</div></div><div>Roads<div><div>— PrimaryRoad</div><div>— ArterialRoad</div><div>— SubArterialRoad</div><div>— LocalRoad</div><div>— UrbanServiceLane</div></div></div><div><div><div>EIS / SPIR Project Boundary (Nov 2013)</div><div>Cadastre</div><div>State Forests</div><div>NPWS Reserves</div></div><div>Design Note: Investigating opportunities for connectivity under the existing roads via existing infrastructure. Fencing to be located to minimise clearing and maximise habitat availability.</div></div></div>			1:2,500 at A3
	Section 10 Chainage: 145 100 to 158 600				Print Date: 5/05/2016
	Map 3 of 6			Author: SPALDINC	

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Figure 6-4. Location of additional permanent Koala fencing – existing highway




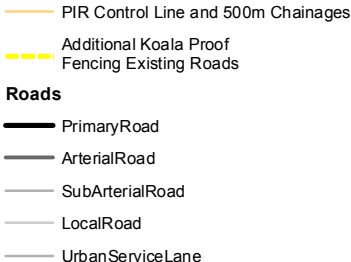




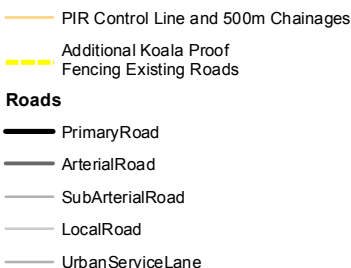



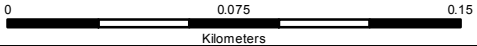
 Transport Roads & Maritime Services	Koala Management Plan Additional Fencing Wardell to Coolgardie Rd	 <p>Roads</p> <ul style="list-style-type: none">Primary RoadArterial RoadSub Arterial RoadLocal RoadUrban Service Lane	 <p>EIS / SPIR Project Boundary (Nov 2013)</p> <ul style="list-style-type: none">CadastreState ForestsNPWS Reserves	<p>Design Note: Investigating opportunities for connectivity under the existing roads via existing infrastructure. Fencing to be located to minimise clearing and maximise habitat availability.</p>		 <p>1:2,500 at A3</p> <p>0 0.075 0.15 Kilometers</p> <p>Print Date: 5/05/2016</p> <p>Author: SPALDINC</p> <p><small>Map produced by Pacific Complete in partnership with RMS. Map data copyright 2015 Roads & Maritime Services, NSW. Spatial data used under licence from Land and Property Management Authority, NSW © 2015. Roads & Maritime Services makes no representations or warranties of any kind about this map product's accuracy, reliability, completeness or suitability for any particular purpose. Roads and Maritime Services disclaims all responsibility and all liability for the full amount of all expenses, losses, damages, costs and injury which may be suffered by any person in connection with, or arising out of, the use of this map product.</small></p>
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Figure 6-5. Location of additional permanent Koala fencing – existing highway



 Transport Roads & Maritime Services	Koala Management Plan Additional Fencing Wardell to Coolgardie Rd	 Roads Primary Road Arterial Road Sub Arterial Road Local Road Urban Service Lane	 EIS / SPIR Project Boundary (Nov 2013) Cadastre State Forests NPWS Reserves			1:2,500 at A3
	Section 10 Chainage: 145 100 to 158 600					
	Map 5 of 6	Print Date: 5/05/2016 Author: SPALDINC				


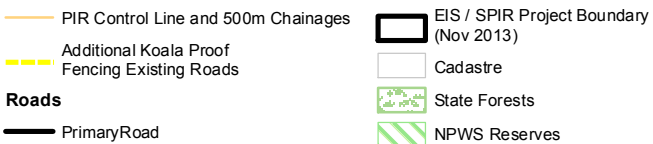


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Figure 6-6. Location of additional permanent Koala fencing – existing highway



SECTION 10

Existing Fauna Connectivity structure approximately 100 meters north of arrow

 Transport Roads & Maritime Services	Koala Management Plan Additional Fencing Wardell to Coolgardie Rd	 <p>PIR Control Line and 500m Chainages</p> <p>Additional Koala Proof Fencing Existing Roads</p> <p>Roads</p> <ul style="list-style-type: none">PrimaryRoadArterialRoadSubArterialRoadLocalRoadUrbanServiceLane <p>EIS / SPIR Project Boundary (Nov 2013)</p> <p>Cadastre</p> <p>State Forests</p> <p>NPWS Reserves</p> <p>Design Note: Investigating opportunities for connectivity under the existing roads via existing infrastructure. Fencing to be located to minimise clearing and maximise habitat availability.</p>	 <p>Casino, Wardell, Ballina, Woodburn, Broadwater, Harwood, Tyndale, Maclean, Grafton, Wooli, Woolgoolga</p>	 <p>1:2,500 at A3</p> <p>0 0.075 0.15 Kilometers</p> <p>Print Date: 5/05/2016</p> <p>Author: SPALDINC</p> <p><small>Map produced by Pacific Complete in partnership with RMS. Map data copyright 2015 Roads & Maritime Services, NSW. Spatial data used under licence from Land and Property Management Authority, NSW © 2015. Roads & Maritime Services makes no representations or warranties of any kind about this map product's accuracy, reliability, completeness or suitability for any particular purpose. Roads and Maritime Services disclaims all responsibility and all liability for the full amount of all expenses, losses, damages, costs and injury which may be suffered by any person in connection with, or arising out of, the use of this map product.</small></p>
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6.3.5 Pre-clearing and clearing procedures

Pre-clearing and clearing procedures will be outlined in the CEMP and FFMP, and will be undertaken in accordance with *Biodiversity Guidelines: Protecting and managing biodiversity on RTA Projects* (RTA 2011), in order to minimise impacts on flora and fauna.

Although Sections 1-8 and 11 have low density Koala populations, pre-clearing surveys would be conducted prior to the commencement of any vegetation clearing works to identify Koalas and other fauna within the construction corridor. The pre-clearing process targets all fauna habitat and is a requirement of the CEMP. Searches for signs of Koala activity and Koala presence will form a part of this process. The results of the pre-clearing process will inform planning and procedures for the staged habitat removal process and are documented as part of the FFMP.

The pre-clearing procedures detailed below were informed by the sequential vegetation clearing and requirements for clearing Koala habitat trees in Queensland (EPA 2006), and by subsequent discussions with a range of Koala experts and the NSW EPA.

Clearing procedures will also be informed by the Roads and Maritime unexpected finds procedures (RTA 2011) should a Koala be encountered in the construction corridor at any time during construction.

Clearing Procedure – all Sections

Specifically for Koalas in all Sections, clearing of trees will be undertaken in a way that ensures Koalas living in or near the clearing area have enough time to move out of the site without human intervention. In summary this involves:

- Staged clearing, i.e. sequential thinning or partial removal of trees in progressive stages, to allow Koalas to safely leave the clearing area and relocate to adjacent habitat.
- An ecologist will undertake daylight canopy search surveys of the scheduled clearing area prior to vegetation clearing (i.e. early in the morning prior to the commencement of vegetation clearing activities) to identify trees in which a Koala is present and any adjacent trees with overlapping crowns.
- Suspension of clearing works for a minimum period of 48 hours if a Koala is found within a clearing area to allow the animal to move out of the construction site on its own volition.
- The direction of sequential clearing will be away from threatening processes or hostile environments, i.e. roads. The ecologist is responsible for verifying that sequential clearing has taken place.
- Each tree identified by the 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 ecologist will physically move Koalas if necessary in accordance with *Biodiversity Guidelines: Protecting and managing biodiversity on RTA Projects* (RTA 2011).
- In the event that a Koala remains in the clearing site for more than 48 hours, it will be captured and relocated by a suitably qualified person to the nearest area of habitat identified as suitable for Koala release and where the individual is at no risk of further harm.

For Section 5, the northern portion of Section 8, Section 9 and Section 10 where the three key Koala populations are located, additional nocturnal spotlighting searches will be undertaken to maximise the likelihood of locating Koalas. These searches will be conducted in the two hours pre-dawn by an experienced ecologist on the day that clearing takes place. This will be followed by the procedure described above (i.e. daylight canopy searches on the morning of proposed clearing). It is considered that the combination of the two survey techniques on the day of clearing will ensure that no Koalas are missed, so that the chance of Koala mortality during clearing works can be minimised.

Section 10 also supports two known Koala ‘hot-spot’ areas: Laws Point (chainage 146000 – 147000) and Wardell Road (152200 – 153500) (Phillips *et al.* 2015). Additional pre-clearing and clearing measures will be undertaken within these areas in recognition of the relatively high likelihood that Koalas may be encountered, and in an effort to minimise any potential impacts to the animals located there. These measures are detailed below.

Phased Resource Reduction - Section 10: Koala ‘hot-spots’

In addition to the measures set out above, Roads and Maritime Services propose to undertake a staged approach to vegetation clearing, referred to as ‘phased resource reduction’,

Phased resource reduction involves the gradual reduction of food resources within Koala habitat (by ring-barking and/or collaring trees) to facilitate the safe and voluntary movement of Koalas into adjacent available habitat and avoid indirect deaths (FitzGibbon *et al.* 2013). Indirect deaths are those that may occur as a consequence of factors and/or ecological processes independent of the Project e.g. predation. It operates on the basis that by slowly reducing the availability of Koala food trees, the value of the habitat to resident Koalas will gradually decline. This will allow resident Koalas to vacate the clearing area over a period of time of their own accord, without human intervention, prior to clearing. The phased resource reduction methodology aims to reduce any stress-induced impacts on Koalas associated with clearing activities for the new highway alignment.

Because this strategy has not been adopted elsewhere, including in NSW by TfNSW, and in order to monitor the potential impacts on the Koalas as a result of this process, an intensive population monitoring program will be undertaken in the vicinity of the ‘hot-spots’, prior to, during and after clearing to monitor the effect of the works on any resident animals. The proposed phased resource reduction strategy is detailed below and the associated Koala monitoring strategy is detailed in Section 8.2. The monitoring process has been designed to be adaptive such that information gained during monitoring will be fed back into the resource reduction and clearing process.

The protocol involves installing collars on all trees within the proposed clearing footprint. All trees to be collared will be mapped and tagged at the beginning of the process, prior to collars being installed. Trees with hollows will also be mapped and tagged as collaring these trees may prevent fauna utilising them to vacate the tree (see below). Hard plastic, polycarbonate or metal sheeting will be placed as a sleeve (or ‘collar’) around the lower trunk of all Koala food trees and other significant shelter and resting trees in the clearing footprint area to prevent Koalas from using these resources and discouraging them from re-entering the clearing area. This will allow resident Koalas to vacate the clearing area over a period of time of their own accord, without human intervention, prior to clearing. The location of the Wardell Road and Laws Point Koala ‘hot-spots’, known food trees and proposed survey areas are shown on Figure 6-7.

In more densely forested areas, such as Laws Point, Koalas may move through the canopy of the trees to access collared food-trees. To minimise the chance of this occurring, in these areas, a percentage of trees that are identified to aid Koala movement through the canopy onto collared food trees will also be ring-barked to induce de-foliation. Ring-barking will require the complete removal of a section of the bark around the circumference of the tree trunk near ground level. It was suggested that this be trialled to assess the rate of de-foliation and to stop the Koalas utilising these trees (Sean FitzGibbon *pers. comm.* 10 June 2016). In order to trial this and also assess the rate of de-foliation, it is proposed that approximately 20% of trees within each hot-spot, that form continuous canopy with neighbouring food trees, be ringbarked. A tree will be deemed to be de-foliated once more than 90% of the leaves have fallen, wilted or dead.

The collars will be approximately 60 cm wide and placed between one and two metres off the ground. The distance of the collar from the ground will depend on whether Koalas have been detected utilising the tree or if there are hollows present where other arboreal fauna might be sheltering. If a Koala is in the tree and/or tree hollows are obvious then the collar will be placed lower (approximately one metre from the ground) to allow safe descent from the trees. If there are no obvious hollows or no Koalas detected, the collar will be placed higher (at least 1.7 metres off the ground) to allow animals to climb the tree and gain temporary refuge from terrestrial predators if required. This height has been found to be a sufficient perch height for common fauna, such as reptiles, fleeing approaching predators (Cooper and Blumstein 2015). If a tree is collared that contains a Koala it will be monitored to ensure the Koala has been able to leave the tree of its own accord. If after 48 hours the Koala has not moved from the tree the collar will be removed and not reinstalled until the Koala has moved on.

Trees will be collared sequentially over a period of approximately six weeks prior to commencement of clearing, with the aim of collaring the majority (80%) of Koala food and shelter trees in each of the Laws Point and Wardell Road Koala hot spot locations, within the first four weeks, and the remaining 20% two weeks after that, such that by the end of six weeks all trees will have been collared/ring-barked. This will allow for three weeks prior to clearing occurring for further monitoring of these hot spot areas for koala activity to determine if additional mitigation (such as installation of additional tree collars in the adjacent habitat) is necessary. The proposed phased resource reduction schedule is shown in Table 6-1.

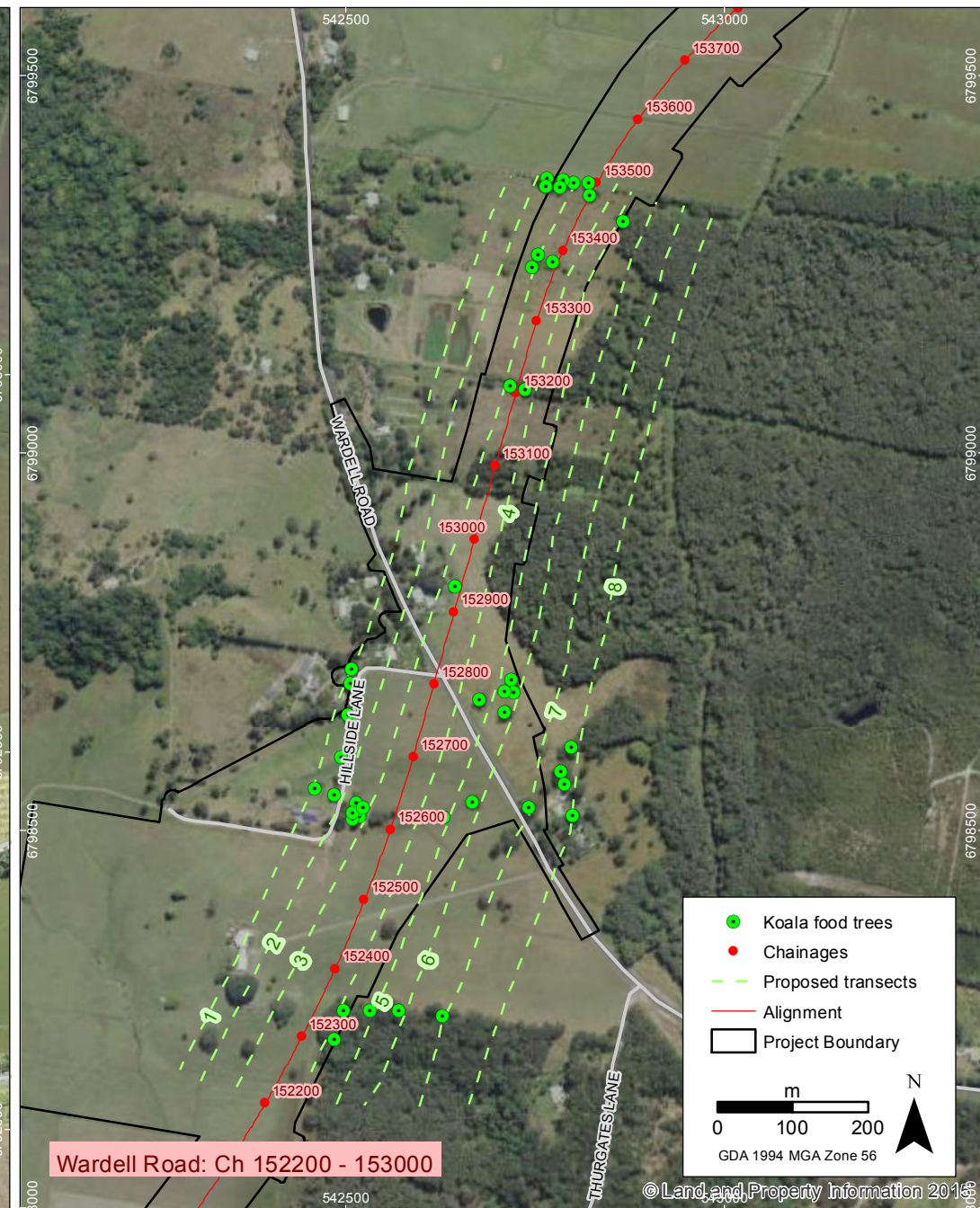
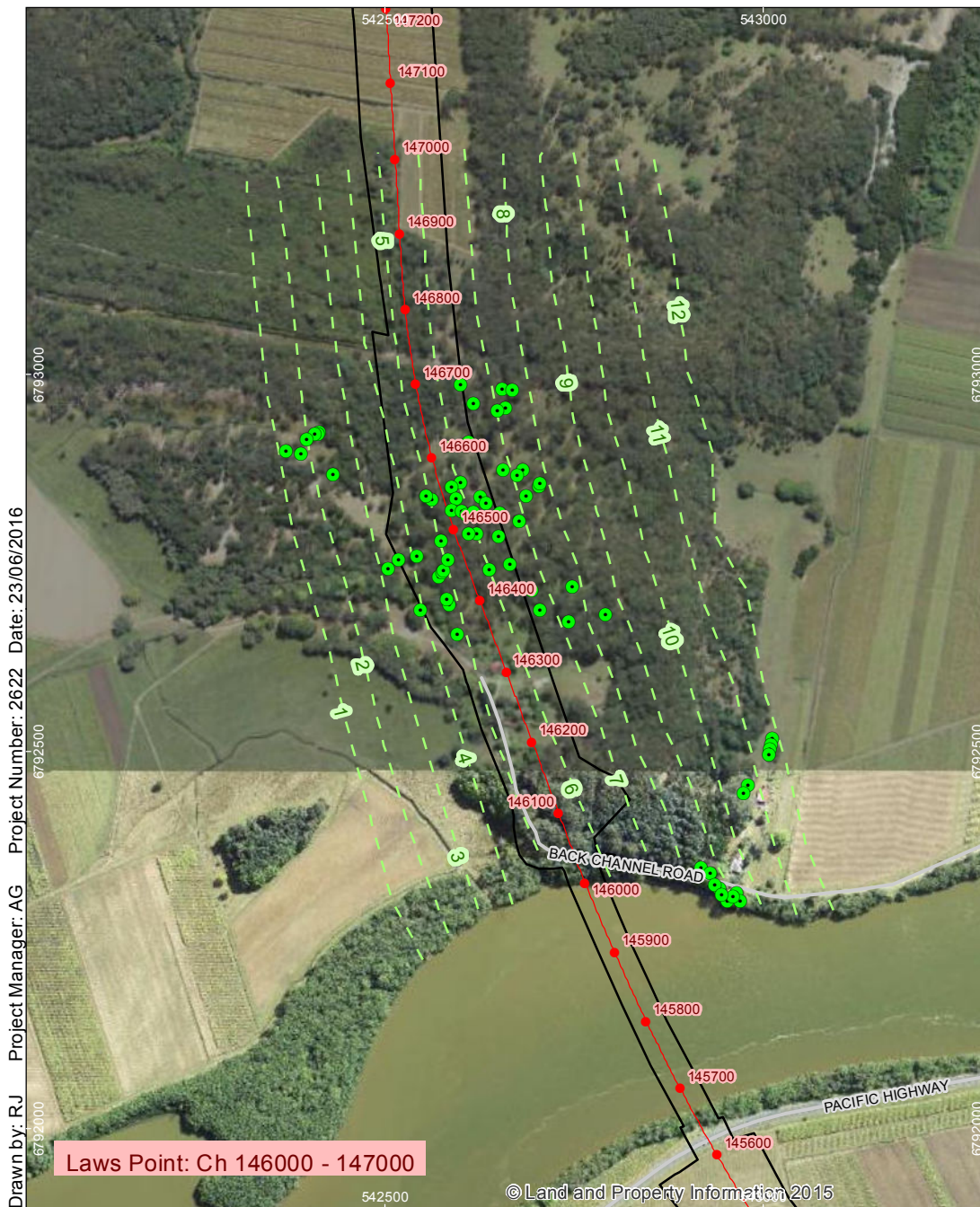
Table 6-1. Proposed phased resource reduction schedule.

Phase	Activity	Timing
1	Tag and map all trees to be collared/ring-barked	Week 1
	Population monitoring	Weeks 1,2,3
2	Collar 40% of all trees within Wardell Road and Laws Point 'hot-spots'	Week 4
	Ring-bark 20% trees within each 'hot-spot'.	
	Population monitoring	Week 5
3	Collar further 40% of trees within 'hot-spot' areas	Week 6
	Population monitoring	Week 7
4	Collar remaining 20% of trees within 'hot-spot' areas	Week 8
	Population monitoring	Week 10
5	Clearing commences	Week 11
	Population monitoring	Weeks 13-16

The area of the phased resource reduction includes approximately eight hectares within the alignment at Wardell Road and 10 hectares within the alignment at Laws Point. The habitat quality within each section differs in that the section of the alignment at Wardell Road includes relatively poor Koala habitat supporting mainly cleared, open grassland with scattered food trees with a marginal area of low-quality habitat; while the section of the alignment at Laws Point includes relatively high quality habitat with densely forested land supporting relatively more Koala food trees (Figure 3-10 and Figure 6-7). Suitable habitat for Koalas is known to occur adjacent to these areas with 77% of mapped Koala food trees located outside the clearing footprint in the identified Koala hot spot areas (refer to Table 4-2).

Koala fencing will be installed on Wardell Road adjacent to the new alignment prior to tree collaring commencing. Roads and Maritime Service will also work with JALI LALC to undertake predator control targeting wild dogs and foxes in the lead up to tree collaring commencing. These management actions are planned to be undertaken to help avoid indirect impacts to Koalas as they gradually re-establish home ranges as a result of the tree collaring process.

Figure 6-7. Location of food trees and proposed survey transects within the alignment at Laws Point and Wardell Road Koala 'hot-spots'.



Location of food trees and proposed survey transects within the alignment adjacent to the Section 10 Koala 'hot-spots'
Woolgoolga to Ballina Koala Management Plan

6.3.6 Koala relocation protocol

An ecologist will be present on site prior to and during all vegetation clearing to allow Koalas to safely leave the clearing site and relocate to adjacent habitat without human intervention. In the event that a Koala does not move of its own volition after a period of 48 hours, it will be trapped and re-located. The 'corflute method' will be used for trapping Koalas. This typically involves the use of a plastic guard, or similar material (approximately 100 centimetres tall) and, optionally, a cage trap arrangement placed in the fence near the base of the target tree, as shown in Photo 6-1 (AMBS 2011). The tree(s) within the trap are fitted with a collar (50cm wide strip of polycarbonate) approximately one metre off the ground to prevent the Koala going back up the tree(s) once on the ground. The animal is captured once it comes down the tree to find alternate food sources (Koalas usually change trees every day but may sometimes stay in the same tree for longer periods). The Koala enters the trap in an attempt to escape as it is the only opening in the plastic guard.



Photo 6-1. Trap designed to capture Koalas (source AMBS 2011)

Once captured, the Koala's health will be assessed and details recorded of age, sex, weight, body measurements, and presence of pouch or back young (for females). All healthy animals will be ear tagged, micro-chipped (using a PIT tag) and relocated into adjacent habitat identified for Koala release. Release points will be not more than 100 metres away provided that suitable habitat is present. If an injured Koala is captured, it will be transported to an experienced wildlife veterinarian for treatment. The NSW Code of Practice for Injured, Sick and Orphaned Koalas (OEH, 2011) (refer to Appendix H) will be followed for trapping and relocating Koalas and dealing with any injured Koalas encountered during the clearing procedure.

Direct interactions with Koalas must only be conducted by a suitably qualified and experienced ecologist who holds the necessary capture and handling permits issued by the OEH, or other licensed wildlife carers.

6.3.7 Managing construction vehicle collisions with Koalas

A licensed wildlife carer/ecologist will be present on site during all vegetation clearing and habitat removal activities to redirect Koalas that may be encountered during clearing activities.

Following the clearing works and throughout the remainder of the construction period, any observations of Koalas in the construction corridor will also follow the unexpected threatened species find procedure as detailed in Appendix O of the approved Construction Flora and Flora Management Plan, which have been developed based on the RTA (2011) unexpected threatened species find procedure.

All construction vehicles will be required to comply with the speed limits set out in the CEMP and to remain within the designated construction corridor. The speed limit within the construction zone will range from 10 km/hr – 60 km/hr, depending on construction activities and construction machinery. Speed limits will be reduced to 80 km/hr on the existing Pacific Highway adjacent to highway upgrade works and 40 km/hr on local access roads.

Given the likely increased traffic on local roads during the construction period, Koala awareness signs will be erected on local roads in Koala road-kill hot-spot areas to make motorists aware of the potential for Koalas to cross the road.

6.3.8 Wave 1 early works Mororo cut (borrow) site

The following management section describes the actions required for the Wave 1 early works at the Mororo cut (borrow) site. Construction is expected to commence at the Mororo cutting in February 2016.

The Woombah-Illuka Koala population is defined as the population that occurs within a five kilometre radius of the Illuka Road/ Pacific Highway interchange and which occurs approximately between chainage 94,000 – 102,000. A material extraction site for the Wave 1 works is proposed within the northern extent of the Woombah-Illuka population at the Mororo cutting between chainage 97,700 and 98,400 (Figure 6-8). The following measures are proposed to minimise any potential impacts on Koalas within the proposed Mororo cut (borrow) site.

The construction at the Mororo cut (borrow) site will involve the removal of approximately 3.55 ha of native vegetation. The clearing of vegetation is to follow the procedure in Section 6.3.5, with the following additional measures:

- Prior to clearing, erect temporary Koala fencing on the eastern side of the existing Pacific Highway for a total length of 1.1km (chainage 97,500 to 98,600), which includes extending fencing 200 metres either side of the cut site. The temporary fencing is to protect any displaced Koalas from road strike as a result of the vegetation clearing process. This fence will be set back on the eastern side of the highway by several metres so that animals crossing the existing highway from the west will not be trapped on the road edge. Where there is a gap in the temporary fence at approximate chainage 97,700 for access off the existing highway, a Koala grid will also be installed and the temporary fencing tied into the grid.
 - Clearing is to follow the two staged clearing process as described in Section 6.3.5, with the addition of nocturnal spotlight searches. Spotlighting is to be done in the two hours pre-dawn on the night prior to the scheduled clearing to provide greater assurance that no animals are present in the area proposed for clearing that day and to ensure that no animals move into the construction site prior to daylight and clearing.
 - An ecologist will also undertake daylight canopy search surveys of the scheduled clearing area prior to vegetation clearing (i.e. in the morning prior to the commencement of vegetation clearing activities) to identify trees in which a Koala is present and any adjacent trees with overlapping crowns.
 - Suspension of clearing works for a minimum period of 48 hours if a Koala is found within a clearing area to allow the animal to move out of the construction site on its own volition.

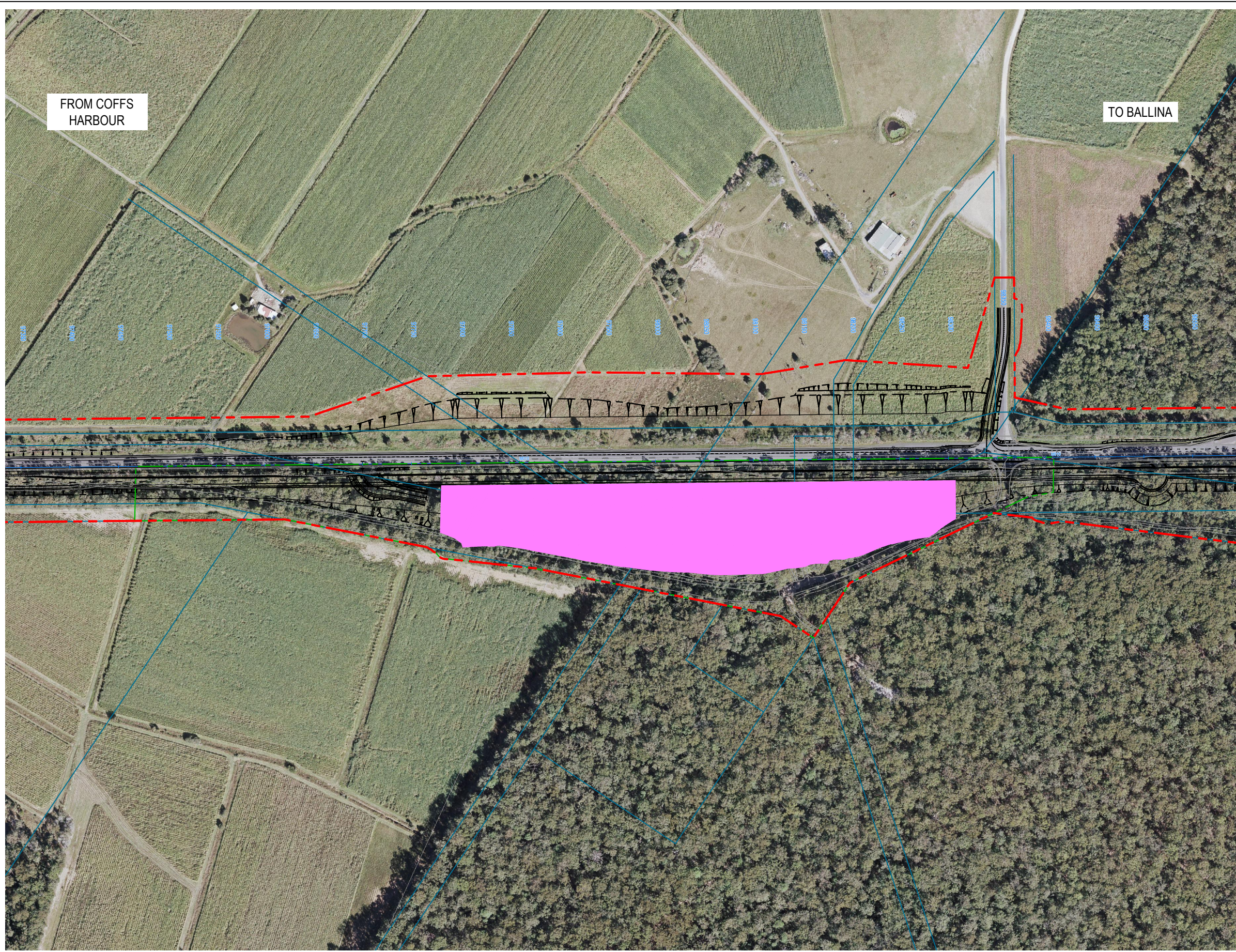
- The direction of sequential clearing will be away from threatening processes or hostile environments, i.e. roads. The ecologist is responsible for verifying that sequential clearing has taken place.
- Each tree identified by the ecologist as being a risk to a Koala if felled, will not be felled, damaged or interfered with until the Koala has moved from the clearing site.
- In the event that a Koala remains in the clearing site for more than 48 hours, it will be captured and relocated in nearby suitable habitat by an experienced ecologist.

