

# Bruce Highway Cooroy to Curra (Section C: Traveston to Woondum)

## Offset Research Proposal

EPBC Approval 2014/7394  
Revision 3



**Australian Government**

**BUILDING OUR FUTURE**



**Queensland Government**

## Creative Commons information

© State of Queensland (Department of Transport and Main Roads) 2015



<http://creativecommons.org/licenses/by/4.0/>

This work is licensed under a Creative Commons Attribution 4.0 Licence. You are free to copy, communicate and adapt the work, as long as you attribute the authors.

The Queensland Government supports and encourages the dissemination and exchange of information. However, copyright protects this publication. The State of Queensland has no objection to this material being reproduced, made available online or electronically but only if its recognised as the owner of the copyright and this material remains unaltered.



The Queensland Government is committed to providing accessible services to Queenslanders of all cultural and linguistic backgrounds. If you have difficulty understanding this publication and need a translator, please call the Translating and Interpreting Service (TIS National) on 13 14 50 and ask them to telephone the Queensland Department of Transport and Main Roads on 13 74 68.

Disclaimer: While every care has been taken in preparing this publication, the State of Queensland accepts no responsibility for decisions or actions taken as a result of any data, information, statement or advice, expressed or implied, contained within. To the best of our knowledge, the content was correct at the time of publishing.

# Document control options

## Departmental approvals

Refer to the appropriate Risk Assessment Tool for relevant reviewer and approver

Date	Name	Position	Action required (Review/endorse/approve)	Due
19/02/2016	Madeleine Page	Senior Environmental Officer	Draft for Review and Approval	19/02/2016
19/02/2016	Don Pitt	Project Director	Approved	19/02/2016
21/03/2016	Madeleine Page	Senior Environmental Officer	Revision 2 for review and approval following comments from the federal Department of the Environment	21/03/2016
21/03/2016	Don Pitt	Project Director	Approved	21/03/2016
23/03/2016	Madeleine Page	Senior Environmental Officer	Revision 3 for review and approval following comments from the federal Department of the Environment	23/03/2016
23/03/2016	Don Pitt	Project Director	Approved	23/03/2016

## Risk level

GACC major       GACC minor       High risk (but not GACC)       Medium risk

<b>Prepared by</b>	Madeleine Page
<b>Title</b>	Senior Environmental Officer
<b>District &amp; Region</b>	Wide Bay
<b>Branch &amp; Division</b>	PDO
<b>Project/program</b>	Bruce Highway Cooroy to Curra (Section C: Traveston to Woondum)
<b>Project number</b>	WBVD-1142 232/10A/5
<b>Project location</b>	Gympie
<b>Status</b>	Revision 3 Final
<b>DMS ref. no.</b>	450/01061 82708

# Contents

<b>Glossary and Definition of Terms</b>	<b>4</b>
<b>1. Introduction</b>	<b>5</b>
1.1 Compliance with EPBC Act Approval	5
1.2 Previous Correspondence with the Department of the Environment	5
<b>2. Background</b>	<b>6</b>
2.1 Cooroy to Curra Project	6
2.2 Research Proposal	6
<b>3. Research Proposal</b>	<b>7</b>
3.1 Background and Aims	7
3.1.1 Background	7
3.1.2 Significance	7
3.1.3 Research Aims	7
3.2 Methodology	8
3.2.1 Survey Area	8
3.2.2 Field Work	12
3.2.3 Analysis	12
3.2.4 Publications and Reporting	13
3.3 Detection Dogs	13
3.4 Program of Works	13
3.5 Funding	14
3.5.1 Financial Contribution	14
<b>4. Compliance with Appendix A of <i>Environmental Offsets Policy</i></b>	<b>14</b>
4.1 Appendix A	14
4.2 Criteria 1 - Improve the Viability of the Impacted Protected Matter	14
4.2.1 Local Impact	14
4.2.2 National Impact	14
4.3 Criteria 2 - Be targeted toward key research/ education activities	15
4.4 Criteria 3 - Be undertaken in a transparent, scientifically robust and timely manner	15
4.4.1 Transparent	15
4.4.2 Scientifically Robust	15
4.4.3 Timely Manner	15
4.5 Criteria 4 - Be undertaken by a suitably qualified individual or organisation in a manner approved by the department	15
4.5.1 Dr Celine Frere	15
4.5.2 Dr Romane Cristescu	16
4.5.3 University of the Sunshine Coast	17
4.6 Criteria 5 - Consider best practice approaches.	17
4.7 Criteria for Research Programs	17
<b>5. References</b>	<b>19</b>
<b>Appendix A EPBC Act Approval Conditions</b>	<b>20</b>
<b>Appendix B Preliminary Research Proposal</b>	<b>21</b>
<b>Appendix C Response to Public Notification</b>	<b>22</b>
<b>Appendix D Compliance with Australian Government’s Conservation Advice for <i>Phascolarctos cinereus</i></b>	<b>23</b>
<b>Appendix E Curriculum Vitae</b>	<b>25</b>

## Table of Tables

Table 1 Compliance with EPBC Act Approval Conditions	5
Table 2 Details of Previous Correspondence	5
Table 3 Research Proposal Timetable	13
Table 4 Compliance with Criteria	17

## Glossary and Definition of Terms

Term	Description
AGRF	Australian Genome Research Facilities
CAHI	Centre for Animal Health Innovation
DDC	Detection Dogs for Conservation
DoE	Department of the Environment
EPBC	<i>Environment Protection and Biodiversity Conservation Act</i>
GRC	Gympie Regional Council
Impact Zone	Area defined as the EPBC Project Area Boundary
MRCCC	Mary River Catchment Co-ordinating Committee
PCR	Polymerase chain reaction
Research Project	Research proposal submitted as part of the EPBC Act approval entitled <i>Non-invasive monitoring of fragmented and rehabilitated koala habitats using detection dogs: maximising koala conservation outcomes from mitigation strategies (e.g. offsets)</i>
Section C Project	Bruce