Figure 6-8. Location of the Mororo cut (borrow) site.

THIS DRAWING MAY BE PREPARED IN COLOUR AND MAY BE INCOMPLETE IF COPIED

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150mm ON A3 SIZE ORIGINAL



PLAN

NOTES

- 1. FOR GENERAL NOTES REFER TO SHEET EW-00010 AND EW-00011
- 2. FOR LEGEND REFER TO EW-00013

EARLY WORKS EXCAVATION EXTENTS

UTILITY INFORMATION SHOWN ON THE PLANS DOES NOT DEPICT ANY MORE THAN THE PRESENCE OF A SERVICE, BASED ON AVAILABLE DOCUMENTARY EVIDENCE. THE PRESENCE OF A UTILITY SERVICE, ITS SIZE AND LOCATION SHOULD BE CONFIRMED BY FIELD INSPECTION, PRIOR TO THE COMMENCEMENT OF ROADWORKS AND THE RELEVANT UTILITY PLANS OBTAINED BY DIALLING 1100 OR FAX 1300 652 077 (DIAL BEFORE YOU DIG). CAUTION SHOULD BE EXERCISED WHEN WORKING IN THE VICINITY OF ALL UTILITY SERVICES.

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DOCUMENT NUMBER / NAME W2B-PC01-B-EW-SKT-00004				DESIGN LOT CODE		DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING		PLOT DATE / TIME 2 October 2015 - 9:57:51 AM		PLOT BY Saba, Michael		CLIENT CLARENCE VALLEY COUNCIL HW10 - PACIFIC HIGHWAY MACLEAN TO DEVILS PULPIT PORTION B MORORO BORROW SITE GENERAL OVERVIEW PLAN		A3	
EXTERNAL REFERENCE FILES				REV	DATE	AMENDMENT / REVISION DESCRIPTION		WVR No.	APPROVAL	SCALES ON A3 SIZE DRAWING		DRAWINGS / DESIGN PREPARED BY		TITLE	
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										CO-ORDINATE SYSTEM MGA ZONE 53		HEIGHT DATUM A.H.D.		DATE 17.10.15	
										Ernst & Young Centre Level 27 680 George Street Sydney NSW 2000		Phone: (02) 9272 5100 FAX: (02) 9272 5101		NAME DALIA DAKKAN	
												DESIGN STEVE ELLIS		DATE 17.10.15	
												DESIGN CHECK DALIA DAKKAN		DATE 17.10.15	
												DESIGN MNGR MIKE DICKENS		DATE 17.10.15	
												PROJECT MNGR ANGUS STURROCK		DATE 17.10.15	
												NSW GOVERNMENT		Transport Roads & Maritime Services	
												PREPARED FOR FOR REVIEW		RMS REGISTRATION No.	
												ISSUE STATUS IFI		EDMS No.	
												SHEET No EW-B-00009		PART 1	
												1 OF 2		ISSUE	

6.3.9 Fauna crossing structures

A number of dedicated and combined fauna/drainage connectivity structures for Sections 1-11 are positioned to maintain existing levels of landscape connectivity for all fauna, including the Koala, and have been developed in close consultation with EPA/OEH and DPI Fisheries. Fauna connectivity structures that are targeted to Koalas, or which may be used by Koalas, are summarised in Table 6-2 below. Note: the numbers and sizes of the connectivity structures listed in this table are subject to revision as part of Connectivity Strategy required under MCoA D2 and DoE Condition of Approval 13.

The locations of these fauna connectivity structures are indicated by the chainages in Table 6-2 and, for Sections 1 and 2, are displayed on maps in Figures 1-1 and 1-2 of the Final Connectivity Strategy (April 2015). It should be noted that many additional under-road structures designed primarily for drainage will also be built in each Section of the highway upgrade and a number of these could also be used by Koalas. Any Targeted Koala structures (identified with a tick in Table 6-2) in the pavement re-use sections shall be built as specified for both carriageways of the upgraded highway.

Approximately 133 combined and dedicated structures that are likely to allow for some dispersal for the Koala are proposed for Sections 1- 11 (Table 6-2). The primary fauna connectivity structures in Sections 1- 11 include:

- Fifty-four bridges with fauna passage beneath, including dry ground retained along river banks
- Forty-four combined drainage / fauna passage culverts in wet areas
- Thirty-five dedicated fauna underpasses for Koalas and other fauna.

Additional fauna crossing structures beyond what was envisaged in the EIS/SPIR will be installed along Section 5, 8, 9 and Section 10 to ensure sufficient connectivity across the highway for these key Koala populations. A total of 39 targeted Koala crossing structures will be installed within Section 8, 9 and 10 including 26 within Section 10 alone (Table 6-2). The number of structures within Section 10 was determined as a function of the PVA such that it was assumed that this number of structures would allow for between 40-100% connectivity for the populations on either side of the road. The crossing structures in Sections 8, 9 and 10 include:

- Fourteen bridges with fauna passage beneath, including dry ground retained along river banks
- Ten combined drainage / fauna passage culverts in wet areas
- Fifteen purpose-built dedicated fauna passage culverts.

Koala proof fencing (e.g. floppy-top, colourbond or chain-link with metal sheeting) along parts of Wardell Rd and the existing highway from Wardell to Coolgardie Interchange, has the potential to create a barrier effect for Koalas. Roads and Maritime proposes to build a connectivity structure on either side of the Wardell Road overpass, as well as a connectivity structure between the township of Wardell and the upgrade to provide connectivity for Koalas and Potoroos within the Wardell Heath shown in Figure 6-1- Figure 6-6. A connectivity structure already exists on the existing highway south of the Coolgardie interchange and Roads and Maritime propose to build a connectivity structure on the northern side of the Coolgardie interchange. Should further opportunities exist along these roads to provide connectivity by retro-fitting existing structures to make them Koala friendly, then this will be investigated.

The dimensions of underpasses that have been shown to facilitate Koala movements (Taylor and Goldingay 2003, AMBS 2011) include:

- Box culvert of three metres height (H) x three metres width (W) – especially for four or greater lane carriageways.
- Box culvert of 2.4 metres (H) x 2.4 metres (W) – as a minimum for a single or dual carriageway (this size may include Koala furniture).
- Preferably, all dedicated underpasses to be less than 50 m in total length.

Fauna furniture will be placed within dedicated Koala underpasses and, where possible, in some combined fauna crossing structures. Fauna furniture includes hard wood horizontal and vertical logs within and outside the culvert to provide a dry passage for Koalas whilst also providing refuge from predators. Previous Koala monitoring on the Pacific Highway in north-east NSW (AMBS 2011) demonstrated that log furniture in underpasses was used by a Koala but not by all animals. This suggests that furniture may facilitate the use of the underpass by some individual Koalas.

Fauna furniture installed at the targeted Koala underpasses will be finalised in the detailed design and adhere to the connectivity guidelines in the EIS which include:

- Horizontal logs placed as high off the ground as possible for Koalas to avoid predators with a minimum space of 600 millimetres between the top of the horizontal log and the structure's roof.
- Horizontal logs supported by vertical logs at regular intervals (approximately every 2-3 metres) along the underpass for Koalas to ascend or descend the Koala furniture as required.
- Logs greater than 200 millimetres in diameter.
- Koala furniture extends beyond the underpass into Koala habitat.
- Where fauna furniture is placed inside a culvert, it is to be constructed on the left or right side of the culvert (not in the middle), to minimise incidence of flooding.

Strategic planting of Koala habitat adjacent to targeted connectivity structures will also be undertaken post-construction, or beforehand if practicable, to improve and maintain connectivity.

Fauna exclusion fencing will be constructed to funnel Koalas to the fauna crossing structures and will be designed with a return at the end to encourage Koalas to move back into habitat and not directly onto the highway. Additional features will be incorporated into the fauna exclusion fencing design, such as fauna drop downs. Permanent Koala fencing will be progressively installed during the construction period, leaving openings at key crossing locations. The project aims to have connectivity structures in key connectivity areas built as soon as possible in the construction program to allow permanent fauna fencing to direct Koalas to these structures.

The monitoring program described in Chapter 8 of this plan will focus on monitoring the effectiveness of crossing structures and exclusion fencing for Koalas. This includes monitoring performance of structures and implementing corrective actions where required.

Table 6-2 Fauna connectivity structures.

Project section	Chainage (m)	Connectivity structure (Cell No x wxhxl*)	Functionality	Targeted Koala Structure
1	2000	3 x 3 x 3 x 45 m	Combined culvert	
1	3600	62 m long	Bridge	
1	4150	300 m long	Bridge	
1	4750	74 m long	Bridge	
1	5660	3 x 3.6 x 1.5 x 25 m	Combined culvert	
1	5660	4 x 3.3 x 1.5 x 35 m	Combined culvert	
1	6170	64 m long	Bridge	
1	6890	1 x 3 x 2.7 x 45 m	Dedicated culvert	
1	7280	1 x 3 x 3 x 80 m	Combined culvert	
1	8470	1 x 3 x 3 x 51 m	Dedicated culvert	
1	8800	1 x 3 x 3 x 50 m	Dedicated culvert	
1	10340	2 x 2.1 x 0.9 x 69 m	Combined culvert	
1	10750	2 x 3 x 3 x 62 m	Combined culvert	
1	11710	1 x 3 x 3 x 57 m	Dedicated culvert	

Project section	Chainage (m)	Connectivity structure (Cell No x wxhxl*)	Functionality	Targeted Koala Structure
1	12420	1 x 3 x 3 x 52 m	Dedicated culvert	
1	12880	1 x 3 x 3 x 54 m	Combined culvert	
1	13310	2 x 3.6 x 3.3 x 27 m	Combined culvert	
1	13310	2 x 3.6 x 3.3 x 66 m	Combined culvert	
1	13800	1 x 3 x 3 x 49 m	Combined culvert	
1	14280	1 x 3 x 3 x 71 m	Combined culvert	
2	17710	1 x 3 x 2.4 x 57 m	Dedicated culvert	
2	18120	2 x 2.7 x 2.1 x 79 m	Combined culvert	
2	19180	1 x 3 x 3 x 59 m	Combined culvert	
2	19880	1 x 3 x 3 x 54 m	Dedicated culvert	
2	20650	4 x 3.6 x 2.7 x 64 m	Combined culvert	
2	20780	57 m long	Bridge	
2	20880	1 x 3 x 3 x 66 m	Combined culvert	
2	21290	1 x 3 x 3 x 47 m	Combined culvert	
2	22400	78 m long	Bridge	
2	23130	1 x 3 x 3 x 22 m	Dedicated culvert	
2	23131	1 x 3 x 3 x 22 m	Dedicated culvert	
2	23750	1 x 3 x 2.7 x 43 m	Dedicated culvert	
2	24570	1 x 3 x 3 x 42 m	Combined culvert	
2	25850	1 x 3 x 3 x 45 m	Dedicated culvert	
2	27420	1 x 3.6 x 3 x 60 m	Combined culvert	
2	29300	1 x 2.4 x 2.4 x 25 m	Dedicated culvert	
2	29360	26 m plus existing	Bridge (Bebo Arch)	
3	35211	2.4x 2.4x 58m.	Combined culvert.	
3	36379	3.6 high x34.5m length	Bridge.	
3	37301	2.4 x 2.4 x 48m	Combined culvert.	
3	39641	3 x 1.2 x22m	Combined culvert.	
3	39671	3x 1.2 x 58m	Combined culvert.	
3	42522	3.6 high x 120m length	Bridge	
3	43102	3.6 high x 370m length	Bridge	
3	43887	3.6 high x 200m length	Bridge	
3	46055	3.6 high x 80m length	Bridge	
3	46325	3.6 high x 90m length	Bridge	
3	46647	3.6 high x 56m length	Bridge	
3	47181	5.2 high x 20m length	Bridge	
3	47643	3.6 high x 60m length	Bridge.	
3	47925	3.6m high x 65m length	Bridge	
3	48742	4.6 high x 29m length	Bridge	
3	49246	3.6 high x 80m length	Bridge.	
3	50280	3.6 high x 45m length	Bridge	

Project section	Chainage (m)	Connectivity structure (Cell No x wxhxl*)	Functionality	Targeted Koala Structure
3	51419	3.6 high x 20m length	Bridge	
3	51854	5.3 high x 55m length	Bridge	
3	52427	3.6 high x 77m length	Bridge	
3	52594	3.6 x 2.1 x 44 m	Combined culvert.	
3	53699	5.5m high x 25.8m length	Bridge	
3	54695	3.6 high x 75m length	Bridge	
3	56885	5.6 high x 29m length	Bridge	
3	57014	5 high x 91m length	Bridge.	
3	58626	5.3 high x 75m length	Bridge	
3	59272	3.6 high x 22.7m length	Bridge	
3	60802	3.6 high x 29m length	Bridge	
3	61033	5.3 high x 31m length	Bridge	
3	64492	3 x 3 x 45 m	Combined culvert.	
3	66190	3 x 3 x 44 m	Dedicated culvert	
4	70455	3.6 high x 28m length	Bridge	
4	74755	3.6 high x 872m length	Bridge.	
4	75565	2.4 x 3.6 x 42 m	Combined culvert.	
4	76450	2.4 x 2.4 x 45m	Combined culvert	
5	83100	4.6 high x 24.9m length	Combined (bridge)	
5	93990	216.6m length	Combined (bridge)	
5	96150	2.4 x 2.4 <40m	Dedicated culvert	√
6	99730	3 x 2.4 x 45 m	Dedicated culvert	
6	100640	2.4 x 1.8 x 62 m	Combined culvert	
6	101100	2.4 x 1.8 x 41 m	Dedicated culvert.	
6	101541	110m length	Bridge	
6	102850	60m length	Bridge	
7	115272	2.77 high x 80m length	Bridge	
7	118500	2.3 high x 20m length	Bridge	

Project section	Chainage (m)	Connectivity structure (Cell No x wxhxl*)	Functionality	Targeted Koala Structure
7	122550	3 x 2.4 x 38.55 m	Combined culvert	
7	123590	3 x 2.4 x 46.985m	Combined culvert	
8	130107	4.48 high x 170m length	Bridge	
8	134600	2.44 high x 40m length	Bridge.	√
8	135575	1.3m height x 15m length	Bridge	
8	136700	Minimum height 2.4m x 20m length	Bridge	√
9	137300	2.4 x 2.4 x <40m length	Dedicated culvert	√
9	138430	1.5 x 1.5m x 64.8m length	Dedicated culvert	
9	139050	4.65m Height x 40m length	Bridge	
9	139440	1.5 x 1.5m x 68.4m length	Dedicated culvert	
9	140520	2.4 x 2.4 x <40m	Dedicated Culvert	√
9	141120	1.87m high x 20m long	Bridge	
9	141890	2.23m high x 20m long	Bridge	
9	142220	2.4 x 2.4 x <40m	Combined Culvert	√
9	142750 (Broadwater Evans Head Rd West))	1.2 x 1.2 x <30m	Dedicated Culvert	√
9	143430	2.4 x 2.4 x <40m	Combined Culvert	√
9	143720	3.6 x 1.2 x <40m	Combined Culvert	
9	144280	3 x 3 x <40m	Dedicated Culvert	√
9	144700	Minimum height 2.4 x 26 m length	Bridge	√
10	146000	Minimum height 2.4	Bridge	√
10	146280	3 x 3 m x <40m	Dedicated culvert	√
10	146390	3 x 3 m x <40m	Combined culvert	√
10	146630	Minimum height 2.4 x 20 m length	Bridge	√
10	146980	Minimum height 2.4 x 15 m length	Bridge	√
10	147100	2.4 x 2.4 m x <40m	Dedicated Culvert	√
10	148592	3 x 3 m x <40m	Combined culvert	√
10	149250	Minimum height 2.4 x 20 m length	Bridge	√
10	150080	Minimum height 2.4 x 20 m length	Bridge	√

Project section	Chainage (m)	Connectivity structure (Cell No x wxhxl*)	Functionality	Targeted Koala Structure
10	150580	2.4 x 2.4 m x <40m	Dedicated Culvert	√
10	150630	Minimum height 2.4 x 20 m length	Bridge	√
10	151196	2.4 x 2.4 m x <40m	Dedicated Culvert	√
10	151825	Minimum height 2.4 x 20 m length	Bridge	√
10	152050	2.4 x 2.4 m x <40m	Dedicated Culvert	√
10	152750 (Wardell Rd)	2.4 x 2.4 m x <40m	Dedicated Culvert	√
10	152970 (Wardell Rd)	2.4 x 2.4 m x <40m	Dedicated Culvert	√
10	153090	3 x 3 m x <40m	Combined culvert	√
10	153620	3 x 3 m x <50m	Combined culvert	√
10	153882	Minimum height 2.4 x 15 m length	Bridge	√
10	154030	Minimum height 2.4 x 20 m length	Bridge	√
10	154770	2.4 x 2.4 m x <40m	Dedicated Culvert	√
10	155280	2.4 x 2.4 m x <40m	Dedicated Culvert	√
10	155920	2.4 x 2.4 m x <40m	Dedicated Culvert	√
10	156300	Minimum height 2.4 x 15 m length	Bridge	√
10	156970	2.4 x 2.4 m x <40m	Combined Culvert	√
10	157250	2.4 x 2.4 m x <40m	Combined Culvert	√
10	157630 (Coolgardie Rd)	3.6 x 2.4 m x <40m	Combined Culvert	√
10	157745	2.4 x 2.4 m x <40m	Combined Culvert	√
10	157900	Minimum height 2.4 x 20 m length	Bridge	√
11	158868	2.4 x 2.4 m x <40m	Dedicated Culvert	√
11	158903	3.6 x 1.8 x 45 m	Combined	
11	158903	3.6 x 1.8 x 25 m	Combined	

NOTE:

1 - * = width x height x length. Note lengths are indicative and there may be minor changes in length as part of detailed design.

2 - Note: the numbers and sizes of the connectivity structures listed in this table are subject to revision and will be detailed in the Connectivity Strategy prepared for Sections 3-11 of the Project.

6.3.10 Habitat revegetation

A landscape design has been prepared for Sections 1 and 2 and includes the use of primary and secondary Koala food trees in those areas that will not cause a road safety traffic hazard. Sections 3–11 will include the same landscape treatments. Areas where specific revegetation is to occur include approaches to fauna connectivity structures and riparian corridors (within the project boundary), which would be directly applicable to Koalas. Methods for topsoiling, seeding and planting will be in accordance with the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA Projects* (RTA 2011).

The landscape design provides due consideration to the landscape requirements around crossing structures by ensuring that the height and density of vegetation does not obscure the structure and provides a clear line of sight, while also providing some cover from predators for fauna approaching and exiting the structure.

Revegetation using primary, secondary and supplementary Koala food trees has been shown to be effective in restoring habitat for Koalas (Kavanagh and Stanton 2012). Revegetation near crossing structures will commence immediately on completion of the construction activity or may commence earlier in the construction period if possible.

A comprehensive re-vegetation strategy has been developed for Section 10 (Niche 2015). This will include the planting of 130 ha of Koala food trees throughout Section 10. A brief summary of the strategy is provided below. Planting of the 130 ha of Koala food trees in Section 10 is expected to commence in spring and/or autumn seasons in 2016/2017.

Details on monitoring the performance of the revegetation, as well as corrective actions to be implemented in instances of change from performance measures, are provided in Chapter 8.

6.3.11 Section 10 Koala re-vegetation strategy

Roads and Maritime) currently owns numerous parcels of land, including approximately 621 ha of forested and cleared land, adjacent to Section 10. These parcels of land were acquired as a result of the Pacific Highway Upgrade, as well as because they provided potential offset habitat for a range of species, including the Koala. Approximately 100 ha will form part of the Highway footprint, leaving approximately 370 ha of retained native forest and 151 ha cleared land. The Minister for Roads and Freight has committed to plant at least 130 ha of Koala habitat – i.e. comprised mainly of primary and secondary Koala food tree species, within these areas. These plantings will be undertaken in two stages; approximately 50% prior to or in the early stages of construction (Spring 2016/Autumn 2017) with the remainder planted when construction of the road has been completed.

A comprehensive revegetation strategy was developed by Niche (2015) as part of the overall strategy to minimise and mitigate the impacts to the Ballina Koala population within Section 10 of the proposed Pacific Highway Upgrade, and is consistent with the NSW Condition of Approval D9(g). The implementation of the revegetation strategy is subject to the necessary approvals being granted by the federal Minister for the Environment for the Ballina Koala Plan.

The revegetation strategy will follow that as described in the *Koala Revegetation Strategy, Section 10, Pacific Highway Upgrade, Woolgoolga to Ballina, NSW* (2015). This is provided in Appendix I and summarised below.

The strategy identifies the goals, the landscape context, areas available for planting, suitable tree species, establishment methods, maintenance regimes and an outline of a suitable monitoring program.

The three main objectives of the revegetation program are: to establish new habitat for Koalas using preferred Koala food tree species to compensate for habitat lost as a result of clearing for the

proposed road-works; to improve habitat connectivity within an already fragmented landscape; and thirdly, to guide the movement of Koalas towards the road connectivity structures (e.g. underpasses) that will be provided to ensure the safe passage across the road for dispersing Koalas.

A list of 21 cleared areas ranging in size from 0.4-17.9 ha has been selected (following on-site consultations with TfNSW, EPA and Koala ecologists from Niche, Ecosure and Biolink) as suitable, available and appropriate for revegetation by planting Koala food tree species. These cleared areas total approximately 151 ha. The strategy identifies areas of high priority for planting prior to road construction, and lower priority to be planted post-construction. Priority 1 areas are needed to facilitate connectivity through the landscape for local “hotspots” or known concentrations of Koalas. The areas that have been identified as Priority 1 will be sufficient to achieve the committed 50% of 130 ha prior to road construction, with the additional Priority 2 areas supplementing the balance of Priority 1 areas for planting that are required to meet the 130 ha commitment after road construction is completed. All properties will be subject to detailed site assessments and agreed offset requirements.

The strategy details tree species and planting locations, site preparation works, planting regimes, maintenance and monitoring. Monitoring will include vegetation and Koala activity monitoring.

6.3.12 Location of ancillary facility sites

Ancillary facility sites (i.e. temporary sites for construction related activities) have been located in cleared land or sites of low ecological value. Locations of plant and equipment will be placed in cleared parts of the site. This will avoid unnecessary clearing of Koala habitat, particularly at locations where Koala food trees and Koala activity have been identified (Roads and Maritime Services 2013).

6.3.13 Minimising dust and noise

Dust and noise impacts will be managed in accordance with the CEMP, including dust suppression measures and construction noise limit measures.

6.4 Performance thresholds and corrective actions

Table 6-3 summarises the operational environmental planning measures for Koalas and corrective actions if the measure reaches the performance threshold.

Table 6-3. Performance indicators and corrective actions – construction.

WOOLGOOLGA TO BALLINA | PACIFIC HIGHWAY UPGRADE: SECTIONS 1–11

Main goals for management	Management measure	Monitoring/timing frequency	Performance thresholds	Corrective actions if performance threshold reached
No injuries to Koalas during clearing of vegetation - including Section 10 Koala 'hot-spots' Wardell Rd and Laws Point.	<ul style="list-style-type: none"> Documented procedures for clearing and relocating. Project ecologist to evaluate situation and approach on each occasion. Implement phased resource reduction as per the management plan for Section 10 Koala 'hot-spots' 	<ul style="list-style-type: none"> Monitored daily during the clearing works. Outcome of clearing procedure reported in ER as per the CEMP requirements. Monitor implementation of phased resource reduction as per monitoring schedule – Section 8.2 	Any injury to an individual Koala during clearing works.	<p>Stop clearing works and consult with Koala specialists and/or NPWS.</p> <p>Update procedure for emergency management if a Koala is encountered and convey changes to construction staff via induction and toolbox talks.</p> <p>Consider erection of temporary exclusion fencing if required.</p>
No injuries to Koalas during construction as a result of Koala construction vehicle collisions	<ul style="list-style-type: none"> All vehicles to stay within the construction corridor. No vehicles to enter exclusion zones. Compliance with construction vehicles speed limits designated in the CEMP. 	<ul style="list-style-type: none"> Reporting of any incidents as, and if, they occur Monthly fauna incident log to be maintained as per FFMP. 	Any injury to an individual Koala during construction activities.	<p>Stop construction activities and review traffic control procedures.</p> <p>Consider erection of temporary fencing if required. Update strategy and speed limit as required and convey changes to construction staff via induction and toolbox talks.</p> <p>Review requirement for additional mitigation measures such as additional Koala fencing.</p>
No damage to Koala habitat within exclusion zones.	<ul style="list-style-type: none"> All vehicles to stay within the construction corridor. No vehicles or machinery to enter exclusion zones. 	<ul style="list-style-type: none"> Monthly inspection of protection zones as part of FFMP. 	Any breaches in protection of Koala habitat within exclusion zones.	Supplementary revegetation of disturbed habitat and monitor recovery for period of 12 months.
Dust and noise managed in accordance with the CEMP.	Implement relevant dust and noise procedures from the CEMP.	Measures to be undertaken in response to weather and construction conditions.	Dust and noise control measures outside of acceptable standards as defined in the CEMP.	Increase the frequency of dust and noise measures as appropriate and implement procedures to avoid unnecessary dust and noise events during construction.
Water quality and weeds managed in accordance with the CEMP.	Implement relevant water quality and weed management procedures from the CEMP.	Measures to be undertaken in response to storm events and construction conditions.	Water quality and weed control measures outside of acceptable standards as defined in the CEMP.	Implement additional procedures to control stream siltation, and undertake weed spraying in problem areas during construction.

WOOLGOOLGA TO BALLINA | PACIFIC HIGHWAY UPGRADE: SECTIONS 1-11

Replanting of Koala habitat adjacent to the road corridor completed as per the landscape design	<ul style="list-style-type: none"> • In situations where no fencing is present, and revegetation is required, roadside plantings to avoid Koala food trees to prevent Koalas being attracted to road edges. • Landscape plantings at fauna crossing zones to use Koala habitat trees to encourage use of the crossing zones by the Koala. • Revegetation in areas disturbed during construction to be restored to the original habitat type at each location. Focus at potential habitat locations 	Final audit of Landscape design	Non-compliance of landscape plan at end of construction with regard to Koala plantings (refer Chapter 7 and 8 for further details on performance criteria).	Complete plantings where gaps identified
Replanting of 130 ha of Koala habitat within Section 10 as per the Section 10 Koala re-vegetation strategy.	Re-vegetation of 130 ha of cleared/semi-cleared land with Koala food/shelter tree species.	Annual monitoring of new plantings from year 1 for 5 years and/ or until plantings across 90% of plots have an average height of 8 metres (unless otherwise agreed) – as per monitoring strategy Chapter 8 Annual koala surveys in seven plantation areas beginning in year 3 - as per monitoring strategy Chapter 8	Annual density of less than one Koala food/ shelter tube-stock per 20 m ² across the revegetation site. Trees within 90% of monitoring plots do not have an average height >8 metres after 5 years. One koala recorded in each of the seven plantation areas.	Where a density of less than this is observed, conduct supplementary planting across the site. Continue surveys until one koala is recorded within each of the seven plantation areas up to year 10. If koalas have not been recorded in all plantation areas by year 10 assess reasons for their absence and determine if additional field surveys are required.

7. Operational management measures

7.1 Potential impacts during operational phase

- Degradation of exclusion fencing leading to Koala vehicle collisions and road deaths or Koalas becoming trapped within the road corridor.
- Degradation of Koala revegetation areas.
- Wild dogs targeting Koalas at designated crossing zones.
- Koalas not using designated crossing structures where recorded in adjacent habitat.

7.2 Main goals for management

- No Koala deaths or injuries associated with road operations (i.e. vehicular collisions) within the upgrade area after a five year period following commencement of the operational phase.
- Evidence of completed crossings by Koalas at targeted fauna crossing structures.
- Less than 30% mortality of planted Koala feed trees in Koala habitat revegetation areas on Roads and Maritime owned land for a period of five years post-construction.
- Section 10 – reducing Koala mortality by an initial 4 animals/year and thus arresting population decline such that it is statistically slower than the lower bound of the 90% confidence interval of the PVA Scenario 6 (195 at year 5, 147 at year 10 and 104 at year 15), which equates to a 1.2% decline over five years, 13.7% decline over 10 years and 27.3% decline over 15 years..

7.3 Management measures

7.3.1 Maintenance of fauna exclusion fencing and fauna crossings

The Roads and Maritime Services will maintain fauna crossing structures and exclusion fencing as part of the standard maintenance requirements for perpetuity as required. A small vehicle access track adjacent to the fence would facilitate rapid inspection and repair. Fauna fencing will be inspected every six months and maintained as required.

Maintenance of fauna fencing will also be conducted in response to observations and reports of any Koala injuries or road kills in the vicinity of exclusion fencing and structures. The work to be commissioned will include repair of any breaches in the exclusion fence, the slashing of overgrown vegetation that breaches the fence or occurs within 3 m of the fence, and the removal of large debris or vegetation from culverts.

7.3.2 Maintenance of revegetation

Maintenance and monitoring will follow that as outlined in Section 8.6 and detailed in the Section 10 revegetation strategy (Niche 2015).

7.3.3 Predator control

The Ballina Koala Plan (Kavanagh 2016) has identified predation by domestic dogs as likely to be a significant contributor to the high rate of mortality and low rate of breeding success for the Koala population living near Section 10, exacerbating its long-term decline. It is recognised that TfNSW is a significant landholder in the region and is committed to dog control at a local and regional level. The lead agency for dog control is NSW Local Land Services (LLS). TfNSW intends to work with LLS/local council/DPI once the KMP is approved to collaborate on landscape level dog control programs where possible. Roads and Maritime will be implementing and funding a dog control program on all of its biodiversity offset properties, including the 130 ha of Koala habitat that will be planted in Section 10.

Wild dogs and other predatory animals have the potential to exploit the channelling function of the fauna exclusion fences by hunting near the entrance to connectivity structures, such as underpasses (Harris *et al.* 2010). Monitoring of predatory animal activity will be conducted as part of the crossing structure monitoring program (refer to Chapter 8). Where monitoring indicates that predators are a threat to Koala movement through the crossing structures, Roads and Maritime Services will engage with the North Coast Local Land Services, NSW National Parks and Wildlife Service (Grafton), and Rural Lands Protection Board (North East) and adjacent landowners to identify and implement strategies to reduce this predation risk. These and other government agencies have an important role to play devising and implementing appropriate strategies to control dog predation on Koalas.

7.3.4 Monitor effectiveness of crossing structures

Monitoring of the targeted Koala connectivity structures (and associated exclusion fencing) will be undertaken to assess their effectiveness to facilitate movement of Koalas across the highway upgrade. Chapter 8 outlines the process that would be used to undertake this monitoring.

7.4 Performance thresholds and corrective actions

Table 7-1 summarises the operational environmental planning measures for Koalas and corrective actions if the performance thresholds for each of the measures are reached.

Table 7-1. Performance indicators and corrective actions – operation.

Main goal	Mitigation / control measure	Monitoring/timing frequency	Performance thresholds	Corrective actions if performance thresholds reached
No Koala deaths or injuries from collisions with vehicles travelling along the new road or associated intersections with minor or feeder roads.	<p>Construction of temporary and permanent fencing in selected locations to encourage the use of designated crossing points and to direct Koalas away from the road corridor. This includes permanent fencing along parts of Wardell Road either side of its crossing with the upgraded highway in Section 10 and also along the existing Pacific Highway north of Wardell to the Coolgardie interchange.</p> <p>Periodic monitoring and maintenance of exclusion fencing for the life-time of the project.</p> <p>Slashing weeds near fences and repair breaches in fence or replace broken fences.</p>	<p>Reporting of any incidents as, and if, they occur.</p> <p>Conduct Koala mortality surveys as per Chapter 8.</p> <p>The program will include inspections of the fence and structures as part of the standard maintenance requirements at the site for the life-time of the project.</p> <p>Monitoring will also be conducted in response to observations and reports of Koala road kills. Monitoring will be conducted for five years initially and the need for further monitoring will be reviewed at the end of this period.</p>	<p>Any injury to an individual Koala from car strikes during operational years 1-5.</p>	<p>Locate and repair faulty exclusion fence within 3 days of Koala death being reported.</p> <p>Review Koala mitigation measures if any Koala has been killed or injured as a result of car strike.</p> <p>Retrofit exclusion fencing, or part there-of, with additional measures to deter Koalas</p> <p>Consider erection of exclusion fencing in areas where none is currently provided.</p> <p>If a Koala is found to have died as a result of the project (within the fenced areas or highway upgrade) then TfNSW will undertake further investigations into installing additional fencing on other Koala road-kill hotspot areas.</p>
Maintain habitat revegetation areas.	Regular monitoring and reporting on revegetation works and keeping Log Book of Maintenance	<p>Monitor and report on revegetation works at month three, month nine and month twelve following initial establishment of revegetation area. A Log Book of Maintenance shall be prepared. The log book shall report on:</p> <ul style="list-style-type: none"> • Date of maintenance actions • Results from performance quadrants • Summary of visual inspection • Further soil test information • Any instructions by TfNSW and response actions from contractor 	<p>Greater than 30% mortality of trees at revegetation sites determined from performance quadrants.</p> <p>Weed infestations not controlled.</p>	<p>Review planting regime and methods, and re-plant areas where significant tree mortalities have occurred. Increase maintenance reporting period until revegetation success rate is achieved.</p> <p>Remove and replace dead trees.</p>
No Koala deaths or injuries from wild dog attacks in vicinity of crossing structures in years 1-5.	Conduct ongoing monitoring at crossing zones as per methods in Chapter 8.	Monitor predator presence and predator related Koala kills as part of ongoing crossing structure monitoring program.	Any injury to an individual Koala near crossing zones that are attributed to predator attack (as per methods in Chapter 8).	Engage with stakeholders involved with predator control to identify and implement actions to minimise attacks.

WOOLGOOLGA TO BALLINA | PACIFIC HIGHWAY UPGRADE: SECTIONS 1-11

Koalas using designated crossing structures	Monitoring of crossing structures: refer to Chapter 8. Includes connectivity structures adjacent to the upgrade and also between the upgrade and the township of Wardell along Wardell Rd.	As outlined in Chapter 8. Undertake monitoring until such time as the use and effectiveness of mitigation measures can be demonstrated to have been achieved over a minimum of three successive monitoring periods.	No evidence of at least one successful crossing by Koalas of the designated crossing structures within 3 years.	<p>Review and update the monitoring methods, including whether Koalas are present in adjacent habitat.</p> <p>Check exclusion fencing for damage and rectify.</p> <p>Improve habitat condition and connectivity adjacent to crossing structures.</p> <p>Consider whether Koala translocation is warranted within isolated areas of habitat.</p>
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8. Monitoring program

Monitoring will be undertaken to determine the effectiveness of mitigation measures implemented in Sections 1-11 of the Pacific Highway Upgrade. The three main mitigation measures requiring monitoring are the effectiveness of Koala-proof fencing along the length of the highway upgrade (Sections 1-11), the effectiveness of Koala connectivity structures along the length of the highway upgrade (Sections 1-11), and the effectiveness of Koala food tree plantings in restoring habitat for Koalas (monitoring focus mainly in Section 10). Coincident with and integral to these programs is the need to monitor trends in overall Koala population size, particularly for the two larger populations along the Pacific Highway upgrade alignment – the Broadwater (Sections 8/9) and the Coolgardie-Bagotville (Section 10) key populations.

The PVA for the Coolgardie-Bagotville key population indicated that this population is projected to decline significantly over the next 50 years (Kavanagh 2016) unless key threatening processes can be controlled. Monitoring of this population is considered important to help determine whether mitigation actions have been effective and management actions are helping to achieve population recovery, or if not, to provide some context as to why not. The Coolgardie-Bagotville (Section 10) population will be monitored against the PVA predictions, but as the Broadwater (Section 9) population has not had PVA completed, it will be monitored against a statistically significant at year 15 compared with year 0.

8.1 Objectives

Monitoring will provide reliable information such that sound conclusions can be drawn in relation to management of the species.

The monitoring objectives for Sections 1-11 of the Pacific Highway Upgrade project include:

- Evaluate the success of mitigation measures against the performance indicators and corrective actions presented in Table 8-4.
- Assess the effectiveness of the fauna crossing structures and fauna exclusion fencing to facilitate movement of Koalas across the upgraded highway. Note that in most areas, except in Sections 9 and 10, and in parts of Sections 5, 6 and 8, Koala “floppy top” exclusion fencing will not be constructed, unless Koala deaths or injuries are observed. However, modified “rabbit-proof” fencing, or other fence types, will be installed along the length of Sections 1-8 and 11 to exclude Koalas and a range of other species (Table 5-1).
- The objective of the Koala population monitoring for Section 9 is to be able to detect whether there is a statistically significant decline at year 15 compared with no decline.

Additional monitoring objectives for Section 10 are to:

- Assess effectiveness of the revegetation program in Section 10 in providing additional habitat for Koalas.
- Monitor the potential impact of tree clearing within the Wardell Road and Laws Point ‘hot spots’ on any resident Koalas.
- Determine whether the population is tracking according the predictions of the PVA (i.e. whether Koala mortality has been reduced by an initial four animals/year thus slowing population decline such that the population is greater than the lower bound of the 90% confidence interval of the PVA Scenario 6 (195 at year 5, 147 at year 10 and 104 at year 15), which equates to an approximate 1.2% decline over five years, 13.7% decline over 10 years and 27.3% decline over 15 years.

The monitoring program may be subject to refinement as a result of the performance of the aforementioned monitoring objectives and assessment against the performance indicators and corrective actions presented in Table 8-4. To fulfil these objectives, several ecological variables will be monitored, with each variable discussed below.

8.2 Phased resource reduction – Koala monitoring at Wardell Road and Laws Point ‘hot-spots’

Monitoring of the Koalas within the known hotspots at Wardell Road and Laws Point will be undertaken in conjunction with the phased resource reduction within these areas. The purpose of the population monitoring is to monitor and assess the impact of the process on any resident Koalas to enable implementation of adaptive clearing procedures such that the goal of zero Koala mortalities in relation to this project is achieved.

The numbers of and resource utilisation by Koalas within the vicinity of the hotspots in relation to the phased resource reduction process will be monitored through regular surveys within the clearing footprint and also adjacent habitat throughout key stages of the process. Surveys will occur before, during and after tree collaring and then again after vegetation clearing. The proposed timing of monitoring in relation to the phased resource reduction schedule is shown in Table 8-1.

Table 8-1. Koala monitoring schedule around Koala ‘hot-spot’ locations.

Phase	Activity	Timing
1	Tag and map all trees to be collared/ring-barked	Week 1
	Population monitoring	Weeks 1,2,3
2	Collar 40% of all trees within Wardell Road and Laws Point ‘hot-spots’	Week 4
	Ring-bark 20% of trees within each ‘hot-spot’.	
	Population monitoring	Week 5
3	Collar further 40% of trees within ‘hot-spot’ areas	Week 6
	Population monitoring	Week 7
4	Collar remaining 20% of trees within ‘hot-spot’ areas	Week 8
	Population monitoring	Week 10
5	Clearing commences	Week 11
	Population monitoring	Weeks 13-16

Koala surveys undertaken at Phase 1 will allow for identification of the animals within each area and provide information on the ‘baseline’ number of Koalas present. Monitoring undertaken after each collaring event and after clearing has commenced will provide information on changes in Koala numbers and resource utilisation that may be attributable to the phased resource reduction process. The regular monitoring of individuals within these two specific areas will allow for implementation of adaptive management of the phased resource reduction process to manage/ mitigate any potential impacts to individual animals.

Surveys will involve diurnal and nocturnal spotlighting surveys along transects that run the length of the alignment within the hotspot areas (see Figure 6-7). Based on the width of the proposed alignment in these areas, this should include at least two transects within the alignment (approximately 50 metres apart) and at least four transects approximately 50 metres either side of the alignment (total of at least 10 transects), as presented in Figure 6-7. The number of transects may need to be increased or decreased depending on the vegetation types present as this will have implications for visibility of the animals (the upgrade alignment at the Laws Point hotspot includes high quality, more densely forested Koala habitat, while the upgrade alignment at the Wardell Road hotspot consists mostly of cleared vegetation). A nocturnal spotlighting survey and a diurnal survey will be undertaken at each location. The location of any Koalas sighted will be recorded with a GPS, and details of the habitat type and tree species in which it was located, and any other relevant information such as behaviour or identifying characteristics will also be recorded. Results of the surveys will be provided to Roads and Maritime in a brief report at the conclusion of each survey, including a map of all recorded Koala locations.

Koala surveys will be undertaken by suitably qualified ecologists/biologists with experience undertaking diurnal and spotlighting surveys for Koalas.

8.3 Koala population monitoring

There is a growing appreciation that the ecological impacts of major linear infrastructure need to be assessed at the landscape scale (Taylor and Goldingay 2010, Van der Ree *et al.* 2011). Many studies (mostly international) have reported the use and effectiveness of wildlife crossing structures (road underpasses and overpasses) and the prevalence of wildlife road mortalities, concluding that most dedicated crossing structures increase the permeability of roads by allowing individual animals to cross more safely (Van der Ree *et al.* 2007, Taylor and Goldingay 2010). However, most studies have been unable to conclude whether “use” of a structure by an individual animal necessarily equates to conservation gain. The important unanswered question is: “Are populations declining in size due to road effects, even though we observe them using the crossing structures?”

The areas with the greatest number of Koala records in relation to the project occur around Wardell, Coolgardie and Bagotville (Section 10) and south of the Richmond River from Rileys Hill to Broadwater National Park (Section 9), both of which are key populations which could be adversely affected by the Pacific Highway upgrade. In contrast, the low density populations of the Koala occurring in or near Sections 1-8 and 11 of the Upgrade are too sparse to warrant the intensive sampling that would be required to document the broader landscape effects of the Pacific Highway. Instead, population monitoring efforts will be focused in Sections 8/9 and 10 where the Koala is most abundant.

The key aim of the Koala population monitoring is to be able to detect changes in the population that may be used to assess the overall effectiveness of Koala management activities implemented as part of the Highway Upgrade, namely use of connectivity structures, use of the re-vegetation areas and effectiveness of road kill mitigation measures. The information would also be used to assess population changes relative to the PVA predictions in Section 10 only. Two types of population monitoring will be undertaken – long-term systematic, repeated direct surveys for Koalas to provide information on Koala population trends, and periodic collection of Koala faecal pellets which will provide genetic information which may be used to provide an additional estimate of the Koala population size as well the level of genetic exchange occurring across the Upgrade.

8.3.1 Design of population monitoring program

Direct counts

Extensive investigations into the type, location and frequency of Koala population monitoring have been undertaken. Initial investigations involved a power analysis to determine the number of control and impact sites required to reliably detect declines in the populations at Broadwater (Section 8/9) and Coolgardie-Bagotville (Section 10) (Rhodes and Preece 2016).

Power analysis is an important aspect of experimental design. It allows determination of the sample size required to detect an effect of a given size, with a given degree of confidence. This information can then be used to design effective monitoring where there is a known level of confidence around the results. In the case of the current study, it was used to determine the number of sites and surveys that may be required to confidently assess changes in the Koala populations at Coolgardie-Bagotville and Broadwater.

Results indicated that in order to detect a decline over a relatively short time frame (monitoring over a three year period) the sample size required to detect any impact was very high (in the order of 800 sites per year per population) and considered likely to be unrealistic to implement. It was determined that the low ability to detect potential impacts was driven by low Koala densities, high spatial variability in the Koala distribution and the short (three year) monitoring period.

The issue of low Koala densities and high spatial variability in the Koala distribution presented similar difficulties in determining an optimal, practical and feasible monitoring strategy.

The program was subsequently extended to 15 years in order to enable changes in the population to be assessed in line with the PVA predictions. Similarly, the monitoring program was designed such that it would be sensitive enough to detect the quantum of change that is predicted to occur by the results of the PVA – that is, approximately 41% decline in population size over 15 years. A variety of scenarios were modelled to determine the optimal survey frequency/intensity that would be required to adequately detect these changes in the Koala population, with Type 1 and Type 2 errors set equal to each other.

Results of the power analysis indicated that, unsurprisingly, as the number of survey sites, number of surveys undertaken at each site and frequency of surveys increased, so did the power to detect change. Based on 50 survey sites within each of the Bagotville and Broadwater populations, and implementation of diurnal and nocturnal searches, the model indicated that in order to obtain 97% power to detect a 30% change in the population size in 15 years, monthly surveys would be required. The number of survey sites was based roughly on the number of sites surveyed in the previous population surveys; 46 in Section 10 and 54 in Section 9 (Ecosure 2014 and Ecosure-Biolink 2015).

Monthly surveys for 15 years were considered unfeasible. However, it was determined that a minimum of approximately 70% power (or confidence) to detect a 30% decline would be an acceptable outcome (Dr Rod Kavanagh and Dr Jonathan Rhodes, email correspondence 30th March 2016). This would involve a sampling frequency once every six months at each of the 50 sites within the Coolgardie-Bagotville and Broadwater populations. Each site would be surveyed twice on the same day – daytime canopy searches followed by night time spotlighting searches. However, the Koala population is probably too low and too variable to estimate population numbers, and their decline, precisely. These limitations need to be recognised and include the risk of wrongly concluding that declines are faster or greater than the PVA projections or, wrongly concluding that declines are slower or less than the PVA projections.

For the reasons above, and particularly because the confidence intervals on the estimated population trends are likely to be high, the monitoring strategy will be adaptive such that following each survey, the data will be analysed and an assessment of the power going forward would be undertaken. Based on this, the required survey effort may change (go up or down). Such an adaptive monitoring strategy

has been shown to provide better outcomes than fixed strategies (Jonathan Rhodes, *pers. comm.* 1st April 2016). The monitoring program should aim to increase the level of power where possible (e.g. additional sites, additional/alternative techniques) to reduce the monitoring timeframe.

Alternative monitoring methodologies (such as the use of drones) will be explored and implemented for future use if determined appropriate. If more efficient or effective monitoring approaches are identified these will be implemented, in consultation and agreement with the EPA and DoE.

Faecal Pellet (scat) Sampling – population genetics

Genetic analysis of scats allows for the identification of individual animals. It operates as a survey technique by identifying individuals (“individualisation”) and their sexes based on the genetic profiles of the samples. Collection and analysis of scats from across the landscape and over time can be used to determine the distribution and movement of individuals (and their relatives) across the landscape (e.g. Epps *et al.* 2005) as well as estimates of population size (e.g. Janečka *et al.* 2008). Genetic sampling (through DNA analysis of faecal pellets and tissue samples) has been used previously to assess the impact of roads and linear infrastructure on wild animal populations (e.g. Epps *et al.* 2005 and Kuehn *et al.* 2007).

Faecal pellet sampling and scat analysis will be undertaken to provide an additional estimate of Koala population size (according to the capture-mark-recapture technique) and also determine the level of genetic exchange occurring across the Upgrade (i.e. determine if Koalas are moving across/breeding on either side of the Upgrade).

8.3.2 Population monitoring procedures (Section 10 and Section 9)

Direct counts

Survey methods incorporating direct observations of Koalas are considered to be the most appropriate methodology (rather than indirect methods such as scat searches) for determining population numbers and density estimates that can be used to assess changes to the population over time. Survey methodology will follow previous survey methodology (i.e. transect and radial search in 1 ha plots) (see Biolink 2015).

Radial searches will involve searches for Koalas in every tree within a 25 m radius of the centre point of each site (0.196 ha) by three personnel. Transect searches will involve transects approximately 250 m in length and 40 m in width (covering a total area of approximately one ha) to be traversed at each survey site. Three observers equipped with a compass and binoculars, spaced ~20 m apart, walk a fixed bearing searching all trees for Koalas. One observer walks the centre line and one on either side. Where possible, transects are to be oriented north-south (on flat to undulating terrain) or along the contour on steeper terrain), and commenced at 125 m from the centre point, continuing for a further 125 m past the centre.

For any Koalas observed, the GPS co-ordinates, along with the tree species, height of the Koala in the tree, and where possible any other individual Koala characteristics (e.g. sex, age, health status) will be recorded.

Diurnal canopy searches and nocturnal spotlighting searches will be undertaken at each site within each of the Coolgardie-Bagotville and Broadwater population areas. Within each site, the diurnal and nocturnal observations will be undertaken on the same day.

Survey locations will include those previously established and used during the previous population surveys of the Broadwater and Coolgardie-Bagotville populations (Biolink 2015, Ecosure 2015) wherever practicable. This includes 46 sites in Section 10 and 54 sites in Section 9 (see Figure 8-1 and Figure 8-2). Any additional survey locations required for Section 10 will be determined based on the distribution of preferred Koala habitat across the landscape including the 130ha of newly established Koala habitat.

Population monitoring will commence in Spring 2017 to coincide with the beginning of the construction period. The benefits of beginning at this time include the ability to detect any population changes earlier in the life of the project (as power to detect change increases with the number of surveys and data) and it would also provide the opportunity to monitor potential impacts of construction.

For the first 5 years the Koala populations will be monitored twice a year. Surveys would be timed to occur in spring (breeding season, when animals are most active and therefore most easily detected) and then again in autumn. The data would be analysed and reported and power analysis will be run at the end of the each survey reporting period to re-assess population survey requirements including frequency of survey events. Data analysis and interpretation would be undertaken by suitably qualified and experienced personnel.

Population monitoring will be undertaken by suitably qualified and experienced ecologists with experience in Koala survey to maximise the chances of detecting Koalas.

Data analysis will involve the calculation of Koala density based on the number of Koalas counted during transect/radial searches, divided by the combined total search area of all transects/radial searches. This will then be used to estimate trends and statistical equivalence tests will be used to determine if the decline is statistically slower than the lower bound of the 90% confidence interval for Scenario 6 of the PVA for Section 10. For section 9 the trend will be compared against no decline.

Scat sample collection and analysis

It is proposed that Koala faecal pellet sampling will be undertaken periodically (every three years) throughout the 15 years of the population monitoring period. Scats would be collected at each of the population monitoring sites (in conjunction with the six-monthly population surveys) in Section 10 (46 sites) in Year 1, Year 3, Year 5, Year 7, Year 10, Year 12, and Year 14. Scats would be located using the Spot Assessment Technique (SAT), where the base of feed trees are searched for Koala scats. Further opportunity exists to collect scats during monitoring surveys at each of the fauna crossing structures (see Section 8.3). Australian Museum Research Institute estimates at least 200 Koala scats would be required to provide information on 20 individuals. It is unknown whether the proposed sampling intensity would be sufficient to provide this information, however, the first sampling period will be used to estimate the true rate of information that is obtained from scat collections in this population and to inform methodology/sampling effort for Koala scat monitoring in subsequent years.

It is anticipated that DNA be extracted and stored at the end of each collection period. However, DNA analysis of the scats will be conducted at the end of year 1 and then at the end of year 15. The year 1 analysis will provide population estimates and information on the distribution and relatedness of individuals across the study area, but also allow for refinement of collection and storage procedures and amendment of the sampling regime if required. Based on the accumulation of genetic material from four sampling periods, the year 15 assessment will provide a relatively robust estimate of population size (to which the direct population counts can be compared) at each sampling period, and also provide information on Koala breeding and movement across the Upgrade, once offspring between cross-Upgrade individuals have been produced.

The success of extracting high-quality DNA from scats can vary depending on the species. Published data suggests that Koala scats in particular pose some challenges to DNA extraction. Methodologies regarding collection and storage techniques to help maximise genotyping success outlined by Wedrowicz et al. (2013) and other similar studies will be referred to. (e.g.) Specific collection and storage requirements of the scats would be discussed and developed in consultation with the laboratory engaged to do the analysis.

Roads and Maritime will engage suitably qualified experts to advise on the program (including collection and storage procedures and requirements) and undertake the genetic analysis and data analysis. This information will then be integrated with information from the population surveys.

8.3.3 Performance indicators

A key limitation to the development of the monitoring methodology was that, as determined by Rhodes and Preece (2016) and detailed above, it is not feasible to statistically measure Koala population change directly as a result of the Highway relative to control sites due to the prohibitively large sampling effort that would be required to achieve a result with any confidence. However, the monitoring methodology described above is considered to have sufficient power (approximately 70%) to enable trend changes (30% decline over 15 years) in the monitored Koala population to be identified. This will be used to compare against PVA predictions in Section 10 and also inform insights and impacts in combination with data from road kill monitoring, fauna connectivity use and exclusion fence monitoring.

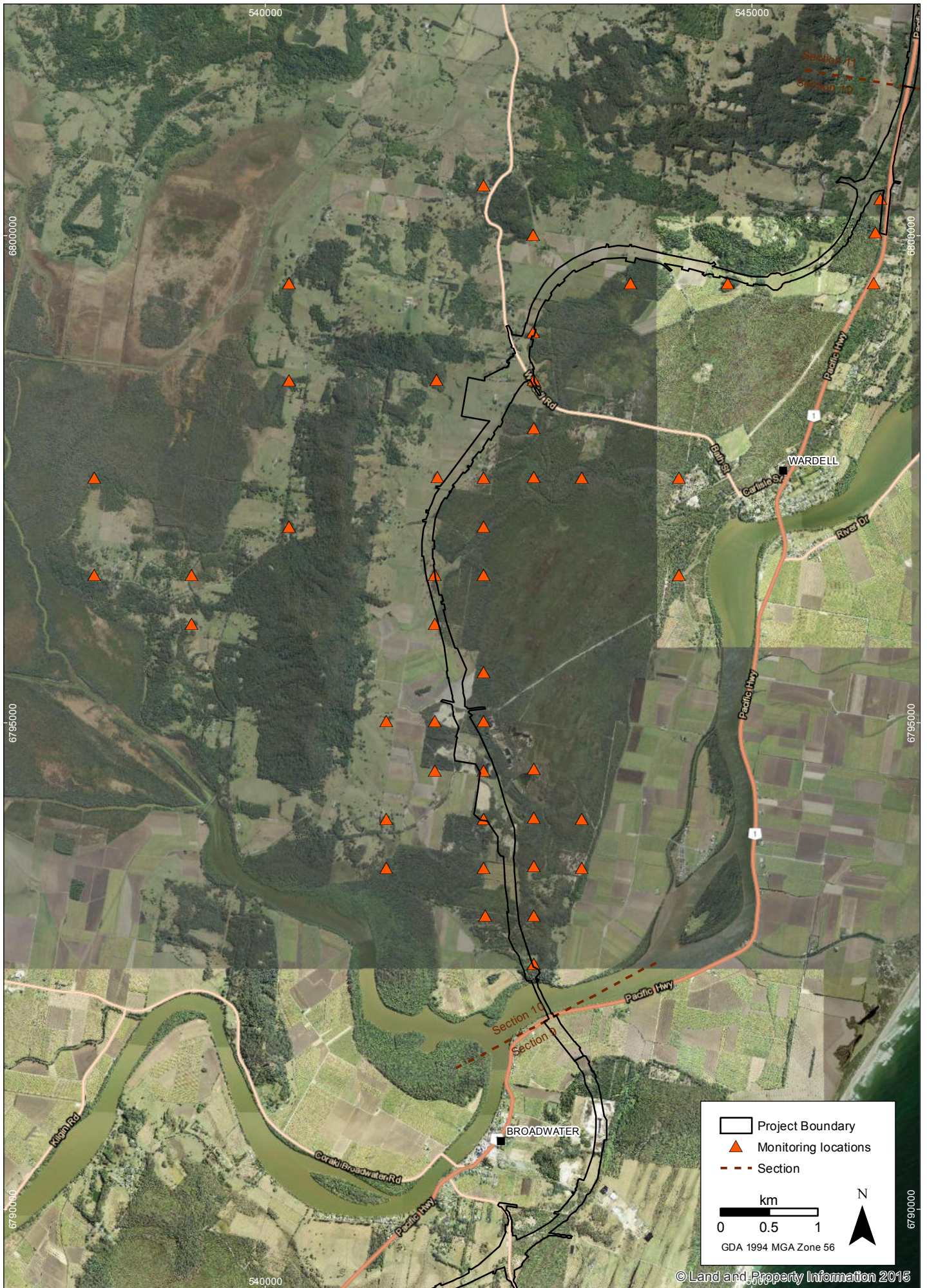
Monitoring information will be used to assess population changes in line with the PVA predictions for scenario 6 (lower bound of 90% confidence intervals) for Section 10 only. The objective of the Koala population monitoring for Section 9 is to be able to detect a statistically significant decline in the population that may be used to assess/inform the overall effectiveness of Koala management activities implemented as part of the Highway Upgrade, namely use of connectivity structures, use of the re-vegetation areas and effectiveness of road kill mitigation measures.

Performance indicated by the population monitoring will be measured by analysis of the data following each survey (to re-assess power of the monitoring program) and a review of population trends, in light of results of other management and mitigation measures, including:

- Evidence of completed crossings by Koalas at targeted fauna crossing structures.
- Koala deaths or injuries due to vehicle strikes in the vicinity of fauna crossing structures.
- Breaches in fauna exclusion fencing or encroachment of shrub or canopy vegetation within two to three metres of fauna exclusion fencing.
- Success of establishment and Koala use of the revegetation areas.
- Road-kill data from local wildlife rehabilitation groups (WIRES, Friends of the Koala).

Should the Section 10 Koala population size decline faster than 17% (lower bound of 90% confidence interval) within the first five years, corrective actions would include identifying the key threatening processes which are continuing to impact on Koala population trends and increase efforts to control these key threatening processes. A complete program review will be undertaken at 5, 10 and 15 years in light of population monitoring data and other monitoring and management outcomes. Should the Broadwater (Section 9) population show a statistically significant decline by year 15, then corrective actions should also be considered, but given PVA has not been conducted for this population, these actions should only apply to threatening processes that can be attributed to the Project.

To measure and provide for success in achieving the aforementioned objectives, performance indicators and corrective actions have been set and are provided in Table 8-4.



Section 10: Coolgardie-Bagotville population
Woolgoolga to Ballina Koala Management Plan

FIGURE 8-1

Imagery: (c) LPI 2009 - 2012



Section 8-9: Broadwater population
Woolgoolga to Ballina Koala Management Plan

FIGURE 8-2

Imagery: (c) LPI 2009 - 2012

8.4 Koala activity and fauna crossing structures

Monitoring of the targeted Koala connectivity structures (underpasses and associated exclusion fencing) will be undertaken to assess their effectiveness in facilitating the movement of Koalas across the highway upgrade.

8.4.1 Selection of monitoring locations

Monitoring locations have been pre-selected and include targeted connectivity structures that have been designed for use by the Koala (i.e. dedicated culverts). Motion sensor cameras will be installed at each end of the Koala dedicated underpass structures listed in Table 8-2 to determine whether the connectivity structures provided are effective (i.e. Koalas undertake complete crossings of these structures).

Table 8-2 Fauna connectivity structures targeted for the Koala as detailed in the Connectivity Strategy.

Project section	Chainage (m)	Connectivity structure (Cell No x wxhxl*)	Functionality	Targeted Koala Structure
1	6890	1 x 3 x 2.7 x 45 m	Dedicated culvert	
1	8470	1 x 3 x 3 x 51 m	Dedicated culvert	
1	8800	1 x 3 x 3 x 50 m	Dedicated culvert	
1	11710	1 x 3 x 3 x 57 m	Dedicated culvert	
1	12420	1 x 3 x 3 x 52 m	Dedicated culvert	
2	17710	1 x 3 x 2.4 x 57 m	Dedicated culvert	
2	19880	1 x 3 x 3 x 54 m	Dedicated culvert	
2	23130	1 x 3 x 3 x 22 m	Dedicated culvert	
2	23131	1 x 3 x 3 x 22 m	Dedicated culvert	
2	23750	1 x 3 x 2.7 x 43 m	Dedicated culvert	
2	25850	1 x 3 x 3 x 45 m	Dedicated culvert	
2	29300	1 x 2.4 x 2.4 x 25 m	Dedicated culvert	
3	47181	5.2 high x 20m length	Bridge	
3	66190	3 x 3 x 44 m	Dedicated culvert	
4	75565	3.6 x 2.4 x 42 m	Combined culvert.	
4	76450	2.4 x 2.4 x 455m	Combined culvert	
5	83100	4.6 high x 24.9m length	Combined (bridge)	
5	93990	216.6 x 10.5 m	Combined (bridge)	
5	96150	2.4 x 2.4 <40m	Dedicated	√
6	99730	3x 2.4 x 45 m	Dedicated culvert	
6	101100	1.8 x 2.4 x 41 m	Dedicated culvert.	
6	101541	110m length	Bridge	
7	118500	2.3 high x 20m length	Bridge	
8	134600	2.44 high x 40m length	Bridge.	√

Project section	Chainage (m)	Connectivity structure (Cell No x wxhxl*)	Functionality	Targeted Koala Structure
8	136700	Minimum height 2.4m x 20m length	Bridge	√
9	137300	2.4 x 2.4 x <40mm	Dedicated culvert	√
9	138430	1.5 x 1.5m x 64.8m	Dedicated culvert	
9	139440	1.5 x 1.5m x 68.4m	Dedicated culvert	
9	140520	2.4 x 2.4 x <40m	Dedicated Culvert	√
9	142220	2.4 x 2.4 x <40m	Combined Culvert	√
9	142750 (Broadwater Evans Head Rd West))	1.2 x 1.2 x <30m	Dedicated Culvert	√
9	143430	2.4 x 2.4 x <40m	Combined Culvert	√
9	144280	3 x 3 x <40m	Dedicated Culvert	√
9	144700	Minimum height 2.4 x 26 m length	Bridge	√
10	146000	Minimum height 2.4	Bridge	√
10	146280	3 x 3 m x <40m	Dedicated culvert	√
10	146390	3 x 3 m x <40m	Combined culvert	√
10	146630	Minimum height 2.4 x 20 m length	Bridge	√
10	146980	Minimum height 2.4 x 15 m length	Bridge	√
10	147100	2.4 x 2.4 m x <40m	Dedicated Culvert	√
10	148592	3 x 3 m x <40m	Combined culvert	√
10	149250	Minimum height 2.4 x 20 m length	Bridge	√
10	150080	Minimum height 2.4 x 20 m length	Bridge	√
10	150580	2.4 x 2.4 m x <40m	Dedicated Culvert	√
10	150630	Minimum height 2.4 x 20 m length	Bridge	√
10	151196	2.4 x 2.4 m x <40m	Dedicated Culvert	√
10	151825	Minimum height 2.4 x 20 m length	Bridge	√
10	152050	2.4 x 2.4 m x <40m	Dedicated Culvert	√
10	152750 (Wardell Rd)	2.4 x 2.4 m x <40m	Dedicated Culvert	√
10	152970 (Wardell Rd)	2.4 x 2.4 m x <40m	Dedicated Culvert	√
10	153090	3 x 3 m x <40m	Combined culvert	√

Project section	Chainage (m)	Connectivity structure (Cell No x wxhxl*)	Functionality	Targeted Koala Structure
10	153620	3 x 3 m x <50m	Combined culvert	√
10	153882	Minimum height 2.4 x 15 m length	Bridge	√
10	154030	Minimum height 2.4 x 20 m length	Bridge	√
10	154770	2.4 x 2.4 m x <40m	Dedicated Culvert	√
10	155280	2.4 x 2.4 m x <40m	Dedicated Culvert	√
10	155920	2.4 x 2.4 m x <40m	Dedicated Culvert	√
10	156300	Minimum height 2.4 x 15 m length	Bridge	√
10	156970	2.4 x 2.4 m x <40m	Combined Culvert	√
10	157250	2.4 x 2.4 m x <40m	Combined Culvert	√
10	157630 (Coolgardie Rd)	3.6 x 2.4 m x <40m	Combined Culvert	√
10	157745	2.4 x 2.4 m x <40m	Combined Culvert	√
10	157900	Minimum height 2.4 x 20 m length	Bridge	√
11	158868	2.4 x 2.4 m x <40m	Dedicated Culvert	√

Koala faecal pellet searches and searches for Koala scratches on trees will be conducted in adjacent habitat (within 100 m) to the above connectivity structures and during the period that the underpass structures are being monitored. The purpose of these searches is to determine whether there is any evidence of Koala presence near the connectivity structures at the time they are being monitored.

It is proposed that Koala faecal pellets located during the underpass monitoring in Section 10 (and also during the population monitoring, described in Section 8.2) will be collected for genetic analysis. Information gained from this would support the camera monitoring of the structures already proposed by providing information on:

- Koala use of the structures
- Koala breeding on either side of the road
- sex ratios of the population and
- incidence of inbreeding.

TfNSW would work with a suitably qualified expert to fully develop the faecal pellet sampling and monitoring program.

8.4.2 Methods, timing, intensity and duration

Monitoring of underpasses will be undertaken using the following techniques:

- Two motion-detecting cameras with infrared flash will be installed either side of the underpasses, facing inwards, and positioned to capture Koala movements on the ground and on fauna furniture. Cameras will operate continuously for at least three months during the monitoring periods (spring/summer). These monitoring periods are scheduled to occur each

year for the first three years following completion of the project, after which the need for further monitoring will be reviewed (Table 8-4). The performance of each dedicated Koala crossing structure will be determined by evidence of one or more completed crossings during these monitoring periods (Table 8-4). A standardised camera set up will be used to allow comparison with subsequent monitoring events.

- Faecal pellet and tree-scratch searches within 100 m of each end of dedicated crossing structures, and faecal pellet searches within each dedicated crossing structure, will be undertaken when installing and checking camera batteries (once per month during the monitoring periods). Scat samples will be sent to an appropriately qualified/experienced specialist for identification if necessary. Predator scats will be analysed for Koala hair.
- Exclusion fence monitoring: Survey of the Koala exclusion fence for 250 metres either side of the structure will be conducted to identify and report any breaches and report maintenance requirements.

Genetic analysis of faecal pellets would be undertaken by a suitably qualified expert.

The timing of surveys will be selected to coincide with the breeding season and likely juvenile dispersal period of the Koala (September to February and July to August). Koala movements are expected to be more frequent and extensive during the breeding season and dispersal periods due to expansion of home ranges and movement of juveniles away from natal areas. Therefore, these periods are likely to represent peaks in fauna movement, resulting in higher rates of usage of connectivity structures and thus higher rates of detection.

Fauna crossing structure monitoring will commence six months after installation of connectivity structures (i.e. Veage and Jones 2007). Monitoring will be undertaken annually (in Spring/Summer) for a period of up to three years at which time the success of the structures and requirement for additional monitoring will be reviewed. Sites will be re-surveyed at each monitoring event until structures are proven to be effective in line with the adaptive management approach.

Where monitoring indicates that predators are a threat to Koala movement through the crossing structures, Roads and Maritime Services will engage with the North Coast Local Land Services, NSW National Parks and Wildlife Service (Grafton), and Rural Lands Protection Board (North East) and adjacent landowners to identify and implement strategies to reduce this predation risk.

Should this monitoring determine that structures are not being effective at facilitating road crossings for the Koala, or that fencing is not being effective in directing Koalas to the crossing structures or preventing them from accessing the roadway, additional measures, such as retrofitting or modifying culverts to improve the structural integrity and functionality of the structure will be considered.

8.4.3 Performance indicators and criteria

The objectives of the fauna crossing structures are to provide a safe passage for the movement of wildlife, including Koalas, across the highway and to minimise wildlife mortality due to vehicle strike, specifically to maintain local and regional wildlife corridors, home-ranges and genetic exchange between populations.

Performance of the underpass structures and associated fauna fencing will be measured by achievement of the following possible outcomes:

- Evidence of at least one successful completed crossings by Koalas at targeted fauna crossing structures.
- No Koala deaths or injuries due to vehicle strikes in the vicinity of fauna crossing structures.
- No breaches in fauna exclusion fencing or encroachment of shrub or canopy vegetation within two to three metres of fauna exclusion fencing.

To measure and provide for success in achieving the aforementioned objectives, performance indicators and corrective actions have been set and are provided in Table 8-4.

In line with requirements of CoAD9(j), if the connectivity structures cannot be demonstrated to be successful within one year of their implementation, procedure for the submission of further offsets in accordance with conditions D5 and D6(j), will be provided within one year of these findings. Potential offsets have already been identified within an approved offsets strategy.

8.5 Road mortality monitoring

8.5.1 Selection of monitoring locations

Monitoring of Koala mortalities will be undertaken along the entire length of the project (Sections 1-11), with particular focus at targeted fauna connectivity structures.

Koala deaths or injuries will be reported as, and if, they occur along the length of the highway upgrade. The GPS location of each road kill specimen will be recorded and assessed in relation to the closest fauna crossing structure and/or fauna exclusion fence to evaluate their effectiveness.

8.5.2 Methods, timing, intensity and duration

Road mortality monitoring will occur twice per year for a period of five years (between July-August and October-November) in the operational stage of the program. The method will involve walking transects along the road edge (500 metres in length) along both sides of each dedicated fauna crossing structure and upgraded highway. Transects will also be undertaken in areas that are fenced on Wardell Road and the existing Pacific Highway between Wardell and Coolgardie Interchange. It is noted that Koala road fatalities are likely to be rare events and therefore this survey methodology may not capture all Koala mortalities that occur at these areas. However, the surveys are timed to coincide with the breeding season (spring) when Koala movements are greatest (and thus the chance of getting hit on the road is greatest) and they will also enable assessment of the integrity of the crossing structures and fauna fencing within these areas. At other times of the year, any Koala deaths or injuries along the length of the highway upgrade will be reported as, and if, they occur.

A Project Road Mortality Register will be established which will allow construction personnel to report any Koala road mortalities identified during project works.

Roads and Maritime will also undertake regular communication with local wildlife rehabilitation groups (WIRES, Friends of the Koala) so that any injured or killed Koalas reported by the general public will be brought to the attention of TfNSW. Any injuries or deaths of Koalas from wildlife care group records will be incorporated into annual reporting for this project.

In Section 10 annual reporting will include review of Koala road-kill mortalities against known data of Koala mortalities in the area (see Table 8-3). It must be noted that there has been no systematic collection of Koala road-kill data across the study area to date. As such there is no comprehensive data set of Koala mortalities along the roads associated with the Upgrade that could be used as a baseline by which to compare the road-kill monitoring for this project.

The current data available (obtained as part of the demographic study to determine inputs into the PVA, Biolink 2015) assessed Koala mortality records across the Ballina LGA from Lismore-based Friends of the Koala call-out records over the past 26 years. The results indicated that an average of 1.23 animals per year are killed on the four roads identified as 'hotspots' within the study area (see Table 8-3), although annual mortalities of 4-6 animals were considered more likely (Biolink 2015). These authors observed six Koala mortalities caused by vehicle-strike during the six months of their field study, and at least 10 mortalities in 2015 (S. Phillips, *pers. comm.* 14/12/2015). It is therefore possible that the averages derived from the long-term roadkill data may actually be lower than the actual number of Koalas killed on the roads within the study area each year. As such, these numbers will be used as a guide only in reference to the efficacy of the road-kill mitigation measures.

Table 8-3. Standardised Koala vehicle-strike data for major roads within the study area. Numbers in brackets represent additional (i.e. non-FoK) records from NSW Wildlife Atlas that have been included in the “n” value being used. The values in the “Average” column were calculated by dividing “n” by the number of years (26) to which the data relate (from Biolink 2015).

Road	n	Average	km	Number of Koala's per km per annum
Pacific Highway	7(3)	0.269	10.5	0.026
Bruxner Highway	8	0.308	5	0.062
Wardell Road	9.5 (5)	0.365	9	0.041
Bagotville Road	7.5	0.288	8.5	0.034

8.5.3 Performance indicators and criteria

Performance of the fauna connectivity structures in preventing Koala road mortalities will be assessed with the aim of achieving zero Koala vehicle strikes.

To measure and provide for success in achieving the aforementioned objectives, performance indicators and corrective actions have been set and are provided in Table 8-4.

8.6 Koala revegetation monitoring

8.6.1 Monitoring

A revegetation strategy has been prepared that identifies the goals, the landscape context, areas available for planting, suitable tree species, establishment methods, maintenance regimes and an outline of a suitable monitoring program (Kavanagh and McLean 2015). The focus of this strategy was to identify at least 130 ha as the priority for planting prior to construction in Section 10.

Annual monitoring is needed to determine the overall success of:

1. the revegetation activities, including whether replanting is required in some areas, and
2. if the planted areas are being used by Koalas.

Monitoring the success of the revegetation should occur across all field sites monitoring one plot per two hectares of revegetation on each occasion. Monitoring should occur at the same month each year, nominally September. Each site should be marked with a star picket and flagging tape and the location should also be recorded with a GPS. Annual monitoring should occur at each site from year 1, where the following variables are recorded within a 50 x 20 m (0.1 ha) quadrat:

- Density of Koala food trees and shelter trees (initial density=approximately 48 trees per quadrat), their average height and number of visible dead stems.
- Presence and dominance of any environmental weeds, including exotic grasses.
- Presence and condition of Acacia cover-crop, if planted.
- One photo taken at the star picket, facing south (on a 180° bearing).

Opportunistic observations via a random meander, which may occur while walking between sites, should also be undertaken throughout the revegetation area. These observations should identify if any large infestations of environmental weeds are occurring and their location, if any large-scale plant deaths have occurred and if any other environmental issues are developing, such as sheet or gully erosion. The results of these field surveys should be summarised in an annual report provided within two months of the completion of the field surveys. The monitoring should continue for at least five years, and/ or until plantings across 90% of plots have an average height of eight metres (unless otherwise agreed with the EPA).

Monitoring koala use of the plantation areas would commence in year 3 post establishment and continue until year 10 post establishment or until evidence of at least one koala is recorded in each of the seven plantation areas (see Figure 8-3), whichever comes first. If a koala is not recorded in a plantation area after 10 years reasons for the nil result and the need for corrective actions will be assessed as per Table 8-4.

A flexible monitoring approach is proposed where a range of accepted survey methods are applied depending on circumstances. This approach is superior to the original method which included surveying a minimum of 60 Spot Assessment Technique (SAT) plots distributed across the plantations. That method would have resulted in targeted survey of approximately 6ha or 4.6% of the 130ha plantation area. The proposed method still aims to confirm koala use of all plantation areas yet recognises the benefit of using a variety of accepted methods to confirm koala presence and capitalising on other koala surveys that are occurring near the plantations. All the proposed methods are identified by DPE (2022) as being acceptable for determining the presence of koalas and both the original and proposed methods have the same aim of confirming that koalas are using all areas of plantation.

Proposed survey methods would include:

- A Remotely Piloted Aircraft System (RPAS) equipped with a thermal camera – RPAS surveys would involve a systematic (lawn-mower pattern) traverse of plantation areas using an RPAS equipped with a thermal camera. Some RPAS surveys would occur in conjunction with surveys of nearby population monitoring transects, whilst others would specifically target the plantations.
- Diurnal and nocturnal traverses – These surveys would typically involve 1-3 persons walking a transect/s (i.e. a track) through a plantation scanning trees for evidence of koalas. Nocturnal surveys would be done with the aid of an 800-1000 lumen spotlight and binoculars.
- Scat searches undertaken by humans or a scat detection dog – Scat surveys would target specific areas of plantation when koalas have been recorded nearby. Surveys would involve two-minute person searches around the base of trees with a diameter at breast height >100mm. The minimum search area would be 0.1ha.
- Song meters – Song meters may be deployed in the larger plantations, in areas where it is certain that a calling individual would be within the plantation.

- Opportunistic observations – these would occur whilst moving around and through plantations conducting other tasks.

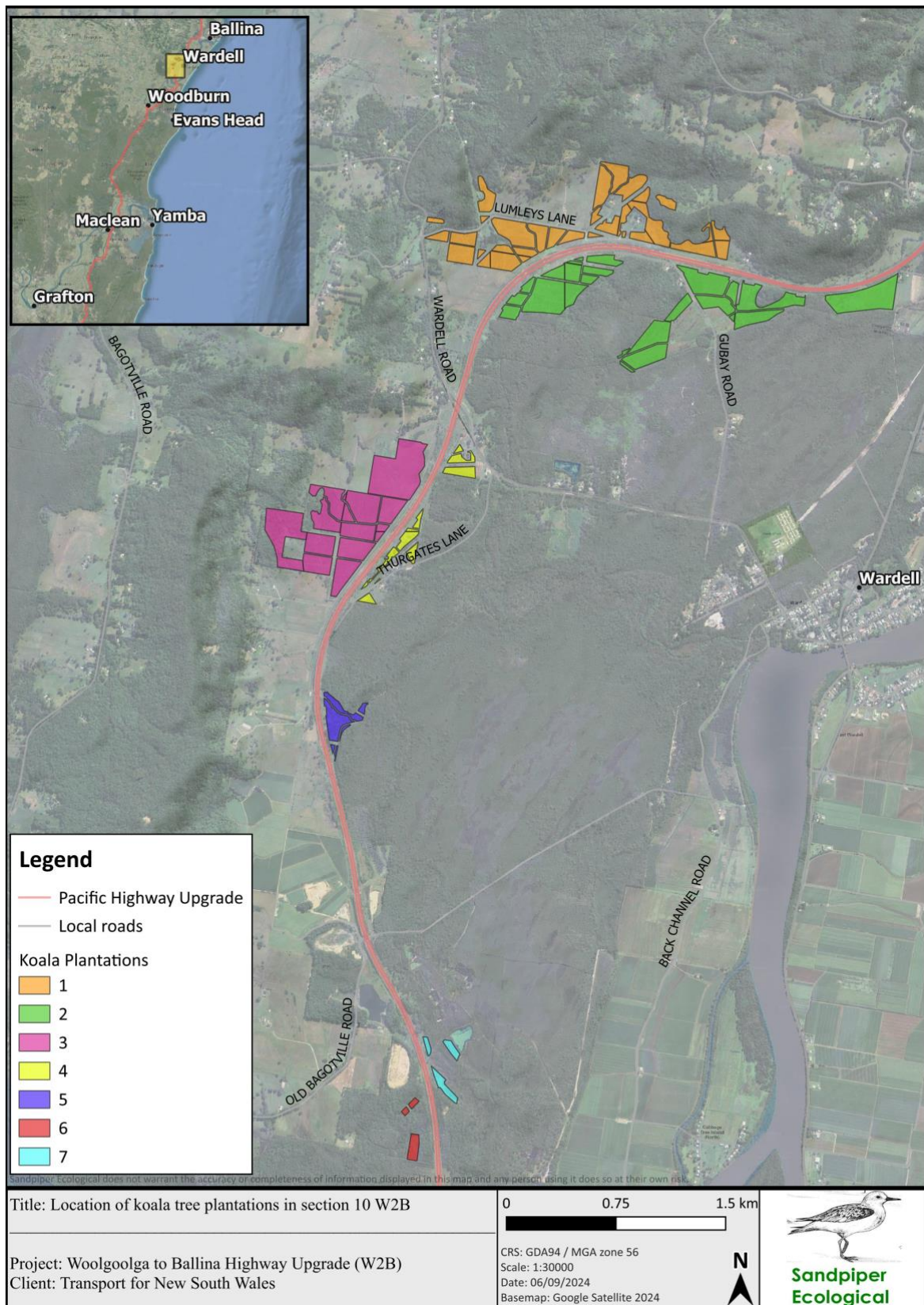


Figure 8-3 Plantation areas to be surveyed for evidence of koalas.

Monitoring within a plantation area (i.e. #1-7) would conclude once use of that area by koalas is confirmed, enabling effort to be re-directed to plantations where koalas have not been recorded. Monitoring would cease when at least one koala has been recorded in each of the plantation areas or at year 10, whichever comes first. Data collected during each survey would include: date, survey duration, personnel, method, area searched, and weather conditions. Once a koala is detected its location would be recorded using a hand-held GPS or the drone and, if possible, its sex and health determined. An annual report will be prepared that documents the results of the field surveys and their success in relation to the management objective, being the use of the plantations by koalas. Results should be interpreted in relation to other information from the study area, including comparable koala “activity” in nearby native forest and trends in the size of the koala population.

By year 10 post establishment if no koalas have been detected it will be necessary to consider additional adaptive management actions, such as planting additional areas with Koala habitat. The requirement for additional re-planting will consider the results of all applied monitoring measures. For example, if the population monitoring indicates the population is declining rapidly, then it may be that there are simply not enough Koalas to use the additional habitat. Any additional, adaptive revegetation works would follow the strategy for site selection and planting methodology as outlined in the current re-vegetation strategy.

8.6.2 Management responses

Management responses should be guided by the results of the monitoring program. At years one, two and three after planting, supplementary tree plantings should occur where it is observed that greater than 20% mortality of tube-stock or densities of less than one plant per 20 m² have resulted. Where woody weeds are present, weeds should be reduced to a density of less than 5% across the revegetation site, while exotic grasses should not be visibly affecting the growth of tube-stock.

After three years, the stand of planted eucalypts should be considered “established” and any further losses should be regarded as part of natural stand thinning due to competition with other planted trees. A stocking rate of 300-400 trees per ha is the expected stand structure of the Koala revegetation program after several decades following plantation establishment.

By year 10 post-establishment, further investigations should be instigated if it is found that Koalas are not using the revegetation areas. These investigations must consider comparable Koala density in nearby native forest, and trends in the size of the Koala population in the study area. Lack of use of the supplementary habitat provided by Koala food tree plantings could occur if the Koala population is in decline due to other factors (e.g. low fecundity, high mortality, limited dispersal opportunities).

8.6.3 Performance criteria

Details of the performance criteria for the provision of 130 ha of new Koala habitat in Section 10 are presented in Table 4 of the Koala Revegetation Strategy (Kavanagh and McLean 2015) and summarised in Table 8-4.

8.7 Evaluation, project review and reporting

Detailed monitoring reports will be prepared outlining the methods and results of the monitoring program.

8.7.1 Responsibility

TfNSW, through its contractor(s) which are employed to undertake the various aspects of monitoring for the project, will be responsible for the evaluation of the monitoring information collected. Monitoring of Koala use of fauna crossing structures and evidence of Koala presence nearby at the time of monitoring, together with habitat revegetation measures, will be undertaken separately for the project, and the success of these mitigation measures will be considered in the evaluation of impacts on the Koala. The identification of appropriate triggers to undertake corrective actions will be the responsibility of TfNSW and its contractors, with TfNSW having the prime responsibility for enforcing any necessary changes as required by this Plan (Table 8-4).

8.7.2 Timing

A brief annual report will be prepared by the contractor(s) for each monitoring project for distribution to the Roads and Maritime, DP&E, EPA and DoE and to document the methods and results from each monitoring period.

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

8.8 Corrective actions

The Koala monitoring program to be undertaken in all Sections (1-11) will focus on the use of mitigation structures, the success of any habitat restoration and its use by Koalas, and the incidence of Koala injuries and road kill during the project, as well as population-level monitoring of Koalas within Section 9 and Section 10. Any contingency measures to be implemented will be agreed to by the relevant regulatory authorities EPA and DoE prior to being commenced. Performance thresholds for each monitoring activity and corrective actions to be implemented if these are not met, and the party responsible for implementation are listed in Table 8-4.

Observations of Koala presence using faecal pellet-search and tree-scratch searches within 100 m in adjacent habitat during the time of monitoring fauna crossing structures will be used to inform assessments of the effectiveness of these structures. If during the operational phase Koalas are found to be unable or unwilling to use designated crossing structures, and Koalas are known to be present in the vicinity of these structures, provisional options will be developed that could be implemented if research and/or monitoring identify that additional or alternative measures are required.

Depending on the outcome of the monitoring of crossing structures, the following options will be considered in consultation with EPA:

- Maintenance of the existing connectivity measures.
- Modify design of existing measures where feasible and reasonable.
- Consider additional offset measures to improve connectivity elsewhere.

Additionally, should a Koala be found to have died as a result of the project (within the fenced areas or highway upgrade) then TfNSW will undertake further investigations regarding the installation of additional fencing on other Koala road-kill hotspot areas – including fencing portions of the Bruxner Highway, if determined to be appropriate.

Table 8-4. Performance indicators and corrective actions.

Performance monitoring	Performance threshold	Corrective actions if deviate from performance threshold	Responsibility
Koala population within Koala 'hot-spots' associated with phased resource reduction.	<p>No injury to a Koala as a result of vegetation clearing within the 'hot-spots' of Wardell Rd and Laws Point.</p> <p>Estimated Koala numbers within hotspot areas do not decline less than 30% compared with baseline numbers (i.e. number prior to works).</p>	<p>Clearing activity to cease until cause of death determined and consult with Koala specialists. Response will depend on cause of death/injury.</p> <p>If Koala numbers within hotspot areas decline by >30% then causes to be investigated and corrective actions implemented accordingly (i.e. dog attack = increased predator control; roadkill = increased fencing).</p>	Roads and Maritime responsible for engaging suitably qualified ecologists/specialists to undertake the required Koala surveys, data analysis and reporting.
Koala population trends in Sections 10 and 8/9	Koala population sizes at or above the minimum expected targets including rate of population change/decline at/above the minimum expected target of 195-276 at five years; 147-272 at 10 years and 103-261 at 15 years.	<p>Complete program review at 5, 10 and 15 years.</p> <p>Identify the key threatening processes which are continuing to impact on Koala population trends (through monitoring of road-kill, connectivity structure use, and use of re-vegetation areas). Incorporate review of roadkill data from local wildlife rehabilitation groups WIRES, Friends of the Koala.</p> <p>Increase efforts to control these key threatening processes. This may include implementing additional dog control, establishing additional Koala habitat, modifying existing or creating new connectivity structures on adjacent road networks, and/or implementing measures to reduce Koala road-kill.</p>	<p>Roads and Maritime responsible for engaging suitably qualified ecologists/specialists to undertake the required Koala population surveys, data analysis and reporting.</p> <p>Roads and Maritime would share responsibility with other government agencies to control threatening processes.</p>
Road mortality monitoring.	<p>All sections - No injury to an individual Koala as a result of vehicle strike.</p> <p>Section 10 - No Koala road mortality within the fenced areas of the Upgrade, on existing Pacific Highway or Wardell Road.</p>	<p>Examine fencing for breach or obstruction within 3 days of report and repair.</p> <p>Retrofit exclusion fencing, or part thereof, with additional measures to deter Koalas.</p> <p>Section 10 – Roads and Maritime would consider erecting Koala proof fencing on the Bruxner Highway (a known Koala road kill hotspot), in an effort to reduce Koala mortality across the region.</p>	<p>Roads and Maritime maintenance responsible for repairing exclusion fencing.</p> <p>Roads and Maritime responsible for undertaking further investigations into installing additional fencing on other Koala road-kill hotspot areas, including fencing of Bruxner Highway if required.</p>
Fauna crossing structure monitoring	<p>Evidence of at least one completed crossing by Koalas at targeted fauna crossing structures.</p> <p>Evidence of Koala individuals using structures and/or breeding on either side of the highway, via scat analysis.</p> <p>No evidence of high visitation/usage rates by exotic predators.</p>	<p>Review monitoring methods, consider increasing frequency, intensity and duration, to ensure individuals are identified.</p> <p>Check fauna furniture associated with underpass for damage and rectify. Investigate habitat adjoining the underpass. Consider improving habitat condition and connectivity.</p> <p>Check general area, including the underpass itself, for the presence of predators. Seek advice and implement predator control.</p>	Roads and Maritime responsible for engaging suitably qualified ecologists to undertake the monitoring and suitably qualified contractors for the maintenance and engaging with regional stakeholders for pest control.

Performance monitoring	Performance threshold	Corrective actions if deviate from performance threshold	Responsibility
Fauna exclusion fencing monitoring	No breaches in fauna exclusion fencing.	Check fauna exclusion fencing and fauna crossing structures for damage/blockage and rectify.	Roads and Maritime maintenance responsible for repairing exclusion fencing.
Predator attack near fauna crossing structures	No Koala deaths or injuries due to predator attack in the vicinity of fauna crossing structures	Where monitoring indicates that predators are a threat to Koala movement through the crossing structures, Roads and Maritime Services will engage with the North Coast Local Land Services, NSW National Parks and Wildlife Service (Grafton), and Rural Lands Protection Board (North East) and adjacent landowners to identify and implement strategies to reduce this predation risk.	Roads and Maritime responsible for liaising with relevant agencies and landowners to identify and implement strategies to reduce this predation risk.
Habitat revegetation monitoring	Years 1-3 - annual density of one Koala food/ shelter tube-stock per 20 m ² across the revegetation site (Years 1-3). Year 5 - trees within 90% of monitoring plots have an average height >8 metres.	Undertake revegetation maintenance, i.e. replanting, replacing, fertiliser treatment, erosion control, weed control where required.	Roads and Maritime responsible for engaging suitably qualified ecologists to undertake the monitoring and suitably qualified contractors for the maintenance of revegetation.
Koala use of food tree plantations	At least one koala recorded in each of the seven plantation areas shown in Figure 8-3 up to year 10 post establishment.	Investigate whether cultivation practices need to be changed to improve the performance of the planted trees. Investigate whether koala occurrence is comparable to nearby native forest. Review trends in the size of the Koala population in Section 10 where the food tree plantings have been established	Roads and Maritime responsible for engaging suitably qualified ecologists to undertake the required Koala surveys to establish whether koala abundance in the food tree plantings are “as expected” based on comparable surveys in nearby native forest.

9. Summary table and implementation schedule

Table 9-1 provides an overall summary of the actions proposed in the above plan. It also identifies the persons responsible for the actions and the estimated timing of the project.

The program schedule will be updated following a review of the approval and project timelines.

Table 9-1 Summary table and implementation schedule of management plan.

No.	Task	Responsibility	Pre-construction	Construction	Operations														
					Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15
1. Pre-construction management																			
1.1	Baseline Koala surveys	TFNSW/Pacific Complete	X																
1.2	Preparation of Koala fencing strategy	TFNSW/Pacific Complete	X																
1.3	Pre-clearing surveys	Contractor’s ecologist	X																
1.4	Identify sensitive ancillary areas and access roads	Contractor and Roads and Maritime	X																
1.5	Dog policy	Contractor and Roads and Maritime	X																
1.6	Phased resource reduction – Section 10 Koala ‘hot-spots’	Koala expert/contractor and Roads and Maritime	X																
2. Construction management																			
2.1	Environmental Work Method Statements	Contractor		X															
2.2	Construction induction and training	Contractor		X															
2.3	Temporary fauna exclusion fencing	Contractor		X															
2.4	Permanent fauna exclusion fencing	Contractor		X															
2.5	Pre-clearing and clearing procedures	Contractor		X															
2.6	Managing Koala / vehicle collisions	Contractor’s ecologist		X															
2.7	Koala relocation protocol	Contractor’s ecologist		X															
2.8	Location of ancillary facilities	Contractor’s ecologist, Roads and Maritime		X															

WOOLGOOLGA TO BALLINA | PACIFIC HIGHWAY UPGRADE: SECTIONS 1-11

No.	Task	Responsibility	Pre-construction	Construction	Operations														
					Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15
2.9	Fauna crossing structures	Roads and Maritime		X															
2.10	Habitat revegetation	Roads and Maritime		X															
3. Operational management																			
3.1	Maintenance of fauna exclusion fencing and fauna crossing structures (ongoing)	Roads and Maritime			X	X	X	X	X										
3.2	Maintenance of revegetation ongoing until revegetation criteria achieved	Roads and Maritime			X	X	X	X	X										
3.3	Predator control dependant on monitoring findings/evidence of predator action on Koala	Roads and Maritime			X	X	X	TBC following year 3 review	TBC following year 3 review										
4. Monitoring program																			
4.1	Selection of population monitoring locations	Ecologist	X																
4.2	Monitoring of Section 10 Koala 'hot-spots'	Ecologist, Roads and Maritime	X	X															
4.3	Fauna crossing structure and exclusion fence monitoring (including faecal pellet genetic analysis) (annually in Spring/summer)	Ecologist, Roads and Maritime			X	X	X	TBC following year 3 review	TBC following year 3 review										
4.4	Road mortality monitoring (bi-annually July/Aug and Oct/Nov))	Ecologist, Roads and Maritime			X	X	X	X	X										
4.5a	Revegetation monitoring (annually) - Plantings (veg plots)	Ecologist, Roads and Maritime			X	X	X	X	X	Until 90% of planting have average height of 8 metres.									

No.	Task	Responsibility	Pre-construction	Construction	Operations														
					Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15
4.5b	Revegetation monitoring (annually) - Koalas	Ecologist, Roads and Maritime						Until evidence of 1 koala is recorded in each of the seven plantation areas.											
4.6	Koala population monitoring (biannually Spring and Autumn)	Ecologist, Roads and Maritime		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
4.7	Review of population monitoring and implementation of adaptive measures if required.	Roads and Maritime							X					X					X
4.8	Evaluation, project review and reporting	Ecologist, Roads and Maritime	X	X	X	X	X	X	X					X					X

Monitoring methodology may change as new technologies/methods are developed and results of power analysis are known. Reporting frequencies are fixed.

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Appendix A Ballina Koala Plan

Appendix B Expert review: Associate Professor Robert Close CV

Appendix C Expert review: Comments and recommendations, and responses by Roads and Maritime Services

The following table summarises the recommendations of the independent expert reviewer and identifies how each of the recommendations have been addressed. Recommendations have been addressed in one of three ways:

- Adopted - plan updated.
- Adopted - plan to be updated prior to implementation.
- To be reviewed - recommendation to be reviewed further by Roads and Maritime prior to implementation.

Table. Summary of recommendations from the expert review and how addressed in this plan

ID No.	Comment / Recommendation	How recommendations have been addressed
KMP1	Reconsider which sections of the Upgrade require focus. Would like to see a map on which all the various Koala sightings are marked as well as the inclusion of vegetation maps so that potential dispersal routes can be visualised.	Adopted- plan updated. See figures 2.1a, 2.2a,
KMP2	Reconsider suitability of methods for gathering base-line data. It will be very difficult to monitor changes, particularly in low density areas for Koalas using the SAT technique	Adopted- plan to be updated, See section 8. monitoring program
KMP3	Reconsider methods for monitoring road kill data (more frequent)	Adopted- plan updated. See section 8.4 Road Kill Monitoring
KMP4	Reconsider methods of catching and treating Koalas located in the clearing areas Ear tagging of captured / relocated individuals is extremely worthwhile	Adopted – plan updated. See Section 6.3.6 Koala Relocation Protocol
KMP5	Captured Koalas should go to the vet rather than the vet goes to the Koala.	Adopted- plan updated. See section 6.3.6 Koala Relocation Protocol
KMP6	Examine side-road fencing	Adopted – plan updated. See section 8.6
KMP7	Consider the approaches to the crossing structure	Adopted- plan updated. See section 6.3.9 habitat revegetation.

Appendix D Agency reviews: Comments and requirements, and responses by Roads and Maritime Services

Department of the Environment review of Koala Management Plan: Sections 1 and 2 February 2015

Requirements of the Conditions	Comment:	Response by TFNSW
General:	<p>Currently, this Plan is intended to cover Sections 1 and 2 of the proposal only. However, as a lot of the content covers the remainder of the action, there is contradicting information between what is proposed for the broader proposal, and what is proposed specifically for sections 1 and 2. This makes the plan difficult to comply with and implement. For example, Table 5.1 refers to temporary fence monitoring to be undertaken, when it is stated in the plan that no temporary fencing will be installed for sections 1 and 2. The same problem occurs for references to population monitoring, which based on this plan is not proposed for sections 1 and 2. Another example is where section 7.1 refers to the objective of determining the extent to which the highway creates a barrier for the Koala, while the plan currently does not provide any mechanism to meet this objective in sections 1 and 2. Furthermore, it is unclear where reference is made to the project, whether this means the whole upgrade or the projects in section 1 and 2.</p> <p>The Department recommends that the format be addressed to amend this as we understand that approval of this plan would be sought prior to it being updated to address the remaining sections.</p>	<p>The format and content of the report has been addressed throughout to clarify that this plan is referring principally to highway upgrades along Section 1 and Section 2. In a number of areas, where it was considered useful to include a broader context, reference has been given to the entire project.</p> <p>Table 5-1 (re-labelled as 5-2) has been revised to deal with temporary fencing. Table 7-1 has been revised to deal with monitoring objectives of Section 1 and section 2.</p>
General	The Department notes and concurs with the EPAs comments on the Plan.	Noted refer to responses below.
General	Key sections of the document, and mitigation measures proposed within, are currently worded as recommendations. The Department recommends that this wording be strengthened to clear commitments by TFNSW.	Word such as “would” have been replaced by “will”, etc. throughout the document.

General	<p>There seems to be confusion in the plan between performance thresholds and triggers for corrective actions. Performance thresholds are thresholds that are trying to be met and for which deviation from these thresholds would result in corrective actions being implemented (as is written in the headings of tables within the document).</p> <p>On the other hand triggers for corrective actions are negative outcomes which would trigger corrective actions. Currently the majority of the actions/statements under the performance measures heading are actually triggers for corrective actions. Therefore, as currently written, deviation from these measures, which would trigger corrective actions, would in effect result in corrective actions being implemented when the desired outcome is being achieved. The actions under the heading or the terminology used in the heading needs to be amended to address this inconsistency.</p>	<p>The column headings for “Performance thresholds” in Tables 4-1, 5-2 and 6-2 have been altered. The language used to describe performance thresholds has been changed to remove inconsistencies in terminology.</p> <p>Alterations to language have also been inserted in 7-2 under “performance indicator”.</p>
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<p>D9 (a) demonstration that adequate surveys have been undertaken to assess the impacts of the SSI with reference to the Mitigation Framework developed under condition D1, including baseline data collected from surveys, undertaken by a suitably qualified and experienced ecologist on threatened species and ecological communities within all habitat areas to be cleared of vegetation for the SSI, that are likely to contain these species and that are likely to be adversely impacted by the SSI (as determined by a suitably qualified expert). The data shall address the densities, distribution, habitat use and movement patterns of these species;</p>	<p>Currently, no reference is made to the Mitigation Framework in the Plan. While there is a brief reference to additional surveys undertaken, further information is required to demonstrate the adequacy of these surveys, as required by this condition (noting the expert comment that SAT surveys are not sufficient to determine population density). Furthermore, the baseline data from the surveys and the detail of the location and methodology of the surveys needs to be provided.</p> <p>Currently, the plan appears to still rely heavily of NSW Wildlife Atlas records, and not on evidence based on surveys undertaken. This may be as a result of the plan being updated in parts for section 1 and 2, but not in other parts (see general comment above). Further information, including the details of surveys undertaken should be included as a part of this plan.</p> <p>The data provided for sections 1 and 2 does not address all the requirements of the condition (distribution and movement patterns). The Department notes that the low density of Koalas in this area may is likely to be the reason for this and requests that this be clarified.</p>	<p>New reference to the Biodiversity Mitigation Framework has been inserted in part 1.2.</p> <p>The population density of Koalas in Section 1 and Section 2 is considered to be too low using any survey method to achieve cost-effective and accurate assessments of Koala density. This is the reason why baseline surveys are not being undertaken in Section 1 and Section 2, because such low population densities will be difficult to monitor and any changes that may occur cannot be determined statistically from the data that would be collected.</p> <p>Additional information about Koala surveys undertaken, and the results of these surveys in Section 1 and Section 2, has been presented in part 2.2 of this Plan.</p>
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		The low density of Koalas in Section 1 and Section 2 is the reason why detailed studies of Koala distribution and movement patterns have not been undertaken in these Sections.
(b) identification of potential impacts on each species;	<p>The Department recommends that this plan needs to contain all the detailed impact assessment for the Koala for sections 1 and 2, including the amount of habitat to be cleared (for example, this is required on page 25)</p> <p>The Department also notes that reference is made to the interim EPBC Act guidelines for the species and not the current guidelines, a draft of which was made available for public comment in late 2013. These are available at http://www.environment.gov.au/biodiversity/threatened/publications/epbc-act-referral-guidelines-vulnerable-Koala</p> <p>Please confirm that these guidelines have been considered in determining the quantum of habitat critical to the survival of the species likely to be impacted by the action.</p> <p>Page 41, 6.1 impacts from operation phase – please add road kill as an impact. This is currently presented as a result of degradation of fauna fencing only, when it can easily occur in unfenced areas or areas where there are gaps in the fence, or where inappropriate fencing is used.</p>	<p>The total amount of Koala habitat that is to be cleared for the entire Project has been amended upwards to 782 ha. This is indicated in part 3.1 of this Plan.</p> <p>A Table showing the breakdown by Sections (including Section 1 and Section 2) is presented in Table 3-1.</p>

		<p>The new (2014) guidelines were consulted, but were not considered to change the results of the now, more conservative, estimates of Koala habitat that will be removed (782 ha across the entire Project). The EPBC Biodiversity Offset Policy, in conjunction with the nominal tree species composition of NSW Biometric Vegetation Types, were used as the basis for calculating areas of habitat critical for the survival of the Koala (see part 3.1 of this Plan).</p> <p>Amendments have been made to Table 6-1 (re-labelled 6-2) to include Koala deaths and injuries as a possible impact.</p>
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<p>(c) details of and demonstrated effectiveness of the proposed avoidance and mitigation and management measures to be implemented for each threatened species including measures to at least maintain habitat values of habitat areas compared to baseline data and maintain connectivity for the relevant species;</p>	<p>Specific measures, as proposed for section 1 and 2, based on surveys undertaken in these areas are required. For example, please provide further information regarding the locations proposed for revegetation and the location of proposed fencing. Reference to a fencing strategy is made on page 31, however the strategy is currently not included. Please attach the strategy to the plan or provide a reference as to which plan the document is attached to, and a discussion of the key outcomes to be addressed in the strategy.</p> <p>Insufficient baseline data is currently presented to meet this requirement. A discussion is also required as to how habitat values will be at least maintained.</p> <p>In section 4.3.3, it is stated that the results of pre-clearance surveys would inform procedures for staged clearing. Please provide further information about how this would occur.</p>	<p>Strategic plantings will be undertaken adjacent to connectivity structures to improve connectivity. Plantings will be endemic species which will include Koala food trees. The fencing strategy is included in the connectivity strategy for Sections 1 and 2 please refer to this document.</p> <p>As above, no baseline surveys undertaken because of low densities and expert review comment.</p> <p>A new paragraph has been inserted into part 4.3.3.to state: Pre-clearing surveys include a 2-staged process for habitat trees and any trees that contain fauna. If a Koala is found, clearing will stop and the area left for 24hrs to allow the Koala to relocate. If the Koala is still present after 24hrs, the Koala will be trapped and relocated. A Koala spotter will also be present during clearing operations.</p>
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	<p>Please identify the basis for selecting exclusion zones and their proposed locations.</p> <p>Location of ancillary facilities page 39 – please define ‘low ecological value’.</p>	<p>Exclusion zones are those that include Biometric Vegetation Types containing Koala food tree species that are located outside the construction footprint.</p> <p>A suitably qualified ecologist will use his/her professional judgement to identify land as being of ‘low ecological value’ based on a site inspection and ecological assessment report,</p>
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<p>(d) an adaptive monitoring program to assess the use of the mitigation measures identified in conditions B10 and D2. The monitoring program shall nominate appropriate and justified monitoring periods, performance parameters and criteria against which effectiveness of the mitigation measures will be measured and include operational road kill and fauna crossing surveys to assess the use of fauna crossings and exclusion fencing implemented as part of the SSI;</p>	<p>D2 connectivity strategy – The Department notes that the location of the proposed crossings can only be confirmed once the strategy has been approved and that these must be informed by the further survey undertaken since the EIS/PIR (e.g. page 37). This is currently not addressed in the plan.</p> <p>Further justification of the monitoring periods proposed is required to address the requirement of this condition. For example, in Table 5.1 a monthly inspection of fencing is proposed, and in section 7.4.2 biannual road kill monitoring is proposed. Further justification is required to demonstrate that this is sufficient.</p> <p>Section 5.3.4 – please provide further detail as to the retrofitting of fencing, specifically how the location and extent would be determined, and what amount of Koala road kill, over what period of time would need to occur to trigger this corrective action.</p>	<p>No further surveys have been undertaken for Koalas in Section 1 and 2 for reasons explained above. The connectivity strategy identifies connectivity structures that will facilitate the movement of fauna including the Koala. The connectivity strategy has been closely developed in consultation with EPA</p> <p>Table 5-2 (previously 5-1) refers to daily inspections for Koala deaths and injuries during the clearing phase, and monthly inspections immediately after clearing.</p> <p>Part 7.4.2 refers to bi-annual road-kill monitoring during the operational phase of the Project.</p> <p>The timing of monitoring of effectiveness of mitigation structures is set to co-incide with periods of peak movements of Koalas (dispersal of sub-adults and movement of adults during the breeding season).</p>
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		Retro-fitting of Koala exclusion fencing in Section 1 and Section 2 is dependent on records of Koala deaths or injuries in these Sections of the highway upgrade. One Koala mortality is sufficient to trigger an investigation to determine whether this course of action is required.
(e) monitoring methodology for threatened flora and fauna adjacent to the SSI footprint,	The Department notes that population monitoring is not proposed based on the density of Koalas in sections 1 and 2. The plan needs to be updated to include the survey data that supports this statement. Once these are included and this is demonstrated, the Department would agree with the proposal to remove population monitoring requirements for these sections.	Additional information about Koala surveys undertaken, and the results of these surveys in Section 1 and Section 2, has been presented in part 2.2 of this Plan.
(f) goals and performance indicators to measure the success of mitigation measures, which shall be specific, measurable, achievable, realistic and timely (SMART), and be compared against baseline data;	<p>Goals and performance indicators do not currently meet this requirement and need to be updated to be more specific, measurable, achievable, realistic and timely (see for example table 5.1, 6.1 and 7.2 and the specific examples below).</p> <p>Section 6.2 page 41 – main goals for management are defined as: zero or reduce rate of reported Koala deaths - For this goal to be achievable, baseline data needs to be provided against which it will be measured; Targeted crossing found to be “used by Koalas” – this should be further defined i.e. Koalas are found to be making a full crossing; “Successful” revegetation also should be defined and can only be achieved when the vegetation is self-sustaining, not for a period of five years post construction</p> <p>Table 5.1 Exclusion zones: The Department suggests adding performance thresholds of damage to vegetation within exclusion zones, not just vehicle breaches; for the proposed replanting of Koala habitat outlined in this table, the thresholds need to include survival rates to be achieved and within what timeframes they will be achieved.</p>	<p>Goals and performance indicators have been revised to better reflect SMART criteria.</p> <p>Goal re-defined to clarify as “No Koala deaths or injuries” (baseline data unnecessary).</p> <p>Goal re-defined as “Evidence of completed crossings by Koalas at targeted fauna crossing structures</p>

	<p>Table 7.2 – in the vicinity needs to be further defined to clarify what distance this is referring to</p>	<p>Goal re-defined as “Less than 30% mortality of planted Koala feed trees in Koala habitat revegetation areas on Roads and Maritime owned land for a period of five years post-construction” is a reasonable metric to assume revegetated area will continue to survive and become self-sustaining. (i.e. additional evidence of flowering/ seeding/ germination is unrealistic).</p> <p>Exclusion zones are normally defined as the boundary of the approved clearing footprint. These areas will be marked with temporary flagging tape or temporary fencing. Any breaches by vehicles or equipment will be reported.</p> <p>Performance thresholds for tree planting of habitat for Koalas will be set at less than 30% mortality of planted trees.</p> <p>The term “vicinity” has been deleted and the performance indicator revised.</p>
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<p>(g) methodology for the ongoing monitoring of road kill, the species densities, distribution, habitat use and movement patterns, and the use of fauna crossings during construction and operation of the SSI, including the proposed timing, and duration of that monitoring;</p>	<p>7.4.1 Please amend incorrect references to sections of the proposal in this section.</p> <p>7.4.2 please provide further justification of the frequency of the proposed monitoring</p>	<p>Edits made as required.</p> <p>Ad-hoc observations of Koala deaths or injuries may occur, and will be reported, at any time throughout the project, However, more formal monitoring, involving searching on foot for any evidence of road-killed animals, will be confined to two sampling periods per year. This constraint is applied because it is necessary to restrict traffic flows along the highway to enable this monitoring work to be done.</p>
<p>(h) provision for the assessment of monitoring data to identify changes to habitat usage and whether this can be attributed to the SSI;</p>	<p>n/a based on low density of individuals</p>	<p>Not applicable within Section 1 and Section 2 because of the very low population density of Koalas that occur in this area.</p>

<p>(i) details of contingency measures that would be implemented in the event of changes to habitat usage patterns, entities, distribution, and movement patterns attributable to the construction or operation of the SSI, based on adequate baseline data;</p>	<p>No baseline data is currently presented to address this requirement</p> <p>The Department recommends that the corrective actions in this table be strengthened. For example:</p> <ul style="list-style-type: none"> • Retrofitting of rabbit proof fence with smooth metal sheeting is proposed on page 34 – further information is required regarding what level of road kill would trigger this action, and the location and extent of fencing that would be installed, and a clear commitment to implement this action if required. • Table 5.1 Proposes a corrective action to review Koala measures if more than one Koala is reported as killed (or injured) as a result of road strike – please clarify over which period this would be measured. • Table 5.1 Retrofitting of fencing is proposed as a corrective action – within what timeframe would this occur from when a Koala road strike is reported? • The Department requests that a corrective action be included that ensures that for sections 1 and 2, where temporary exclusion fencing is not proposed, that it be installed should Koalas be recorded, injured or killed in the clearing footprint • Section 6.3.1 Fencing monitoring– how often will this occur? How will it be undertaken? In what timeframe would fencing be repaired once a breach is reported? • Table 5.1 The Department recommends that “adding additional exclusion fencing in unfenced areas” is added as a corrective action; identify and <i>implement</i> actions is added to the corrective action proposed for mortality from dog attacks. 	<p>Not applicable within Section 1 and Section 2 because of the very low population density of Koalas that occur in this area.</p> <p>Clear commitment has been made to consider the need to retro-fit fencing to provide further deterrence to Koalas.</p> <p>Table 5-2 refers only to the construction period, however, this corrective action applies for up to five years during the operational period (Table 6-2).</p> <p>Action to locate and repair a faulty exclusion fence (if present) will be undertaken within 3 days of Koala death being reported. Retro-fitting, if required, will be undertaken in consultation with suitably qualified ecologists.</p> <p>Corrective actions will include the provision of exclusion fencing where there is none if Koala deaths or injuries are recorded.</p>
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		<p>Periodic monitoring and maintenance of exclusion fencing will be undertaken for the life-time of the project.</p> <p>Edits made to Table 6-2 regarding exclusion fencing and corrective actions for mortality from dog attacks.</p>
(j) mechanisms for the monitoring, review and amendment of these plans;	Requirement met	
(k) provision for ongoing monitoring during operation of the SSI (for operation/ongoing impacts) until such time as the use and effectiveness of mitigation measures can be demonstrated to have been achieved over a minimum of three successive monitoring periods, unless otherwise agreed by the Secretary in consultation with the EPA, DPI (Fisheries) and DoE; and	The commitment to undertake monitoring until such time as the use and effectiveness of mitigation measures can be demonstrated to have been achieved over a minimum of three successive monitoring periods for the monitoring proposed for mitigation measures must be included in this plan. (for example road kill monitoring in table 6.1)	This commitment is stated in Table 6-2.

<p>(l) provision for annual reporting of monitoring results to the Secretary and the EPA, DPI (Fisheries) and DoE, or as otherwise agreed by those agencies.</p>	<p>Requirement met</p>	
<p>In developing the Plans, the Applicant shall demonstrate to the satisfaction of the Secretary and DoE, how the public authorities and expert reviewer recommendations provided for each draft plan in the documents listed in condition A2(c) have been addressed, including detailed justification of any variance from the recommendations of the expert reviewer of the management plans, including analysis of potential risk to the threatened species.</p>	<p>The Department notes the expert's comment that the SAT technique is recommended as being unsuitable to determine population densities. Please discuss how this has been addressed.</p>	<p>The key thing to note is that the SAT technique is not designed to provide a measure of Koala population density. The SAT technique is an “indirect” method which can provide estimates of relative use by Koalas of different areas or vegetation types. Other “direct” survey methods are required to estimate Koala population density. These direct survey methods are not effective or cost-efficient when Koala population densities are very low, as in the case of Section 1 and Section 2.</p>

NSW Environmental Protection Authority review of Koala Management Plan: Sections 1 and 2
December 2014

Comment:	Response by TFNSW
<p>Section 4.3.1 - EPA recommends using fauna drop downs rather than escape poles in sections 1 & 2 due to the low number of Koala records. Drop downs need to be designed with 1200mm clearance down the front. Place drop downs close to entry nodes and less frequently further away from entry roads, arbitrarily every 500m. The EPA welcomes the opportunity to consider alternative escape mechanism designs. The EPA believes escape mechanisms are a vital design feature of 4 lane highways however further research and experiment is necessary to improve the efficacy of designs.</p>	<p>New text has been inserted in part 4.3.1 to reflect this requirement.</p>
<p>Sections 5.3.4 – EPA supports the decision not to provide temporary Koala exclusion fencing during construction and operation. However as discussed in this section and in Table 6-1 any Koala road accidents/ kill should trigger analysis of potential Koala movement areas and the subsequent need for retrofitted metal sheeting.</p>	<p>The Table has been updated to reflect this requirement.</p>
<p>Section 5.3.8 - EPA recommends that all Koala furniture is a minimum of 200mm diameter. Also the EPA would prefer the installation of horizontal logs rather than planks.</p>	<p>New text has been inserted in part 5.3.8 to reflect this requirement.</p>

NSW Department of Planning and Environment review of Koala Management Plan: Sections 1 and 2

January 2015

Comment:	Response by TFNSW
<p>The plan needs to more clearly demonstrate what surveys have been undertaken for W2G (condition D8(a)). Some detail is required on each of the key points in D8(a) (e.g. density, habitat use and movement patterns).</p>	<p>Additional information about Koala surveys undertaken, and the results of these surveys in Section 1 and Section 2, has been presented in part 2.2 of this Plan.</p>
<p>For D8(a), it is also necessary to link to the Mitigation Framework. Could you let me know the status of the framework for W2G?</p>	<p>New reference to the Biodiversity Mitigation Framework has been inserted in part 1.2.</p>
<p>Information about how the expert review comments have been reviewed and incorporated into the plan should also be provided.</p>	<p>Provided in Appendix B of this Plan.</p>

Department of the Environment review of Koala Management Plan: Sections 1 and 2

Additional comments - April 2015

Condition No	Condition requirement	Section/ Page Reference of the document/Plan	Department Comment Date – 14/4/2015	TFNSW Response Date – 28/4/2015
8	Develop a Koala management plan as per NSW condition 8 and 9 for each relevant stage	This plan	This plan has been prepared to address mainly section 1 and section 2 of the project which is from Woolgoolga to Halfway Creek	
General		Table 3-1 and page 17	Response required The figures provided for total clearing of vegetation within sections 1 and 2 (section 3.1) do not appear to correspond with those provided in Table 3-1.	Table 3-1 displays the correct information, following merging of the vegetation polygons used by different consultants and constraining analysis to the areas proposed for clearing as part of the highway upgrade footprint. The text on p. 17 has been updated to correspond to the information presented in Table 3-1.
8	Plan must minimise impacts to Koala to the satisfaction of the Minister	Sections 4, 5 & 6	See below.	
	Management – pre construction	Section 1.3	Response required Tables 4-1 should include a column on responsibility/responsibly party	Table 8-1 lists the responsible parties for each stage of the Koala Management Plan, including pre-construction works.

	Management-construction	<p>Section 5</p> <p>Section 5.3.7</p>	<p>clearing procedures, relocation protocol are discussed satisfactorily.</p> <p>Response required</p> <p>Please ensure that this plan designates the speed limit for construction vehicles within the construction corridor, as this plan will need to be implemented by the Contractor as part of the CEMP for sections 1 & 2.</p> <p>The expert review raised the issue of side roads joining the main highway as a major hazard which can funnel Koalas on to the highway and suggested fencing side roads in conjunction with permanent fencing on the adjacent highway or removing vegetation from around the road entrance. It would appear that the applicability or otherwise of this recommendation, and if applicable appropriate mitigation measures to sections 1 and 2 have not been included.</p>	<p>The designated speed limit will vary between different construction activities and construction machinery. The Traffic Management Plan will identify speed limits for each construction activity. The speed limit within the construction zone will range from approximately 10km/hr – 60km/hr.</p> <p>Speed limits will be reduced to 80km/hr on the existing Pacific Highway and 40km/hr on local access roads. Koala floppy top fencing is not proposed on Section 1 and 2 because of the low population densities. For instances where fauna become trapped in the road corridor the connectivity strategy for Section 1 and 2 includes escape drop downs to allow fauna to exit the construction corridor. The issue of side roads funnelling Koalas onto the highway will be further considered for the populations referred to in MCoA D9. TFNSW is currently looking into solutions to resolve this issue (e.g. Koala “roller grids”). TFNSW is also required to meet MCoA D9 (d) (vii) “provide passage for Koalas under or over the existing highway and service roads or local roads (servicing over 100 vehicles per day)”.</p>
	Management construction	Table 5-2	<p>Response required</p> <p>It is unclear why the measure provided under main goal for management (performance objective) and the</p>	Performance measures in Table 5-2 amended to:

			<p>performance threshold (trigger) is the same. If there are no injuries to a Koala this should not trigger corrective action. The trigger should be any injury to a Koala individual.</p> <p>Please include a column on responsible party for monitoring and taking corrective action.</p>	<p>“Any injury to an individual Koala during clearing works”.</p> <p>Also:</p> <p>“Any injury to an individual Koala during construction activities”.</p> <p>Table 8-1 lists the responsible parties for each stage of the Koala Management Plan, including construction activities.</p>
	Management construction		<p>Response required</p> <p>Should include weed management and water quality management in table 5-2</p> <p>Please confirm that general fauna fence (F1) referred to in Table 54 of the connectivity strategy provides for Koalas as described in section 5.3.4 of the Koala Management plan.</p>	<p>Table 5-2 amended to include references to weed management and water quality management</p>

				<p>Section 1 and Section 2 have relatively low Koala population densities and, as such, typical floppy top fencing used for Koalas will not be applied to these sections. Instead, a modified rabbit proof fence has been developed which is minimum 1200 mm high mesh fence pegged into the ground and secured with concrete posts. Although this fence is not targeting Koalas, it will act as a barrier for Koalas. In developing this fence design, extensive consultation was undertaken with biodiversity specialists from the EPA. If Koala accidents or road kills occur during the operation of Section 1 and 2, this fence, or parts thereof, will be retro-fitted with smooth metal sheeting as an additional deterrent to Koalas.</p>
	Management – Operation	<p>Section 6.3</p> <p>Table 6.3.2</p>	<p>Response required</p> <p>Frequency of maintenance inspections of fauna exclusion fencing will need to be specified.</p> <p>Table 6.3.2 needs to include a column on responsible party.</p>	<p>Section 6.3.1 has been amended to indicate that fauna exclusion fencing will be inspected and maintained every six months, or in response to any Koala injuries or death.</p> <p>Table 8-1 lists the responsible parties for each stage of the Koala Management Plan, including maintenance activities.</p>
	Responsibilities for implementation of the plan	Section 1.3, Chapter 8	<p>Construction contractor and ecologist engaged will be responsible during construction phase.</p> <p>TFNSW will be responsible for operational phase.</p>	Table 8-1 lists the responsible parties for each stage of the Koala Management Plan.

			<p>Please see comments above for inclusion in to the relevant Tables</p> <p>Response required It is important to delineate responsibilities as per previous comments given the split of responsibilities.</p>	
NSW D8(a)	Demonstration of adequate surveys	Sections 2.2, 2.2.1, 2.2.2 and figures 2.1 a & 2.2a	The level of surveys undertaken for sections 1 & 2 appears reasonable.	
		5.3.8 & Table 5-1	Table 5-1 provides a list of key Koala connectivity structures and their locations for sections 1 & 2 and includes 6 bridges and 18 culverts. These have been developed in consultation with NSW EPA/OEH and DPI (Fisheries). This will need to be updated with the information provided in the Connectivity strategy (final connectivity structures).	Table 5-1 has been updated to include the relevant information provided in Table 5 of the Final Connectivity Strategy (April 2015). One additional bridge (64 m) over a tributary of Corindi Creek at chainage 6170 has been included in Table 5-1. Additional changes to the text of the Plan have been made in part 5.3.8.
NSW D8(d)	Monitoring program to assess the use of mitigation measures-include monitoring periods, performance parameters and criteria against which effectiveness will be measured.	Section 7	<p>Response required Please confirm if Table 7-1 indicates locations of under passes where motion cameras will be located on either end of each culvert. Section 7.3.2 states motion detection cameras will operate continuously during the monitoring period (spring/summer). Please specify the monitoring duration. Duration is given as until structures are proven to be effective. This will need to be defined in terms of how many successful crossings over what period of time.</p>	Text has been added in part 7.3.1 to clarify that: "Motion sensor cameras will be installed at each end of the Koala dedicated underpass structures listed in Table 7-1 to determine whether Koalas are prepared to undertake complete crossings of these structures". Additional text also includes: "Koala faecal pellet searches and searches for Koala scratches on trees will be

			Ideally x number of years following the construction of structures and following operation of the highway.	<p>conducted in adjacent habitat (within 100 m) to the above connectivity structures and during the period that the underpass structures are being monitored. The purpose of these searches is to determine whether there is any evidence of Koala presence near the connectivity structures at the time they are being monitored.”</p> <p>Section 7.3.2 has been amended to read “Cameras will operate continuously for at least three months during the monitoring periods (spring/summer). These monitoring periods are scheduled to occur each year for the first three years following completion of the project, after which the need for further monitoring will be reviewed (Table 8-1). The performance of each dedicated Koala crossing structure will be determined by evidence of one or more completed crossings during these monitoring periods (Table 7-2).</p>
NSW D8(e)	Monitoring methodology	Section 7	<p>Motion cameras, remote cameras, digital photography, SAT assessment are proposed.</p> <p>Response required</p> <p>For SAT and remote camera monitoring of adjacent habitat – please provide a definition in terms of distance for adjacent areas</p>	<p>Text in 7.3.2 has been amended to clarify distance (100 m) and timing (monthly) over which Koala faecal pellet searches and Koala tree-scratch searches will be undertaken either side of dedicated fauna crossing structures that are being monitored with remote cameras.</p>

NSW D8(f)	Goals and performance indicators		See previous comment under condition 8	Amendments made to performance indicators in Tables 6-1 and 7-2.
D8(g)	Methodology for ongoing monitoring of road kill, species densities, distribution, habitat use and movement and use of fauna crossings Timing and duration of monitoring	7.3.2	See previous comment under D8(d)	Amendments made within part 7.3.2 to clarify monitoring methodology. Further information in Tables 7-2 and 8-1. Scat-search and tree-scratch searches will be undertaken within 100 m in habitat adjacent to each dedicated crossing structure. Methodology is clarified in 7.3.2. The purpose of these search plots is to identify whether Koalas have recently been in proximity to the dedicated fauna crossing structures which are being monitored.
D8(h)	Provision for assessment of monitoring data to identify changes attributable to the project	7.3.2, 7.6	No comment	
D8(i)	Details of contingency measures in the event of changes to habitat usage patterns, distribution and movement patterns attributable to the project	7.6		Text amended in 7.6 to read “Observations of Koala presence using faecal pellet-search and tree-scratch track searches within 100 m in adjacent habitat during the time of monitoring fauna crossing structures will be used in assessments of the effectiveness of these structures.”

D8(j)	Mechanism for monitoring, review, and amendment of the plans	7.5	Not addressed under section 7.5	7.5 amended to include the following new text: “The responsibility for identifying appropriate triggers to undertake corrective actions, if needed, will be shared between TFNSW and its consulting ecologists, with TFNSW having the prime responsibility for enforcing any necessary changes as required by this Plan (Table 8-1).”
D8(k)	Provision for ongoing monitoring during operation until the success of mitigation measures are demonstrated	7.3.1 & 7.4.2	Has not been satisfactorily addressed under section 7.3.1 or section 7.4.2. se comment under D8(d)	Table 8-1 outlines the implementation schedule for monitoring activities in this Plan. Text has been amended in 7.3.1 and 7.4.2 to clarify these issues.
D8(l)	Annual reporting of monitoring results	7.5	No comment	

Department of the Environment review of Koala Management Plan: Sections 1-8 (excluding Woombah population), and 11 (version 3)

Comments - September 2015

Condition No	Condition requirement	Plan Reference	Department Comment Date – 15/09/2015	Proponent Response Date - November 2015
General Comments		2.2.5 – 2.2.6	<p>Section 5: Maclean to Iluka Road states that further discussions of this population will be deferred until Update 3 (version 4) of this Koala Management Plan as the Iluka /Woombah population is present from chainage 94000 to 102000.</p> <p>Figures 2-5 and 2-6 show that the areas between these chainages are predominately in section 6.</p> <p>Queries</p> <p>Will further discussion of this population be included for section 6 in the updated version since this population spans both sections 5 and 6?</p> <p>Will the updated version (version 4) be provided for approval before works will begin for sections 5 and 6? Under EPBC approval Condition 8, the relevant stage cannot commence until the KMP for that stage is approved.</p> <p>The information for stages 5 and 6, including the Woombah population, is required in order to approve this KMP for those stages.</p>	<p>Further information will be included in Update 3 (Version 4) about the populations between chainage 94000 to 102000.</p> <p>Construction will not commence within chainage 94000 to 102000 until version 4 is approved.</p>
		Figures 2-1 – 2-11	<p>No information for connectivity structures has been proposed in this plan. The titles for these figures indicate that connectivity information is detailed.</p> <p>ACTION</p> <p>Please consider revising the title of these figures.</p>	<p>The titles of all figures (1-8, 11) have been revised to remove reference to connectivity structures.</p>

EPBC 8	The approval holder must develop a Koala Management Plan(s) pursuant to the requirements of NSW approval conditions D8 and D9 for each relevant stage(s) . The Koala Management Plan must minimise impacts to the Koala to the satisfaction of the Minister and must be submitted to the Minister for approval.		This plan has been submitted as a requirement under NSW approval condition D8 as the plan covers sections 1-8 (section 1-2 previously approved – 11/5/2015) and section 11. MCoA D9 is not required for these sections as it is not within Koala populations at Coolgardie/Bagotville, Broadwater and Woombah/Illuka. Version 4.0 to the KMP will incorporate these populations for MCoA D9.	No action required
NSW MCoA D8	The Applicant shall prepare and implement Threatened Species Management Plans to detail how impacts of the SSI will be minimised and managed specifically for each species identified as significantly impacted.			Actions underway
a)	demonstration that adequate surveys have been undertaken to assess the impacts of the SSI with reference to the Mitigation Framework developed under condition D1, including baseline data collected from surveys	Ch 2	<p>Figures 2-1 to 2-11 have been provided to the Department separately to the Koala Management Plan.</p> <p>Figure 2-3 shows two Koala scat search plots where scats were located. Table 2-3 indicates that 'four plots recorded Koala scats in the Bushgrove area. This occurred in three different vegetation types.'</p> <p>At least 17 Koala Atlas sightings have been recorded at the southern region of section 3 on both the Bom Bom and Glenugie state forest sides (Figure 2-3). Table 2-3 states 'Four BioNet records in the broader landscape, with other records outside of the broader landscape'.</p>	<p>This was a plotting overlay issue which has now been rectified and the Figure redrawn.</p> <p>Text edited in Table 2-3 to indicate many older records present in southern part of Section 3</p>

			<p>Section 2.2.3 Section 3: Glenugie to Tyndale states that ‘BioNet records of the Koala for this section are sparse compared to other locations’ and ‘Koalas occur at very low population densities along Section 3 of the Pacific Highway Upgrade’. The historic records as shown in figure 2-3 indicate a high density of Koala activity in the southern region of this section, particularly relative to other sections of the project as outlined in this plan.</p> <p>ACTION</p> <p>Please consider the use of floppy top fencing in the southern portion of section 3 due to the higher level of historic Koala records in the area.</p> <p>There are multiple types of fencing described, please consider descriptions of fencing as an appendix to this document.</p> <p>Section 4.3.2, states that ‘no baseline surveys for Koala population size and distribution are proposed for Sections 1-8 (see 3.6 above for the Woombah/Illuka Koala population), and 11 due to the low population density of animals in these locations.’ Under NSW MCoA D9, TFNSW must prepare and implement a KMP to demonstrate the ongoing survival of populations at Coolgardie/Bagotville, Broadwater and Woombah/Illuka and include detailed assessment of the impacts to the Koala populations based on survey results.</p> <p>ACTION</p> <p>Please include the provision for baseline surveys for the Woombah/Illuka Koala population.</p>	<p>Text modified in Section 2.2.3 to indicate that most of the mapped records are more than 10 years old.</p> <p>Most of the records of Koalas in the southern portion of Section 3 are old (> 10 years). Recent surveys suggest that Koala population density is very low in these areas. However, in this section, from chainage 35000-40000, it is proposed to erect “Phascogale fencing”, which is Mammal fencing with 600 mm wide galvanised steel panel near the top that should provide a barrier to Koala movement onto the road.</p> <p>A description of the fencing types that are most relevant to protection of the Koala is now provided in section 4.3.1, and their locations are provided in Table 4-1 which has been updated.</p> <p>A meeting between TFNSW, DoE and DP&E on 15 June 2015 confirmed that no additional Koala baseline surveys are required for Section</p>
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				<p>5 for the Woombah/Iluka Koala population.</p> <p>The proposed monitoring design and methods for the Broadwater and Coolgardie/Bagotville populations will be presented in Update 3 (Version 4) of this Management Plan</p>
b)	identification of potential impacts on each species;	2.4	<p>A discussion of key threats has been provided in Section 2.4 and includes any of the key threats associated with Koala population decline.</p> <p>Section 3.1 provides an overview of those potential impacts to Koala populations associated with the project.</p> <p>Based on field surveys, a total of 885 ha of Koala Habitat will be directly impacted on, within the clearing footprint.</p> <p>ACTION</p> <p>Please consider including increased predator attacks around fauna road crossing structures as a potential impact associated with the project.</p>	This is addressed in section 6.3.3
c)	details of and demonstrated effectiveness of the proposed avoidance and mitigation and management measures to be implemented..... including measures to at least maintain habitat values of habitat areas compared to baseline data and maintain connectivity.	3	<p>Table 3-2 outlines mitigation measures and an evaluation of their effectiveness as demonstrated by other, previous roads projects in NSW.</p> <p>The Koala relocation protocol (Section 5.3.6) has been provided as mitigating the effects of impacts on individuals due to clearing works.</p> <p>A revegetation strategy and connectivity strategy are being developed to outline these mitigation and management measures under both the EPBC and NSW CoAs.</p> <p>Table 7-1 outlines the location and detail of the fauna connectivity structures.</p>	No action required
d)	An adaptive monitoring program to assess the use of	7	Section 7.2 states that due to the presence of low density populations in sections 1-8 and 11, population monitoring efforts	A meeting between TFNSW, DoE and DP&E on 15 June

	the mitigation measures..... The monitoring program shall nominate appropriate and justified monitoring periods, performance parameters and criteria against which effectiveness of the mitigation measures will be measured and include operational road kill and fauna crossing surveys to assess the use of fauna crossings and exclusion fencing		will be focused in later stages and in other sections where the Koala is more abundant. ACTION Please include the provision for Koala population monitoring for the Woombah/Iluka Koala population. Methods, timing, intensity and duration of monitoring of fauna underpasses are provided in section 7.3.2. The timing of monitoring will coincide with peak movement periods; breeding season and juvenile dispersal periods. Fauna crossing structures will be monitored 6 months after installation and will continue annually until structures are proven to be effective.	2015 confirmed that no additional Koala baseline surveys are required for Section 5 for the Woombah/Iluka Koala population.
e)	monitoring methodology	7	Section 7.3.3 provides performance indicators and performance criteria for success of the fauna underpasses and associated fencing.	
f)	goals and performance indicators to measure the success of mitigation measures, which shall be specific, measurable, achievable, realistic and timely (SMART), and be compared against baseline data	7	ACTION Please consider including the following as a performance indicator and provide corrective actions and responsibility in Table 7-2: No Koala deaths or injuries due to predator attack in the vicinity of fauna crossing structures. Section 7.6 states that: “Further monitoring/assessment will be undertaken if a decline of Koala population numbers is identified as being attributable to the construction and operation of the project.” ACTION Please outline how the decline in population numbers will be identified in sections 1-8 and 11. Road Mortality monitoring has been provided in section 7.4, with an aim of achieving zero Koala vehicle strikes.	In section 6.3.3 it states the following: “Where monitoring indicates that predators are a threat to Koala movement through the crossing structures, Roads and Maritime Services will engage with the North Coast Local Land Services, NSW National Parks and Wildlife Service (Grafton), and Rural Lands Protection Board (North East) and adjacent landowners to identify and implement strategies to reduce this predation risk”. This has been included as a performance indicator in Table 7.2.

			QUERY Please provide information regarding how Koala mortalities will be reported during the operational phase of the project. Will there be liaison with local wildlife care and rescue organisations in order to accurately report mortalities?	In Section 7.6, sentences referring to population monitoring and responses to population decline have been removed because this is relevant to Sections 9 and 10 only. Road kill monitoring will occur as per section 7.4 during the operation for up to 5 years in operation. A new point has been added to section 7.4.2 stating “Regular communication will occur with local wildlife rehabilitation groups (WIREs, Friends of the Koala) so that any injured or killed Koalas would be brought to the attention of TFNSW. Any injuries or deaths of Koalas from wildlife care group records would be incorporated into annual reporting for this project.”
g)	methodology for the ongoing monitoring of road kill, the species densities, distribution, habitat use and movement patterns, and the use of fauna crossings during construction and operation,	7		

	including the proposed timing, and duration of that monitoring			
h)	provision for the assessment of monitoring data to identify changes to habitat usage and whether this can be attributed to the project	7	Section 7.2 includes the following statement in reference to important populations (Wardell, Coolgardie and Bagotville; section 10 population, and south of the Richmond River from Rileys Hill to Broadwater National Park; section 9 population.	
i)	details of contingency measures that would be implemented in the event of changes to habitat usage patterns, entities, distribution, and movement patterns attributable to the construction or operation, based on adequate baseline data	7	<p>“The low density populations of the Koala occurring in or near Sections 1-8 and 11 of the Upgrade are too sparse to warrant the intensive sampling that would be required to document the broader landscape effects of the Pacific Highway. Instead, population monitoring efforts will be focused in later Stages and in other Sections where the Koala is more abundant.</p> <p>ACTION Please include the provision for the assessment of monitoring data to identify changes to habitat usage for the Woombah/Iluka Koala population.</p> <p>ACTION Where appropriate, please provide contingency measures that would be implemented in the event of changes to habitat usage patterns, entities, distribution and movement patterns attributable to the construction or operation.</p>	<p>A meeting between TFNSW, DoE and DP&E on 15 June 2015 confirmed that no additional Koala baseline surveys are required for Section 5 for the Woombah/Iluka Koala population.</p> <p>These issues, as they relate to the Koala populations in Sections 8/9 and 10, will be addressed in Update 3 (Version 4).</p>
j)	mechanisms for the monitoring, review and amendment of these plans	1.3	<p>ACTION Please include under Plan Updates that EPBC Project Approval Condition 8 requires the approval holder to develop a Koala Management Plan(s) pursuant to the requirements of NSW approval conditions D8 and D9 for each relevant stage. The Plan must minimise impacts to the Koala to the satisfaction of the Minister and must be submitted to the Minister for approval.</p>	These two paragraphs have been inserted in section 1.3 under “Plan updates”.

			<p>The relevant stage cannot commence until the KMP for that stage is approved by the Minister.</p> <p>And</p> <p>Condition 23 states that if the approval holder wishes to carry out any activity otherwise than in accordance with this plan, the approval holder must submit to the Department for the Minister's written approval, a revised version of this plan. The varied activity shall not commence until the Minister has approved the revised plan or agreement in writing.</p>	
k)	<p>provision for ongoing monitoring during operation, until such time as the use and effectiveness of mitigation measures can be demonstrated to have been achieved over a minimum of three successive monitoring periods</p>		<p>As above, please provide information regarding how Koala mortalities will be reported during the operational phase of the project.</p> <p>Will there be liaison with local wildlife care and rescue organisations in order to accurately report mortalities?</p>	<p>The method for monitoring Koala mortalities is described in section 7.4.2. Also, as indicated above, a new point has been added to section 7.4.2 stating "Regular communication will occur with local wildlife rehabilitation groups (WIRES, Friends of the Koala) so that any injured or killed Koalas would be brought to the attention of TFNSW. Any injuries or deaths of Koalas from wildlife care group records would be incorporated into annual reporting for this project."</p>
l)	<p>Provision for annual reporting of monitoring results to the Secretary and the EPA, DPI (Fisheries) and DoE, or as otherwise agreed by those agencies.</p>	8	<p>Table 8.1-4 outlines that annual reporting of monitoring results will occur and will be provided by ecologists and TFNSW.</p>	

	<p>In developing the Plans, the Applicant shall demonstrate to the satisfaction of the Secretary and DoE, how the public authorities and expert reviewer recommendations provided for each draft plan in the documents listed in condition A2(c) have been addressed, including detailed justification of any variance from the recommendations of the expert reviewer of the management plans, including analysis of potential risk to the threatened species.</p>		<p>Section 11, Appendix B provides the Expert Review comments of Professor Robert Close and how the recommendations have been addressed. All comments have led to a plan update.</p> <p>It is not clear if this review includes the update to include sections 3-8 and 11 or if this review was provided on Version 2.0 for sections 1-2.</p> <p>ACTION Please clarify which version of the plan was reviewed.</p>	<p>Professor Rob Close reviewed Version 1 of the Plan only which was included as part of the SPIR</p>
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NSW Environmental Protection Authority review of Koala Management Plan: Sections 1-8 (excluding Woombah population), and 11 (version 3)

Comments – September 2015

Reference	EPA Comments	TFNSW Response
General	<ul style="list-style-type: none"> References to OEH need to be replaced by EPA where appropriate (e.g. table 1.1) There are numerous typo's throughout the document 	Amended throughout
3.1 potential impacts associated with the project	The stated 885ha of impacted Koala habitat is seemingly incongruous with the stated section values. The total Koala habitat clearing of the sections included in this plan (all except sections 9 and 10) total 816.08ha. This indicates that only approx. 70ha of Koala habitat is to be cleared in sections 9 and 10? Please confirm this is the case.	That is correct – there is approximately 34 ha of Koala habitat that will be cleared in each of Sections 9 and 10.
3.1	Potential indirect impacts listed include vehicle strike. Vehicle strike appears more as a direct impact of upgrade construction.	In this context, refers to unmitigated or unintended impacts.
Table 3-2 Mitigation measures	A recommendation listed in this table is that clearing be undertaken outside of the breeding and dispersal seasons. Is this to be considered going forward, particularly in sections 9 and 10?	This was a recommendation from the AMBS study. This is not practical for Sections 9 and 10 to meet the current program. Some clearing would be required within the breeding season and will need to be managed accordingly. The clearing procedures TFNSW has developed are very successful in not harming fauna, including Koalas.
Table 4-1	The EPA suggests including a descriptive text for each type of fencing listed in this table. There are numerous 'types' of fencing and some confusion as to what they all are.	Section 4.3.1 has been updated to describe main fence types relevant to the Koala. Table 4-1 has also been updated.

5.3.3 (and 5.3.7)	What are the triggers to temporary fencing in the sections relating to this plan? The EPA supports the use of well-defined triggers, for example any Koala presence within project footprint be the trigger for temporary fencing.	Text in section 5.3.3 amended to read: “if a Koala is sighted before clearing within the highway footprint area, this will trigger action to erect temporary fencing to prevent this animal or other nearby animals from re-entering the area.
5.3.5	Koala specific, staged and sequential clearing. What are the triggers for these protocols relevant to this plan/sections 1-8 and 11. Is this to be standard in sections 9 and 10?	This is a standard clearing process for all TFNSW projects and will be the same for Section 9 and 10. Section 5.3.5 amended to include spotlighting as part of the pre-clearing protocol, and to indicate that temporary fencing will be erected at sites where a Koala is found within the clearing footprint and returned to adjacent habitat to prevent its re-entry into the construction zone. Further information on the clearing process will be included in the next update to the Plan (Version 4)
5.3.8	<p>Fauna furniture is to be placed in both combined and dedicated fauna crossing structures, not only in dedicated structures as you have stated.</p> <p>Combined structures are not necessarily less relevant to fauna, just in an area that has a shared drainage need. Watercourses are often natural pathways for many fauna taxa.</p> <p>The usage of these structures is dependent upon linkages to habitat and adequate revegetation adjacent to the structures. In recognition of this the EPA supports a focus on achieving an effective linkage from structure to adjacent habitat as effectively and quickly as possible. In acknowledgement of this important feature the EPA encourages a more robust focus on this, in this and subsequent KMP.</p>	Section 5.3.8 amended to read: “Fauna furniture will be placed within dedicated Koala underpasses and, where possible, in some combined fauna crossing structures”.

	The EPA encourages that 2.4m high culverts have a maximum length of 40m and 3.3m high box culverts have a maximum of 50m length. These are benchmarks the EPA has endeavoured to see adopted on all TFNSW projects and are part of the MCoA (D9) for the omitted sections of this plan (sections 9 and 10).	TFNSW has adopted this for the specific Koala populations in MCoA D9 which are not relevant to this Koala Management Plan for Sections 1-8 and 11. Culverts longer than 40 m are required to be 3 m high rather than 3.3 m.
Section 7 Monitoring General	The EPA recognises the validity of the goals proposed for the monitoring program. These are primarily focussed upon the integrity of exclusion fencing and usage of connectivity structures. There are no measures included (or possible) to determine any population changes generally, or related specifically to construction, so any reference to actions resulting from observations of population declines etc should be removed from this plan as redundant (see 7.6). Obviously this is an integral feature of the future version incorporating sections 9 and 10, so will be a prominent feature then (as discussed in 7.2).	In Section 7.6, sentences referring to population monitoring and responses to population decline have been removed.
7.4.2	As well as the listed formal and informal methods to capture road kill data, is there opportunity to enlist public reporting of Koala roadkill, e.g. on TFNSW website or other. Every opportunity to capture road kill data should be taken, i.e. involving TFNSW staff where possible. Road kill provides an important trigger to repair fence, upgrade fence, or add to fence if not already there. In addition it supplements Koala population data in an area of documented low density.	A new point has been added to section 7.4.2 stating “Regular communication will occur with local wildlife rehabilitation groups (WIRES, Friends of the Koala) so that any injured or killed Koalas would be brought to the attention of TFNSW. Any injuries or deaths of Koalas from wildlife care group records would be incorporated into annual reporting for this project.”
7.5.1 Responsibility.	<p>Stated in this section is:</p> <p>” the responsibility for identifying appropriate triggers to undertake corrective actions, if needed, will be shared between TFNSW and its ecologists,...”</p> <p>The EPA have do not support this approach, as the triggers for corrective actions are at the heart of the monitoring program and EPA involvement in their selection is implicit in the MCoA (D8).</p> <p>Table 7-2 is general in detail, with specific triggers not included.</p>	<p>Section 7.5.1 amended to include clarification that monitoring is the responsibility of TFNSW.</p> <p>“TFNSW, through its contractor(s) which are employed to undertake the various aspects of monitoring for the project, will be responsible for the evaluation of the monitoring information collected.</p> <p>The last sentence in this section amended to read:</p>

	<p>The lack of background population data and associated low population in these sections of upgrade necessitate the need for hard, well defined triggers to corrective actions. Some examples follow:</p> <ul style="list-style-type: none"> • What number of predators sighted in structures trigger the need for corrective actions • Stated in 7.3.2 is the examination of predator scats for Koala hair as a technique for detecting Koala presence near structures. In addition the EPA suggests this as an additional trigger for predator control. • What level of Koala presence, as represented by adjacent survey, coupled with a lack of Koala transit in the connectivity structure will constitute a trigger for further corrective actions? <p>In light of these concerns the EPA is not satisfied that this section of the plan is adequate and seeks to be involved in the selection of the specifics of the monitoring criteria and triggers for corrective actions that are alluded to in this plan.</p>	<p>“The identification of appropriate triggers to undertake corrective actions will be the responsibility of TFNSW and its contractors, with TFNSW having the prime responsibility for enforcing any necessary changes as required by this Plan (Table 8-1).”</p> <p>Table 7-2 <u>does</u> provide specific triggers for actions.</p> <p>For example: “<u>Any</u> injury to an individual Koalas as a results of a vehicle strike...”</p> <p>“<u>No</u> breaches in fauna exclusion fencing...”</p> <p>“<u>No</u> Koala deaths...”</p> <p>Etc.</p>
Table 8-1	<p>Point 1.1 baseline Koala surveys and 1.2 Preparation of Contractor fencing strategy are stated as Contractor ecologist’s responsibility whereas they are TFNSW responsibility.</p> <p>Is the terminology TFNSW strictly accurate here (and throughout document) where do Pacific Complete fit into this picture?</p>	<p>Point 1.1 and 1.2 amended to state that responsibility for these two actions is TFNSW/Pacific Complete.</p> <p>Pacific Complete will be responsible for construction requirements however TFNSW will be responsible for any post construction monitoring.</p>

NSW Department of Planning and Environment review of Koala Management Plan: Sections 1-8 (excluding Woombah population), and 11 (version 3)

Comments - September 2015

Document		Woolgoolga to Ballina Pacific Highway Upgrade Koala Management Plan	
Version No.		Version 3.0 August 2015	
Agency Name		Department of Planning & Environment	
Date		9 September 2015	
Item	Condition No/Report Reference	Department's Comment	TFNSW Response
1.	Acronyms and abbreviations	<ul style="list-style-type: none"> CMS – is the Construction Method Statement the same as an Environmental Work Method Statement (EWMS)? If so the same terminology should be used in all the management plans. the project – the project is the area to which this management plan applies – sections 1 to 8 and 11 (excluding the Woombah Koala population). 	<p>CMS updated to EWMS in Acronyms and Table 8-1</p> <p>The Project re-defined in Acronyms</p>
2.	Section 1.4	<p><u>Expert review</u> – has Professor Jonathon Rhodes reviewed this Plan (version 3.0)? Please provide details of comments made and TFNSW response.</p> <p><u>Agency review</u> – update to version 3.0 and consultation with agencies.</p>	<p>Independent review not required for MCoA D8. Only required for MCoA D9 for the specific Koala populations around Iluka/Woombah, Broadwater and Coolgardie/Bagotville, which is the next update to the Plan (Version 4).</p>

3.	Section 2.2.3 and Table 2-3	It is concluded that Koalas occur at very low population densities in section 3. However, Figure 2-3 shows concentration of Koala Atlas sightings in the State Forests to the east and west of the project to the north of the Glenugie upgrade. Based on these records can the conclusion be made that Koalas exist at low densities in this area? Compared to other sections of the project this area has a relatively large number of recorded sightings. There would appear to be an east-west corridor along the State Forests which the project traverses.	Section 2.2.3 has been amended to read: “Many older (> 10 years) and few recent Bionet records of the Koala occur along the southern parts of Section 3, particularly within nearby Glenugie, Bom Bom and Devines State Forests which maintain good connectivity. Much of the northern part of this Section has been cleared for agriculture, with minimal vegetation connectivity between the east and the west. However, Pine Brush State Forest occurs in the east which maintains good north-south connectivity to larger tracts of native vegetation. It was concluded that Koalas now occur at low population densities along Section 3 of the Pacific Highway Upgrade, despite the existence of potentially suitable habitat.” Text in Table 2-3 has also been revised.
4.	Section 3.5	Are Koalas in the east – west corridor in section 3 to the north of Glenugie likely to have reduced level of impact. Based on existing records there appears to be a concentration of Koalas in the state forests and good connectivity in this area is required to facilitate Koala movements.	Reduced impact in the sense that Koala population density is much less than in other sections (e.g. 9 and 10). Most of the Koala records in Section 3 are more than 10 years old. Many connectivity structures are proposed in Section 3 (see Table 5-1), including large bridges designed for Emus that can be used by Koalas

5.	Section 4.3.1	<p><u>Sections 3-8 and 11</u></p> <p>The type of fencing in section 3 to the north of Genugie should be reviewed in light of large number of existing Koala sightings to the east and west of the highway alignment. In particular review the provision of floppy top Koala fencing in this area.</p>	The fence proposed in this area is the general Mammal / Phascogale fauna fence with concrete posts (Table 4-1). Between chainages 35000 – 40000, this fence will have 600 mm wide galvanised metal sheeting fitted which will act as a significant barrier to Koalas.
6.	Table 4-1	The location of fauna fencing may need to be updated to be consistent with the Connectivity Strategy (CoA D2) for sections 3-11.	Noted
7.	Table 5-1	The table may require updating to be consistent with the Connectivity Strategy (CoA D2) for sections 3-11.	Noted
8.	Section 5.3.9	Is the detail of the landscape design for revegetation areas to be provided in the Urban Design and Landscape Plan required by CoA D20? The Plan should provide details of key landscaping and revegetation features.	Correct

NSW Department of Planning and Environment review of Koala Management Plan: Sections 3-8, and 11, including Mororo Cut Site

December 2015

Comment:	Response by TFNSW
The Management Plan should discuss impacts (if any) on proposed fauna crossing structures (in particular those targeting Koalas) to the north and south of the Mororo cutting).	The cutting extends 400 m north and south of the proposed extraction site therefore no fauna crossing structures are within cut areas.
Will the clearing of vegetation for the Mororo cutting affect north-south fauna movements?	Clearing of any vegetation for construction of the highway has the potential to affect fauna movements. Significant amounts of vegetation remain to North/East of the site including the Bundjalung National Park. No additional clearing is proposed beyond the approved project boundary.
Will permanent Koala fencing be installed following completion of the works?	Yes permanent fauna fencing will be progressively installed as part of the main construction works.
How will the site be rehabilitated/landscaped? Will Koala food tree species be planted as part of the landscaping of the site?	The rehabilitation and landscaping of the site will be subject to the Urban Design and Landscape Plan. Landscaping will aim to include endemic species which is most likely to include Koala food trees.
The Wave 1 CEMP (and sub-Plans) will need to be updated and approval sought from the Secretary to include the additional scope of the project, being the extraction of road material from the Mororo cutting, prior to the work commencing.	Noted, the CEMP will be updated accordingly to the additional scope of works.

NSW Environmental Protection Authority review of Koala Management Plan: Sections 3-8, and 11, including Mororo Cut Site
December 2015

Comment:	Response by TFNSW
<p>Further to our discussion with TFNSW, the EPA clarifies and amends our response to the proposed changes to the KMP update 2 in the following:</p> <ul style="list-style-type: none"> • The EPA notes the reference to adhere to the clearing protocols detailed in the KMP for targeted Koala areas. • With regard to the proposed fencing, the EPA advises that as the fencing is not proposed to be mirrored on the western side of the highway that the temporary fence either; <ul style="list-style-type: none"> 1) be adequately set back from the highway (by several metres), or 2) that the installation of escape mechanisms/drop-downs will be necessary. <p>This stems from the possibility of animals crossing the existing highway from the west and being trapped on the road edge by the temporary fence. This situation has been observed to occur on other projects and needs to be addressed.</p> <ul style="list-style-type: none"> • The EPA seeks confirmation that the temporary fence will be ‘floppy top’ and adequately maintained. 	<p>Correct</p> <p>New Section 5.3.8 describes the proposed fencing arrangements at the Mororo cut (borrow) site. Prior to clearing, temporary Koala fencing will be erected on the eastern side of the existing Pacific Highway for a total length of 1.1km (chainage 97,500 to 98,600), which includes extending fencing 200 metres either side of the cut site. The temporary fencing is to protect any displaced Koalas from road strike as a result of the vegetation clearing process. This fence will be set back on the eastern side of the highway by several metres so that animals crossing the existing highway from the west will not be trapped on the road edge.</p> <p>TFNSW confirms that the temporary fence will be floppy top.</p>

Department of the Environment review of Koala Management Plan: Sections 1-8, and 11, including Mororo Cut Site

Comments - December 2015

Comment:	Response by TFNSW
<p>According to the Koala Management Plan (KMP), Version 3.0, the Woolgoolga to Ballina Project (2012/6394) will directly impact on 885 hectares of Koala habitat (Section 1-11). The additional information provided on 11 December 2015 states that the construction at the Mororo cut site will involve the removal of approximately 3.55 hectares of native vegetation. Is this impact additional to the 885 hectares outlined in section 3.1 of the version 3.0 KMP?</p> <p>Will this 3.55 hectare impact require offsets under the EPBC Act Biodiversity Offsets Policy?</p>	<p>No, this work is part of the approved project. No additional impacts on native vegetation are proposed.</p> <p>As above</p>

Department of the Environment review of Koala Management Plan: Sections 1-11 (version 4.1)

Comments – 2 June 2016

Condition 8.	Department Notes/Comments	Approval Holder Comments
Section 4.1	<p>Action Item: As per the Ballina Koala Plan (BKP) Addendum, could you include a table which lists the number of koala food trees that will be impacted In particular by the highway, Laws Point, Jali Land and Wardell Road. The BKP Addendum lists the number of trees that will be impacted, and it would be good to see this detail in the Koala Management Plan as well.</p> <p>In previous conversations with TFNSW officers, it has been indicated that sections of the route can be slightly 'tweaked' to reduce the number of vegetation impacted.</p>	<p>Through the detailed design process the alignment has had minor tweaks. This has resulted in a slight reduction in impact on Koala food trees around the Laws point area. Approximately 23% of the identified food trees will be removed for the road alignment.</p> <p>Table 4.2 lists the number of Koala food trees that will be impacted by the highway, at Laws Point and Wardell Road, as provided in the BKP addendum, now included in Section 4.1 of the KMP.</p>
<p>All of Section 5.0</p> <p>6.3.4</p>	<p>Question: Can you clarify that the entire fencing (permanent fencing, temporary fencing or both) for section 10 will be installed prior to construction?</p> <p>If so, what level of clearing will need to take place in order to erect the fencing?</p> <p>Will relocation of koalas need to occur before the fencing is installed? (so they are not fenced within the alignment)</p> <p>What is the typical length for a clearing zone, and what length will the fencing extend past the point of clearing? The Department has concerns that koala will still be able to get in the clearing zones.</p> <p>Action Item:</p> <p>Could a diagram be included in the plan that shows exactly where the additional fencing will be?</p>	<p>Koala fencing will be installed on both sides of the highway within the three key population areas occupied by the Woombah-Iluka, Broadwater and Coolgardie-Bagotville Koala populations (i.e. Sections 5, 8-9 and 10). This fencing will not be installed prior to construction. Progressive installation of permanent Koala proof fencing in these areas will connect to the new connectivity structures as they are built.</p> <p>Temporary fencing will be erected along either side of the existing highway alignment that is adjacent/parallel to construction works and where clearing will occur within the locality of the key populations in Section 5, Section 8 (part), Section 9 and Section 10. This will be done to minimise the risk of Koalas being hit by highway traffic during vegetation clearing works.</p> <p>In addition, Koala fencing will be installed on other roads within Section 10, including on parts of the existing Pacific Highway north of Wardell to Coolgardie interchange and on parts of Wardell Road either side its crossing with the upgraded highway in Section 10, in accordance with the Ballina Koala Plan. This fencing will run parallel to these roads and installed prior to the commencement of mainline clearing for the road alignment. Figures showing the location of this fencing now provided in Section 6.</p>

	<p>In addition to the connectivity structures being placed adjacent to the proposed alignment, is there progress on developing connectivity structures on other sections of Wardell Road? The Department is concerned about the connectivity from the south – crossing over Wardell Road towards the North. In particular, the northern section of Wardell Road already has a barrier to the eastern side (old Pacific Highway).</p> <p>Where will the fencing on Wardell Road be placed? Next to the road, or behind residential properties?</p> <p>The Department supports the fencing proposed for the new alignment, however the details of fencing for Wardell Road and surrounding roads, including the old Pacific Highway, is lacking details.</p>	<p>The exact location of the fence in relation to the properties is still under investigation. Roads and Maritime will be consulting with landowners with the intention to install koala grids on drive ways and self-closing gates for pedestrian access where appropriate. Fauna escape structures will also be installed along the fence to allow koala to escape, if they become trapped within the fence.</p> <p>Pre-clearing surveys for Koalas will be undertaken prior any vegetation clearing, including for temporary and permanent fencing.</p> <p>TFNSW no longer propose to adopt the extended re-location program within Section 10, but rather leave the animals in situ and undertake a phased resource reduction ' approach. This would include progressively collaring of all habitat (feed and shelter) trees within the alignment prior to clearing to encourage resident animals to progressively move away from the area of their own accord, in conjunction with population monitoring in the vicinity of the sites, prior to, during and after clearing to monitor the effect of the works on any resident animals. Relevant details are included in Section 6.3.5.</p> <p>Roads and Maritime proposes to build a</p> <p>Connectivity structure on either side of the Wardell Rd overpass. A connectivity structure already exists on the existing highway south of the Coolgardie interchange and Roads and Maritime propose to build a connectivity structure on the northern side of the Coolgardie interchange.</p> <p>Roads and Maritime also propose to build an additional connectivity structure on Wardell Road, between the highway alignment and Wardell to provide connectivity within the Wardell Heath for Koalas and Potoroos. This is also shown on the Figures in Section 6.</p> <p>Further details on connectivity structures will be included in the Connectivity Strategy required by NSW CoA D1 and DoE Condition 13.</p>
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<p>6.3.6 (Relocation Program)</p>	<p><u>General Comments and questions:</u></p> <p>The Department is concerned about the close proximity from where koalas will be removed, to proposed receiver sites. The Department has reviewed the Oxley highway relocation program and the success with a number of the measures. However this plan does not provide the same level of detail as the Oxley Highway plan. This KMP proposes more risk with close proximity of release with no detail on how the risk will be managed.</p> <p>Where are the receiver sites for the relocation (the plan does not provide a specific location) and are they adequate to accommodate large groups of new koalas? The Department notes that the receiver sites have not been assessed yet, so if these sites are not adequate for the relocation, are there additional sites that could be used? The plan will also need to provide justification for the proposed sites and why they are most suitable for relocation.</p> <p>There is frequent reference to “suitable” unoccupied habitat into which koalas will be relocated. The Department isn’t in a position to be confident in what constitutes as koala habitat unless there’s actually a koala in it. So the KMP should refer to <i>potential</i> suitable habitat and then act accordingly.</p> <p>The reasons why some vacant ‘suitable habitats aren’t be utilised. The Department is of the view that some koalas would need to be utilising a proposed area for relocation to ensure it is suitable.</p> <p>The Department believes there is a risk of fencing koalas in to a new area with what <i>looks</i> like good food trees but that really aren’t. This needs to have an adaptive element to say that they will monitor the animals for clear evidence that they are feeding, with an option to provide supplementary food if not.</p>	<p>All noted.</p> <p>Extended re-location program including capture and radio-tracking no longer proposed.</p> <p>Based on new information regarding the actual number of food trees to be removed within the alignment in Section 10 (only 12 of 70 within the Laws Point area and 14 of 43 within the Wardell Road area) it is understood that far fewer feed trees will be removed as a result of the proposal than previously indicated (45% of feed trees within the Laws Point area and 95% of feed trees within the Wardell Road area, S Phillips unpublished data). As such, given the risks to the animals associated with intervention (stress, sickness and mortality), it has been determined that it would be better not to intervene to move the animals, but rather leave the animals in situ and undertake a ‘soft clearing’ approach. This would include collaring of all habitat (feed and shelter) trees within the alignment prior to clearing to encourage resident animals to move away from the area of their own accord, in conjunction with population monitoring in the vicinity of the sites, prior to, during and after clearing to monitor the effect of the works on any resident animals. Relevant details are included in Section 6.3.5.</p> <p>Noted. Re-location no longer proposed.</p> <p>Noted. Re-location no longer proposed.</p>
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	<p>If additional information and/or a greater level of certainty can't be provided, then the Department would consider that a number of the affected koalas could be lost. This outcome is not acceptable given the Ballina Koala Plan assures there will be no impact as a result from the highway construction. Given a relocation of this nature has not been attempted before; the Department would need a greater level of comfort that the receiver site is suitable, and the monitoring would provide additional level of comfort. The monitoring program alone for this relocation needs to be more robust. The tracking of these animals and the information collected will need to ensure that these koalas aren't going to be significantly impacted, and proof that the koalas are re establishing new home ranges.</p> <p>Will the koalas be closely monitored in their new environment to ensure they are feeding? And if not, whether supplementary feed will be provided. If the koalas are feeding in the new environment, then we could be more confident that they will be ok.</p> <p>Will the koalas be GPS tracked?</p> <p>What measures will be put in place if a radio tracked koala/s moves away from the site and dies as a result? The plan states that movements of all animals relocated in this program will be monitored for up to one year (the expected life of the radio-transmitter batteries) to determine whether each animal is healthy and has established a new home range. However the in the plan there is no indication of any response if they're found <i>not</i> to be healthy or have established a new home range. What adaptive measures will be put in place? Ideally, there should be some compulsion to make those data available to the Department and publicly available from the project website so that it can inform decisions on subsequent developments.</p> <p>Is it possible to provide more clarity in the plan regarding the 'release points'? Section 6.3.6 states that release points will be no longer than 100m away, however in reference to Attachment H; there is information that suggests koalas could be relocated up to 10km away from their original site.</p>	<p>Noted. Re-location no longer proposed.</p> <p>Noted. Re-location no longer proposed.</p> <p>Noted. Re-location no longer proposed.</p> <p>The Koalas come down the tree of their own accord when looking to move trees for food (usually daily) but may sometimes stay in the trees longer. The Koalas are unable to re-climb the tree as collars are attached to the tree to prevent this. The Koala enters the trap in an attempt to escape as it is the only opening in the plastic guard. Detail has been added in Section 6.3.6.</p>
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	<p>At a minimum, the Department requests that all risks are detailed in a risk assessment. All the risks identified with this relocation program would need to be documented with the relevant mitigation measures.</p> <p>Could the permanent fencing be put in place after the koalas are relocated, and before construction?</p> <p>The “corflute” method doesn’t detail the process in which the koala is brought to ground level. It is difficult to presume that a koala will come down and then not simply re-climb the tree once it sees it has no option. This is not a problem, but should be provided for the sake of completeness/transparency.</p> <p>In line with the Department’s policy statement on translocation of threatened species, unless it can be shown that there is a high degree of certainty that a translocation will be successful in contributing to the long term conservation of the species or community, a proposal for translocation associated with an action will be unlikely to be approved.</p> <p>Until this relocation strategy is supported by the relevant state agency, (OEH, EPA and DPE) the Department will not approve this plan. The Department will also need to consult on a more refined version of this plan to ensure every risk has been thought out.</p>	<p>Noted. Re-location no longer proposed.</p>
8.0	<p><u>Monitoring program</u></p> <p>The Department would like to see the plan amended to include baseline figures of current mortalities in the surrounding area (based on Dr Phillips surveys) and records of koala road strikes to create a starting figure by which the following years of monitoring look to decrease that figure. For example on average, in 2015 it was estimated that there were around 10 koala mortalities. Once the fencing is erected on surrounding roads, could this data be looked at again to see if a reduction in mortalities has been achieved? Is annual rate of mortality easily accessed from Friends of the koala or council?</p>	<p>Noted. Have included number, locations, and rates of vehicle-strike at known hotspots as identified in Koala demographic study for PVA by Biolink 2015. This information will be used in annual reporting to see if numbers have gone up/down and thus assess efficacy of fencing mitigation measures. Section 8.4.2.</p> <p>See above.</p>

Table 7.2	<p>The Department would support any strategy that presents a current/average number of koala mortalities to be used as a starting level of mortalities and one of the main objectives of the KMP is to reduce that number after fencing has been put in place. This potential reduction should be consistent every year for the life of the monitoring program.</p> <p>The reason is that the Department needs to see a reduction in the rate of current road strikes within the subject area. If there is any other way to prove that 4 – 8 koalas will actually be saved, then please provide that information.</p> <p>The performance indicators is this table sets out the main goals and measures, however it is unclear how the separate measures specific to section is managed. Is it possible to create a separate table of Performance Indicators and corrective actions for those measures that are critical for the Section 10, and the measures that are linked to the BKP?</p> <p>The plan does not clearly distinguish the additional monitoring to be undertaken under section 10.</p>	<p>The reduction in road mortality of 4-8 individuals is very difficult to monitor directly, although the Plan will require data collected by Friends of the Koala and WIRES to be analysed to estimate Koala deaths on surrounding roads to the Project compared with current roadkill numbers. The current road mortalities on Wardell Road and Pacific Hwy have been estimated based on roadkill data from Lismore Friends of the Koala. In addition to the roadkill data, the PVA scenario against which population estimates will be compared takes into consideration mortality of 4 koalas per year, so if the population estimate is equal to or above that predicted by the PVA then the mitigation measures will be assumed to have been effective.</p>
Section 8.2.1	<p>The Department understands the rationale behind the power analysis and the level of monitoring that is feasible over the 15 year period. However there are some elements such as the relocation program that will need more monitoring to ensure success. Is it possible for this section to delineate between the necessary monitoring with specific of the management measures such as the relocation program?</p> <p>Will the fencing, population monitoring, revegetation monitoring be done at the same time?</p>	<p>Noted. This Table relates to main goals, performance indicators/measures and corrective actions for the duration of <i>operation</i> of the upgrade. As identified in Table 7.2 – this is largely dependant on outcomes of the detailed monitoring program, described in Section 8. Have included words to clarify this.</p> <p>Additional monitoring to be undertaken within Section 10 is described in Section 8.2 – Monitoring.</p> <p>Note relocation program no longer proposed.</p>
Section 8.3.2		<p>Monitoring of road mortality, fencing, underpasses and the population will co-incide in Spring, although each of these activities will be monitored for different time periods and some bi-annually. Details of timing of each monitoring activity provided in Section 8.2, 8.3, 8.4 and 8.5 and summarised in Table 9-1.</p>

	<p>The monitoring of connectivity structure usage, i.e. analysis and revision of motion sensor cameras will be done twice per year in conjunction with other population monitoring?</p>	<p>Connectivity structure monitoring will occur in Spring/summer annually. Population monitoring will occur bi-annually in Spring and also Autumn (see Table 9-1).</p>
Section 8.4	<p>The Department supports the need for genetics testing of faecal pellets to inform future gene flow of the population. Could the plan provide more details on how this will be carried out, and provide information on how the results will be evaluated? Also the KMP needs to provide a commitment to providing the results to the Department for consideration.</p>	<p>Genetic testing of faecal pellets has been included in conjunction with the population monitoring to support monitoring of Koala use of the connectivity structures and also provide additional estimates of population size. Faecal pellets will be collected during the 6 monthly population surveys across the study area and analysed at year 1 and then also at year 10 to determine population estimates but also breeding and movement across the road. Details are included in Section 8.2.2</p>
Section 8.5	<p>Road mortality monitoring – the Department requests that monitoring of surrounding roads, such as Wardell road be included in the plan. Also how will the results be presented for future reference?</p>	<p>TFNSW will include road mortality monitoring along the additional areas to be fenced – Wardell Road and the existing Highway. These results will be included in an annual report as stated in Section 8.4.2.</p>
Table 8.2	<p>It is unclear the delineation between revegetation monitoring periods and sampling periods.</p>	<p>Removed reference to ‘sampling’ for clarification.</p>
	<p>This section of the plan states that if reveg areas do not contain koalas within 20% of the plots (by year 10 of the monitoring program) then adaptive management actions such as additional plating would need to be considered. The Department would request the potential adaptive measures be expanded and more detail provided.</p>	<p>Adaptive management response will depend on review of other monitoring data. Clarification included in Section 8.5.</p> <p>Section 8.2.2 has been updated to provide more detail on survey methodology (derived from previous surveys, Ecosure 2015). Figures of survey locations also provided. Population assessments will be carried out every 6 months starting Spring 2017 to co-incide with the beginning of the construction period; to provide population estimates prior to operation of the road. The PVA has been re-run to determine approximate population numbers at years 5, 10 and 15 to enable assessment of changes to the population prior to Year 15. It must be noted that to accurately detect population declines prior to 15 years would require an unfeasible sampling intensity (monthly) due to the relatively small population size. The predicted population sizes generated by the PVA are guidelines only.</p>

WOOLGOOLGA TO BALLINA | PACIFIC HIGHWAY UPGRADE: SECTIONS 1-11

Table 9.1	<p>The Department supports the need for evaluating future population trends, as per this table. The Department would request firm timing as to when population assessments will be carried out and expansion of how the work will be undertaken. The Department understands the requirement to undertake population assessments to enable population trends should be carried out 3-5 years into the project.</p> <p>The Department supports this layout to inform future management actions. Could this table be expanded to capture all monitoring years up to year 15? Noting there are some management activities that state 'up to year 15'. Some measures such as population trend analysis, genetics testing of faecal pellets have not been included.</p>	Table 9.1 has been expanded to include management actions/monitoring up to Yr15.
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NSW Environment Protection Authority review of Koala Management Plan: Sections 1-11 (version 4.1)

Comments – 26 May 2016

Report Reference	EPA Comments	Response
General	This Management Plan is attendant upon approval of the Ballina Koala Plan, and the following EPA comments are on this draft document only, and may need to be revised if/when the BKP is approved as the content of that document approval may have ramifications on the content contained in this one (KMP vers 4).	Noted.
General	There are several sections contained within this current KMP (vers 4) that the EPA considers as underdeveloped, requiring further research and expert expansion to reach the standard essential for implementation as a management plan. This reflects primarily the unique management challenges relating to the federally significant Koala population in section 10 (and to a lesser extent sections 9,8 and 5). Management necessities associated with this population and the more comprehensive ministerial conditions of approval attached to it has required the expansion of management into a less traditional arena, outside the road corridor and into a regional context. The EPA is specifically referring to the relocation proposal (section 6.3.8) and the monitoring strategy (chapter 8). Specific issues relating to these sections are addressed below. The EPA supports the substantial refinement of these sections, potentially involving referral to/development of a separate document, or sub-plan of management (for e.g. for the proposed relocation strategy).	See below for responses.
3.4.1. (Adequacy of Survey for the) Illuka/Woombah population	It was agreed by DoE and DP&E on 15 June 2015 to cease any further baseline population studies on the Illuka/Woombah koala population. In short this was, in part, based on the recognition that satisfactory information was available to inform the nature and placement of connectivity structures. Attendant upon this was a TFNSW commitment that this funding (for further survey work) was better diverted to ensuring that good connectivity was achieved for this recovering population. Currently there is only one structure available for Koalas in this area.	A new connectivity structure (2.4m x 2.4m x <40m RCBC) has been included into the design at chainage 96020 to provide for koala connectivity.

Report Reference	EPA Comments	Response
	The EPA would like assurance that discussions continue regarding the potential utilisation/enhancement of other available incidental structures in this area (e.g. Mororo creek and other structures as identified in the field) for koalas specifically, and other fauna generally, as crossing structures.	Roads and Maritime will continue to consult with EPA in regards to incidental connectivity structures in the vicinity of the Iluka Interchange. Although some incidental structures are available, the length, height and flood immunity of these structures may not be ideal for koalas. The site is constrained with available fill height, Iluka interchange, Banana Rd etc.
6.2 Main goals for management	Amend second dot point to read: No injuries to koalas during construction as a result of any construction related activity (which includes vehicular collision)	Amended accordingly.
6.3.4 Permanent Koala Exclusion Fencing (and 6.3.9)	<p>The EPA supports the extension of koala exclusion fencing onto road kill hot spot areas (Wardell Rd, existing highway) but remains concerned about connectivity, particularly across Wardell Road. There are 2 structures currently proposed through Wardell Rd adjacent to the new alignment which is noted. However, the remainder of Wardell Road, from the upgrade to the township currently offers no connectivity options. This relates to Koalas but also to other fauna, most notably Potoroo in the heath areas north and south of Wardell Road.</p> <p>The EPA cannot support this (essential) fencing of Wardell road until connectivity for koala and Potoroo are further addressed in the span between Wardell and the upgrade.</p>	<p>TFNSW recognises the need for a connectivity structure between the township of Wardell and the upgrade to provide connectivity within the heath areas north and south of Wardell Road for the Koala and Potoroo. As such, TFNSW are including provisions for development of such a connectivity structure and the location of this structure is included in the management plan.</p> <p>Further details on connectivity structures will be included in the Connectivity Strategy required under NSW CoA D2.</p>
6.3.8 relocation /translocation	<p>The EPA has the following concerns and reservations relating to the proposed relocation/translocation proposal for section 10:</p> <p>The proposed relocation is an unprecedented action that has no previous history of experience to draw on. The suggested relocation of animals 1-1.5km away from their contemporary sites differs significantly in concept from translocation experiences such as the Oxley highway project quoted in the management plan.</p>	Noted.

Report Reference	EPA Comments	Response
	<p>The proposal is in a concept/ raw state only, with many unaddressed risks and a lack of necessary information. There is no detailed information regarding the number of animals involved, with home ranges directly compromised by the construction, as well as any details regarding the receival sites, including inherent dangers and habitat quality, patch isolation etc. In addition the actions and risks associated with the relocation process itself aren't adequately detailed and addressed.</p> <p>The EPA does not consider what is contained in the current MP regarding the proposed relocation of what seems may be up to 20 koalas (?) as adequate to provide definitive comment on. At the moment there is no evidence provided that expert opinion supports the notion that the risk to koalas is lesser under the proposed relocation than simply following standard procedure of relocating adjacent to the upgrade.</p> <p>The survival of these resident animals in these hot-spot cells is integral to satisfying TFNSW commitments, MCoA and PVA parameters. As such the EPA recognises the need to provide robust management of these 2 hot spot areas, however the EPA believes that not enough detail is presented and not enough work, involving species experts, has been done to determine the most robust approach to successfully ensure the persistence of these koalas, and is unable to support the proposed relocation procedure in section 10 at this time.</p>	<p>Based on new information regarding the actual number of food trees to be removed within the alignment (only 12 of 70 within the Laws Point area and 14 of 43 within the Wardell Road area) it is understood that far fewer feed trees will be removed as a result of the proposal than previously indicated (45% of feed trees within the Laws Point area and 95% of feed trees within the Wardell Road area, S Phillips unpublished data). As such, given the risks to the animals associated with intervention (stress, sickness and mortality), it has been determined that it would be better not to intervene to move the animals, but rather leave the animals in situ and undertake a phased resource reduction approach. This would include progressively collaring of all habitat (feed and shelter) trees within the alignment prior to clearing to encourage resident animals to progressively move away from the area of their own accord, in conjunction with population monitoring in the vicinity of the sites, prior to, during and after clearing to monitor the effect of the works on any resident animals. Relevant details are included in Section 6.3.5.</p>
6.3.9 Fauna crossing structures	The following statement from the KMP relates to connectivity structures in section 10:	Noted and re-worded accordingly.

Report Reference	EPA Comments	Response
	<p>“Based on the population modelling requirements in the PVA this number was considered sufficient to allow for the movement/dispersal of Koalas throughout Section 10 “</p> <p>This statement is ambiguous and should be removed or altered.</p> <p>It is suggesting that the PVA supports the number of structures as adequate, which is not true. The adequacy of the connectivity structures (number of and function) was an assumption inputted into the PVA and not a conclusion of the PVA. The assumption was that this number of structures is likely to provide some measure of connectivity ranging between 40% and 80% (as discussed in the Oct 2015 PVA workshop). The PVA actually assumed it as between 40-100% connectivity, which was done for other reasons, but the important point is that this figure of 26 structures is an assumption not a (mitigation) conclusion of the PVA as suggested in the KMP text.</p>	
<p>General discussion regarding stated goals throughout the KMP.</p>	<p>The following commentary relates to 2 goals repeatedly stated throughout different sections of the text, both of which have emerged from the PVA conclusions.</p> <p>1) Reduction in mortality of 4-8- animals/year.</p> <p>2) Zero koala mortality due to construction activity in the pre-, construction and operational phases.</p> <p>Comments relating to these goals follow below:</p>	<p>See below.</p>

Report Reference	EPA Comments	Response
	<p>1) The reduction of mortality by 4-8 koalas is a significant and important goal that is intertwined with the PVA conclusions and MCoA.</p> <p>How will this be monitored?</p> <p>In addition, are the actions proposed in the KMP adequate to deliver this reduction in mortality? Are the current road mortalities on Wardell road and Pacific highway this high annually?, Because this and a restricted dog control program are the only avenues provided to achieve this over the entire population area.</p> <p>TFNSW need to provide some evidence supporting the possibility of achieving this reduction in mortality and the method this will be monitored and demonstrated.</p>	<p>The reduction in road mortality of 4-8 individuals is very difficult to monitor directly, although the Plan will require data collected by Friends of the Koala and WIRES to be analysed to estimate Koala deaths on surrounding roads to the Project compared with current roadkill numbers. The current road mortalities on Wardell Road and Pacific Hwy have been estimated based on roadkill data from Lismore Friends of the Koala. In addition to the roadkill data, the PVA scenario against which population estimates will be compared takes into consideration mortality of 4 koalas per year, so if the population estimate is equal to or above that predicted then the mitigation measures will be assumed to have been effective.</p>
	<p>2) Zero koala mortality is essential if the goal of 4-8 less mortalities a year (as above) are to be achieved as well as a raft of other commitments. If zero mortality is not achieved the EPA suggests this will trigger actions above those suggested as corrective actions in tables 7-2, etc in the plan, and these need to be explored more fully in the context of the PVA, and further mitigation actions.</p>	<p>Noted. If a Koala is found to have died as a result of the project (zero mortality not achieved) then TFNSW will undertake further investigations into additional mitigation measures (depending on the causes of mortality) including installing additional fencing on other Koala hotspot areas, including koala-proof fencing portions of the Bruxner Highway if required. This additional corrective action has been included in Table 8.2 and Section 8.7.</p>
7.3.3 Predator Control	<p>The EPA support the development of a landscape based approach to predator control to be built onto what occurs on TFNSW offset properties and revegetation lands. This may be as a co-ordinator or seed money for LLS/local council/DPI involvement. To achieve the target of a 4-8 reduction in koala mortality per annum as stated will necessarily involve an ongoing reduction in dog kills, in addition to side road fencing as proposed.</p>	<p>The lead agency for dog control is NSW Local Land Services.</p>

Report Reference	EPA Comments	Response
		<p>It is recognised that TFNSW is a significant landholder in the region and is committed to dog control at a local and regional level. TFNSW is intends to work with LLS/local council/DPI once the KMP is approved to collaborate on landscape level dog control programs where possible.</p>
Chapter 8 Monitoring	<p>These comments relate to koala population monitoring in sections 8-9 and 10:</p> <p>15 years is too long a time frame before some kind of review regarding the fate of these populations must occur. The EPA supports the long term monitoring as proposed, and recognises that it will be necessary and very valuable. However there should be a review conducted within a 5 year time frame; which by collating all facets of the monitoring (culverts/road mortality/population etc as well as any available non TFNSW/ council KPOM data) will be able to inform as to the trajectory of the local Ballina and Broadwater koala populations. Associated with this will be the need to build in triggers for corrective actions, as per MCoA.</p> <p>It is important to note that the amount of population data collected by the 5 year mark will be approximately 10 times the amount that went into the PVA, that forms the basis of this KMP version 4 and any federal approval, and should be adequate to provide the basis for review.</p>	<p>The monitoring program has been amended to allow for review of Koala population estimates at 5, 10 and 15 years. It must be noted that the power (confidence) in our ability to detect change in the population at these earlier time intervals is lower than at 15 years, however, the projected population estimates and associated confidence intervals may be used as a guide to assess changes in the population relative to the PVA redictions. As indicated, all facets of the monitoring (roadkill, use of crossing structures and re-veg areas) will be reviewed at this time also to inform the results of the population assessment. Details on this process are described in Section 8.2 and Table 8.2</p>

Report Reference	EPA Comments	Response
General	<p>The EPA notes the absence of regional collaboration in the development and proposed implementation of this KMP as it relates to the important koala population in section 10. Due to the unique and comprehensive nature of the proposed actions and mitigations contained in this plan the EPA encourages inclusion and input from Ballina council at least. There is a Ballina Shire Koala Management Strategy that may provide a source of supplementary information and possible avenues of mitigation actions. As the proposed mitigation efforts necessarily exceed the usual road based focus in section 10, to facilitate a regional affect on the Koala population, it seems remiss not to involve regional managers to ensure successful outcomes are achieved.</p> <p>In addition the proposed side road fencing on Wardell Road at least will involve council management in the long term?</p>	<p>As noted above, once the KMP is approved, TFNSW intends to consult with Local Council regarding Koala management issues including dog control and implementation of additional fencing/signage/mitigation strategies on local council owned land/roads if required.</p>

NSW Department of Planning and Environment review of Koala Management Plan: Sections 1-11 (version 4.1)

Comments – 27 May 2016

Document		Woolgoolga to Ballina Pacific Highway Upgrade Koala Management Plan Sections 3-11	
Version No.		Version 4.0 April 2016	
Agency Name		Department of Planning & Environment	
Date		27 May 2016	
Item	Condition No/Report Reference	Department's Comment	TFNSW Response
9.	Chapter 2.1	Add information about Stage 2 following paragraph 4. Does not have to be detailed – relevant sections/portions.	Information about Stage 2 now included in Section 2.1.
10	Chapter 2.2	Paragraphs 3 and 4 refer to “important population” in the guidelines for assessments in the Commonwealth’s Interim Koala Referral Advice. What is an important population as described in the referral advice. Paragraph 5 states the DoE significant impact guidelines include generic assessment criteria that refer to important populations. It goes on to state that important populations has not been used in the koala referral guidelines. Please clarify paragraphs 3-4 and 5 in relation to important populations.	DoE has general assessment guidelines for all threatened species (Significant Impact Guidelines 1.1 http://www.environment.gov.au/system/files/resources/42f84df4-720b-4dcf-b262-48679a3aba58/files/nes-guidelines_1.pdf) and specific guidelines for certain species such as the koala . https://www.environment.gov.au/system/files/resources/dc2ae592-ff25-4e2c-ada3-843e4dea1dae/files/koala-referral-guidelines.pdf Where specific guidelines exist they provide more detailed guidance on DoE assessment requirements.

			<p>The general assessment guidelines include reference to considering whether proposal will impact on an important population of a species. For vulnerable species, “an ‘important population’ is a population that is necessary for a species’ long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:</p> <ul style="list-style-type: none"> • key source populations either for breeding or dispersal • populations that are necessary for maintaining genetic diversity, and/or • populations that are near the limit of the species range.” <p>In June 2012, DoE released interim koala referral guidelines. https://www.environment.gov.au/resource/interim-koala-referral-advice-proponents</p> <p>These guidelines required that “If you identify a koala population in your study area, you need to determine whether it is an important population. Until important populations can be adequately identified through consultation with koala experts, apply the criteria for an important population of a species outlined in Significant impact guidelines 1.1:”</p> <p>These were relevant guidelines that applied when the EIS assessments were undertaken.</p>
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			<p>In revising its referral guidelines for koala in 2014, https://www.environment.gov.au/biodiversity/threatened/publications/epbc-act-referral-guidelines-vulnerable-koala DoE have moved away from the requirement to identify “important populations” noting that “The Department’s Significant Impact Guidelines 1.1 include a number of generic significant impact assessment criteria that refer to ‘important populations’. The concept of ‘important populations’ has not been used in these koala referral guidelines. Sufficient information was not available at the time of writing to adequately identify and separate the nature of any important populations throughout the range of the listed species. The guidelines now focus on habitat assessment and field survey and consideration of the severity of impacts and the likely success of mitigation as main consideration in determining significance of impacts.</p> <p>The KMP text has been drafted to reflect these current DoE referral guidelines.</p>
11	Table 2-1	The approval requirement for CoAD8 (a) is addressed in Chapter 3 of the KMP not Chapter 2.	Amended accordingly
12	Chapter 2.3.1	The third paragraph states the responsibilities of implementation of the KMP are summarise din Chapter 8. Chapter 8 describes the monitoring program and does not mention implementation of the KMP.	Amended accordingly – implementation summarised in Chapter 9.
13	Chapter 2.3.2	Figure 2-1 illustrates the process followed for updating of the KMP. It is recommended that the Figure also show the process for updating of KMP Version 4.0 following monitoring of sections 9 and 10 populations and triggering of corrective actions, if required.	Process for updating KMP version 4 following 5 year review of population monitoring data included. Figure 2-1.

14	<p>Chapters 3.2.1 to 3.2.11</p>	<p>These chapters describe by project section the potential koala habitat identified through vegetation assessments, the habitat quality, connectivity and survey effort and potential for suitable habitat. The information includes total area of mapped vegetation, including area already cleared. Please provide information on the area of vegetation that was assessed:</p> <ul style="list-style-type: none"> • Is the vegetation assessed within the project boundary? • Vegetation already cleared – is this vegetation cleared for early works (utility adjustments, soft soil treatment, emu fencing). <p>The description for section 10 (Chapter 3.2.10) states 220.54 ha of vegetation was assessed, which includes 116.09 ha of previously cleared land (more than half the total area of vegetation assessed). Please clarify this statement as construction in section 10 cannot commence until the KMP is approved.</p> <p>Cleared areas are also listed in Table 4-1.</p>	<p>Yes, the vegetation assessed was within the project boundary as stated in the first paragraph of Section 3.2 “The distribution of potential habitat for the Koala throughout the footprint area of the Pacific Highway upgrade between Woolgoolga and Ballina was assessed by means of vegetation assessments etc...”</p> <p>‘Vegetation already cleared’ relates to land that was cleared (for grazing or other purposes) prior to the project. Have replaced ‘already cleared’ with ‘previously cleared’ to provide clarification.</p> <p>Have also added definition of ‘cleared land’ into Section 3.2</p>
15	<p>Chapter 3.4.2</p>	<p>Paragraph 5 – the project in section 9 includes an alignment along the existing footprint through Broadwater National Park and a greenfields alignment bypassing to the east of Broadwater to the Richmond River. The upgrade in section 9 is not largely within the existing highway footprint.</p>	<p>Agreed. Replaced “largely” with “partially”.</p>

16	Chapter 4.1	Paragraph 2 states the koala habitat score methodology is in accordance with the EPBC Environmental offsets policy and offsets assessment guide in Part 2.2 of the Plan. Chapter 2.2 of the KMP does not make reference to the koala habitat score methodology.	Agreed. It is referred to in Section 3.2 – amended accordingly.
17	Table 4-2	Exclusion fencing is proposed along Wardell Road and the existing highway. The KMP must consider property access and include measures to restrict koala movements through property access (driveways, gates, etc.).	Roads and Maritime will be consulting with landowners with the intention to install koala grids on drive ways and self-closing gates for pedestrian access where appropriate. Fauna escape structures will also be installed along the fence to allow koala to escape, if they become trapped within the fence.
18	Chapter 4.5	This chapter specifically refers to the section 10 Koala population. This chapter should discuss the mitigation measures for sections 5 and 8-9, the other key populations, and other sections with low density Koala populations.	It was considered that a separate chapter was required to provide the background and results of the PVA for the Koalas in Section 10 as this required the development of specific and substantial management measures within that Section, that were not applicable to the other 'key population' sections. Additional mitigation measures for the other key populations (Section 5, 8-9) are detailed within Sections 5.3, 6.3 and 7.3.
19	Chapter 5.1	Does pre-construction include geotechnical investigation and utility adjustments/relocation and property access relocation? Potential impacts including vehicle movements through vegetated areas, establishment of access tracks and pads, vegetation clearing and construction noise. These activities must be discussed in Chapter 5	Have included geotechnical investigation, utility adjustments/relocation and property access adjustments within potential impacts. Also included discussion on vegetation clearing (associated with access tracks and ancillary areas) in Section 5.3.4. Detailed information on impacts and mitigation measures to meet goals detailed in Table 5.2. Management of dust and noise also addressed in Section 6 and summarised in Table 6.2.

20	Chapter 6.3.3	Temporary fencing must be provided along both sides of Wardell Road adjacent/parallel to construction works, in addition to the existing highway. It is proposed to keep the temporary fencing in place for three months following clearing. Should the temporary fencing along these roads be kept for the duration of construction or until permanent fencing is erected along Wardell Road and the existing highway.	Permanent fencing will be installed on parts of Wardell Rd and existing highway prior to construction. Where works are undertaken adjacent/parallel to these roads temporary fencing will be required and will be in place until permanent fencing can be constructed.
21	Chapter 6	The timing of Koala relocation and commencement of clearing is unclear. In section 10, in particular, the length of time between capture and relocation of Koalas and commencement of clearing for both the temporary/permanent fence and mainline clearing is not specified. Is mainline clearing expected to commence soon after the exclusion fencing has been erected? Details of the hold points after Koala relocation, erection of fauna fencing, Koala surveys of the alignment prior to mainline clearing should be provided.	Based on new information regarding the actual number of food trees to be removed within the alignment (only 12 of 70 within the Laws Point area and 14 of 43 within the Wardell Road area) it is understood that far fewer feed trees will be removed as a result of the proposal than previously indicated (45% of feed trees within the Laws Point area and 95% of feed trees within the Wardell Road area, S Phillips unpublished data). As such, given the risks to the animals associated with intervention (stress, sickness and mortality) it has been determined that it would be better not to intervene to move the animals, but rather leave the animals in situ and undertake a phased resource reduction approach. This would include collaring of all habitat (feed and shelter) trees within the alignment to encourage resident animals to move away from the area of their own accord, in conjunction with population monitoring in the vicinity of the sites, prior to, during and after clearing to determine and monitor the effect of the works on any resident animals. Relevant details are now included in Section 6.3.5.
22	Chapter 6.3.6	Koalas once relocated will be kept as a group. Food trees will be fenced to prevent animals returning to their place of capture. Will one Koala be placed in a group of food trees or will several be placed in an enclosure and free to move around and interact within the enclosure? Is 2-3 weeks sufficient time for animals to adapt to the new habitat prior to the removal of fences?	Re-location of animals within Section 10 no longer proposed. See above.

		The Department considers that further discussion and justification of the relocation strategy is require, in particular its objectives, methodology, appropriateness and success. The need for the relocation program should be assessed against the permanent fencing of the construction corridor and the relocation of Koalas within the alignment to outside the fence should be considered.	
23	Chapter 6.3.12	Ancillary facility sites (including Lumleys Lane borrow site) and associated access roads must be fenced with Koala proof fencing.	Lumleys Lane borrow site will be accessed off Wardell Road, which will have permanent Koala-proof fencing. No further Koala proof fencing is proposed around the ancillary sites given they are sited in cleared/disturbed areas and there is considered to be a low likelihood of Koalas entering these areas. Additionally, all personnel will be inducted regarding no-go zones and restricted to speed limits as per the CEMP (Table 6.2).
24	Table 6-2	Add capture and relocation of Koalas in temporary enclosure as a management measure.	No longer relevant.
25	Table 7-2	<p>Add provision of fauna fencing along Wardell Road and the existing Pacific Highway and connectivity structures along Wardell Road as mitigation measures.</p> <p>The Department supports this measure however, details of the proposed connectivity structures must be provided and whether other roads such as Old Bagotville Road should also be fenced.</p>	<p>Information added to Table 7.2.</p> <p>Roads and Maritime proposes to build a Connectivity structure on either side of the Wardell Rd overpass. A connectivity structure already exists on the existing highway south of the Coolgardie interchange and Roads and Maritime propose to build a connectivity structure on the northern side of the Coolgardie interchange.</p> <p>Roads and Maritime also propose to build an additional connectivity structure on Wardell Road, between the highway alignment and Wardell to provide connectivity within the Wardell Heath for Koalas and Potoroos.</p> <p>Details of location of connectivity structures on Wardell Rd and existing highway provided in Section 6.3.9.</p>

			TFNSW do not propose to fence Old Bagotville Road at this stage but will work with Local Council regarding further opportunities to mitigate potential impacts to Koalas within this area e.g. establishment of vehicle activated messaging signs indicating presence of Koalas in the area and potential speed restrictions.
26	Chapter 8.2	<p>The Department supports monitoring over an extended period to determine changes to the Broadwater and Bagotville/Coolgardie Koala populations. It is proposed that 6-monthly surveys would be undertaken, however more frequent (monthly) monitoring should be considered if Koala deaths through vehicle strike or predation become apparent/increase to determine if additional mitigation measures are required. Review after 15 years is considered to be too long a timeframe to implement corrective actions.</p> <p>Further details of the population monitoring methodology must be provided, including the methodology to determine population numbers/density.</p>	<p>The monitoring program has been amended to allow for review of Koala population estimates at 5, 10 and 15 years. Monitoring of roadkill, use of crossing structures and re-veg areas will provide information within a much shorter time frame that may trigger the need for further mitigative actions. The population estimates will be reviewed in light of the results of the monitoring of the roadkill, crossing structures and re-veg areas.</p> <p>If a Koala is found to have died as a result of the project then TFNSW will undertake further investigations into additional mitigation measures (depending on the causes of mortality) including installing additional fencing on other Koala hotspot areas, such as the Bruxner Highway if required. This additional corrective action has been included in Table 8.2 and Section 8.7.</p> <p>Further information regarding population survey methodology has been included in Section 8.2.2.</p>

NSW Department of Planning and Environment review of Koala Management Plan: Sections 1-11 (version 4.3)

Comments – 21 July 2016

Document		Woolgoolga to Ballina Pacific Highway Upgrade Koala Management Plan Sections 3-11	
Version No.		Version 4.3 July 2016	
Agency Name		Department of Planning & Environment	
Date		21 July 2016	
Item	Condition No/Report Reference	Department's Comment	TFNSW Response
1.	Section 2.1	Detailed design of Stage 2 is underway and opportunities to re-use existing sections of the existing Pacific Highway is being explored. This would involve the re-use of the existing highway for the northbound or southbound carriageway of the upgraded highway. Sections under investigation include section 5 (CH88900 to CH96400) and section 6 (CH96400 to CH 105400). A key Koala culvert is proposed in section 5 at CH 96150. The KMP is silent on the provision of fauna crossing structures in sections of the highway to be re-used for the upgraded highway. It is acknowledged that the provision of fauna connectivity in Stage 2 would be subject to the final structures identified in the Connectivity Strategy required under condition D2. Notwithstanding, the Department seeks a commitment in the KMP that the provision of key Koala crossings (and other structures that provide connectivity for Koalas) in the re-use sections shall be built as specified in Table 6-2, subject to the Connectivity Strategy, for both carriageways of the upgraded highway.	<p>TFNSW can confirm that the culvert at Ch96150 is not within the re-use section. This culvert will be a new build with a new pavement construction.</p> <p>A commitment has been included in section 6.3.9 that any Targeted Koala Structures (identified with ticks in table 6-2) in the pavement re-use sections, shall be built as specified in Table 6-2, for both carriageways of the upgraded highway.</p>

2.	Table 2-1	<p>CoA D9(d)(vii) requires passages for Koalas under/over the existing highway (where the existing highway forms part of the SSI) to be provided and for service/local roads servicing over 100 vehicles per day. This requirement would apply to the re-use sections of the existing highway. The requirement for koala passage on local roads with over 100 vehicles per day would apply to Old Bagoville Road, identified as a hot spot for Koala mortality (see Chapter 4.5 Section 10 PVA results). No provision of Koala fencing or connectivity structures are proposed for Old Bagotville Road which is identified as a hot spot for Koala road mortality.</p> <p>The Department considers that this requirement has not been adequately addressed in the KMP.</p>	<p>In the Ballina Koala Plan, TFNSW has committed to undertake further work, such as fencing and installation of connectivity structures, at two known Koala hot-spots that occur on other roads that are adjacent to and interact with this Project (i.e. part of Wardell Road in the vicinity of the new highway, and part of the existing Pacific Highway north of Wardell to Coolgardie). The aim of these management measures is to achieve a reduction in Koala mortality in the order of 4-8 animals/year in an effort to arrest population decline as predicted by the PVA models.</p> <p>The annual average traffic count for Old Bagotville Road is approximately 100 vehicles per day or less. No additional fencing or connectivity structures are proposed for Old Bagotville Road.</p>
3.	Table 2-1	CoA D9(e) specifies additional mitigation requirements should monitoring indicate the mitigation measures are ineffective. The KMP states that this requirement is addressed in Section 6.3.9. The Department does not consider that this requirement has been addressed in Chapter 6.3.9. Further information is required specifically addressing the requirement for additional structures at 500 metre intervals.	Through the development of the Plan, the connectivity structures have been determined in consultation with species experts and government agencies. These structures are considered to be appropriate for koala connectivity and therefore TFNSW does not propose to include additional structures every 500 metres.
4.	Chapter 4.1	This chapter discusses potential impacts, including the Koala hotspots in Section 10 (Wardell Road and Laws Point). Cross reference should be made to Figure 6-7 which shows the location of these two hotspots.	Chapter 4.1 updated to include cross-reference to Figure 6-7
5.	Table 4-3	Incorrect cross reference to Section 5.3.6 which should read Section 6.3.6.	Cross-reference updated to Section 6.3.6

6.	Chapter 4.5	The last paragraph on page 4-64 refers to Figure 4-1 (PVA population projections) and various scenarios (6 in total) that were modelled. This paragraph, currently is hard to understand and does not enlighten the reader as to the information that is being conveyed. The paragraph/Figure 4-1 needs to explain the 6 scenarios, how the population in 50 years (40 to 109) was calculated, and the selection of scenario 6 as the benchmark/goal for population monitoring.	The paragraph has been updated to include dot points for each scenario that describe the assumptions of each.
7.	Chapter 4.5	The specific goals for management of Koalas in section 10 are specified on page 4-66, including (3 rd dot point) reducing Koala mortality by 4/year in terms of PVA scenario 6, which equates to 1.2% decline over 5 years, 13.7% over 10 years and 27.3% over 15 years. This goal also applies to construction (Chapter 6.2, 7 th dot point), operation (Chapter 7.2, 4 th dot point) and monitoring (Chapter 8.1, 3 rd dot point of additional monitoring objectives for section 10). However, the relative decline specified for the latter two goals is different to the decline specified in Section 4.5. The discrepancy in the percentages quoted must be explained.	Percentages are correct on page 4-66 3 rd dot point and section 8.1 3 rd dot point. The 7 th dot point in section 6.2 and 4 th dot point in section 7.2 have been updated with the correct percentages.
8.	Chapter 6.3.4	It is stated a connectivity structure exists in the existing highway south of the Coolgardie interchange. The dimensions of this structure should be provided and the structure shown in the relevant figure (6-4, 6-5 or 6-6).	Figure 6-6 has been updated to indicate location. Section 6.3.4 has been updated to include the dimensions of the structure.
9.	Chapter 6.3.5	Table 6-1 shows the different phases of the proposed Phased Resource Reduction program with trees being collared over a period of 6 weeks prior to clearing. Ring barking of trees would also be undertaken during this period. Several matters are raised with this proposal: 1. Is 6 weeks sufficient period for ring barked trees to lose their foliage? 2. Are the trees that will be collared or ring barked the key food trees identified in Table 4-2?	All koala food trees and other koala shelter trees will be collared. As a trial 20% of the trees that already have collars on them will be ring barked to induce de-foliation. It was suggested that this be trialled to assess the rate of de-foliation and in an effort to stop the Koalas utilising these trees (Sean FitzGibbon <i>pers. comm.</i> 10 June 2016).

10	Chapter 6.3.7	Reference is made to the RTA's 2011 unexpected threatened species find procedure. The relevant procedure should be the unexpected find procedure in Appendix O of the approved Construction Flora and Fauna Management Plan. If the KMP's procedure is different then justification must be provided why the CFFMP is not relevant to the KMP.	<p>The unexpected threatened species find procedure in the FFMP has been developed from the RTA's 2011 unexpected threatened species find procedure and are essentially the same procedure.</p> <p>This section has been updated in the KMP to refer to unexpected find procedure in Appendix O of the approved Construction Flora and Fauna Management Plan.</p>
11	Chapter 6.3.9	The final connectivity structures are discussed in this chapter. However the KMP does not provide measures to allow Koalas (and other fauna) to cross the alignment during its construction. Temporary/permanent fauna exclusion fencing is to be provided for the full length of the upgrade. It is understood that connectivity structures are to be constructed early in the construction period to allow unimpeded fauna connectivity during the construction of the upgrade. The KMP is silent on measures to allow fauna connectivity during construction. The Department recommends that measures similar to those provided for the Coastal Emu during construction are implemented for the KMP. Exclusion fencing is erected during construction hours and removed when no construction is occurring (eg. nights, Sundays and public holidays).	As noted in Appendix D response to DoE comments June 2016:Koala fencing will be installed on both sides of the highway within the three key population areas occupied by the Woombah-Iluka, Broadwater and Coolgardie- Bagotville Koala populations (i.e. Sections 5, 8-9 and 10).This fencing will not be installed prior to construction. This will also provide the opportunity for dispersing koalas to move across the construction corridor during out of hours/night time. However, temporary and/or permanent koala fencing will be installed where the new works are adjacent to the existing Pacific Highway prior to clearing commencing. This will be done to minimise the risk of Koalas being hit by highway traffic during vegetation clearing works.

			<p>Progressive installation of permanent Koala proof fencing on the new alignment in the three key koala population areas will connect to the new connectivity structures as they are built. Bridges in connectivity areas will be built as soon as possible in the construction to allow permanent fauna fencing to direct koalas to these structures.</p> <p>In addition, Koala fencing will be installed on other roads within Section 10, including on parts of the existing Pacific Highway north of Wardell to Coolgardie interchange and on parts of Wardell Road either side its crossing with the upgraded highway in Section 10, in accordance with the Ballina Koala Plan. This fencing will run parallel to these roads and installed prior to the commencement of mainline clearing for the road alignment.</p> <p>With regard to early construction of connectivity structures, a constructability review by Pacific Complete has indicated building the connectivity structures early requires significant access works, enabling works, clearing and earthworks similar to mainline construction works.</p> <p>In terms of early installation of temporary koala fencing within construction corridor, numerous construction access points are required into the construction corridor throughout the day which creates openings in the temporary fence and could potentially create issues for fauna trapped in the construction corridor.</p>
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			<p>It was recognised that the risk to koalas within the construction corridor is low because koalas prefer to keep their distance from the construction activity at least during the day. History on Pacific Highway projects show that koala deaths within corridor have not been an issue. However, as per the Ballina Koala Plan, it is important that fencing of adjacent local roads and existing Pacific Highway between Wardell and Coolgardie is undertaken prior to clearing commencing to minimise road strike.</p>
12	Chapter 8.3.2	<p>The Department considers that population monitoring and scat sample collection should be undertaken in Section 5 for the Woombah Koala population, in addition to connectivity structure monitoring. This will provide evidence of the status of the Woombah population over the 15 year period.</p> <p>Population monitoring is scheduled to commence in Spring 2017. The Department considers that the commencement of monitoring should commence soon after approval of the KMP to provide baseline information for the existing populations.</p>	<p>As noted in section 3.4.1: Based on review of the available material regarding the potential impacts of the Upgrade, and consultation with the relevant regulatory authorities (DoE and DP&E, 15 June 2015), it was determined that, there was a low risk that the Woombah- Iluka and Ashby Koala population would be impacted by section 5 of the Woolgoolga to Ballina upgrade project. The review determined that no additional baseline Koala surveys were required for Section 5 for the Woombah- Iluka Koala populations. TFNSW does not propose to undertake and further population monitoring for the Woombah-Iluka population.</p>

			As noted in section 8.4.1, TFNSW propose to undertake connectivity structure monitoring for the Koala structure located at chainage 96150 in Section 5. Koala faecal searches and searches for koala scratches on trees will also be undertaken in adjacent habitat (within 100m) of the connectivity structure.
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Department of the Environment review of Koala Management Plan: Sections 1-11 (version 4.3)

Comments – 27 July 2016

Condition 8.	Department Notes/Comments	Approval Holder Comments
General comment	The Department understands that fencing of local roads such as Wardell Road and the existing Pacific Highway will occur before main line clearing of section 10 commences. This is aimed to reduce any risk of koalas moving away and being killed on surrounding local roads. The Department has consulted with EPA and DPE regarding the possibility for additional fencing on Old Bagotville Road. However the Department understands there are a number of issues with this request. Please provide any information that details the constraints of this exercise. The Department notes this area has very low traffic activity; however any measures to avoid road strikes in this area would be welcomed. Is there a possibility to work with council for signage, i.e. reduced speed limits, or koala signage?	Traffic volumes on Old Bagotville Rd adjacent to the project are very low <100 vehicles per day and do not warrant permanent fencing. Also important to note that fencing itself can have impacts in restricting ecological movements. However, to help avoid road strikes in this area during construction TFNSW will examine the feasibility of installing temporary fencing prior to mainline clearing taking into consideration public safety and clearing of native vegetation. This will be confirmed as part of the Connectivity Strategy in Section 10 required to be approved prior to construction commencing.

General comment	<p>After consultation with the EPA, the Department notes the reasons why temporary fencing will not be erected during construction of section 10. Could the plan be updated to include these benefits of connectivity being maintained (during both construction and the phased resource reduction) and the measures in place that will ensure that when clearing is resumed at the beginning of each day that koalas that may have moved into the alignment will be safely moved on? (If this has been overlooked, please point out the relevant section that details this).</p> <p>The Department notes the process for capturing any koalas that will not move from a tree on its own accord, however the Department still has remaining concerns that koalas may be confused and stay close by to the clearing zones (especially near hot spots). Is this information captured in the monitoring section?</p>	<p>Refer previous response to DP&E comments.</p> <p>In terms of koalas staying close to clearing zone. The pre-clearing procedures outlined in the KMP(refer to Sections 6.3.6 and 6.3.7) address this concern ie TFNSW will still be undertaking pre-clearing surveys using experienced ecologists to ensure no koalas are harmed during clearing operations. The monitoring of the phased resource reduction program will also provide additional information on the numbers and proximity of Koalas adjacent to the alignment near the 'hot spots'.</p>
Section 4.5	<p>The information regarding the PVA and the predictions of population size will be estimated and monitored every 5 years (5, 10 and 15). While the Department accepts the power analysis and what is an appropriate (and feasible) amount of monitoring during the first 15 year period, is there a risk that any great decline between each 5 year intervals will be too long to detect any sharp declines? So how will the other monitoring events (detailed in Table 9-1) between each of these 5 year intervals detect any steep decline in the population?</p>	<p>Population monitoring will occur every year, twice a year and will be reported yearly. Large changes between individual years will be able to be detected through this method of monitoring. Specific performance targets every 5 years were selected as the statistical power of the results are more meaningful (i.e. more data to allow detection of statistically significant changes).</p>
Chapter 4.5	<p>After discussions with EPA and DPE, they are unclear what the 6 PVA scenarios referenced in the revised KMP and don't fully understand how the PVA ties in to the KMP, specifically for Section 10. Could TFNSW include more background on each of the 6 scenarios, i.e. Steve Phillips predictions, P Miller input and how the proposed scenario was developed? The Department understands the details, however for people who have not read the PVA may struggle to understand this section.</p>	<p>Refer previous response to DP&E. Section 4.5 has been updated to include dot points for each scenario that describe the assumptions of each.</p>

Chapter 8.5	Are there any trigger points for road fatality monitoring? Whilst the Department accepts the monitoring proposed within the subject area/ habitat is robust – however once the highway is operational, and all fencing has been constructed, could there be additional monitoring of fences and fauna crossings within the first year? Just to clarify, the KMP proposes 6 monthly monitoring of fencing in the first year and every year after.	Through ongoing maintenance regime there will be capacity to detect koala road kills. TFNSW road crews drive the Pacific Highway on weekly basis and will record and notify Pacific Highway Office of any Koala road kills which would trigger need to review fencing and undertake inspection maintenance.
Chapter 8	Please ensure that any annual road kills are monitored in comparison to previous mortality data collected.	Section 8.5.2 already states that road kill data needs to be compared to data collected prior to operation of the road to detect any changes in road kill numbers, although it does note that there are issues with doing this as the data has not been collected systematically.
Table 9-1	<p>This table provides a good breakdown for each type of monitoring event over a period of 15 years. Although do these monitoring events represent 1 single monitoring event for that year? In most cases for example in the Operational Management Section of this table, the maintenance of fauna and exclusion fencing and crossing structures has an 'X' marked for year 1 of operation. Is it fair to say there should be 2 X to represent 6 monthly monitoring? 2 monitoring events for that year (happy to chat if this isn't clear).</p> <p>This is just to be clear when monitoring events occur and the frequency (some monitoring events in this table actually do state 'bi-annually, 'on going' etc, however some monitoring events are unclear in their frequency).</p>	The table is intended as a summary of the monitoring plan, but does state the frequency of each monitoring procedure in the "Task" column, where relevant. Details of the timing and methodology for each monitoring procedure are provided in Section 8.

Appendix E Koala Pre-construction Surveys - Ecosure Report (2014)

Appendix F Broadwater Koala Population Survey - Ecosure Report (2015)

Appendix G Adequacy Reviews

Appendix H NSW Code of Practice for Injured, Sick or Orphaned Koalas



Appendix I Section 10 Koala Revegetation Strategy

Appendix J

Guidelines and conditions for Koala Care in NSW



Appendix K Associate Professor Jonathon Rhodes' adequacy review of the Plan

Appendix L Addendum to the Ballina Koala Plan



Appendix M Addendum to Appendix I – Koala Revegetation Strategy
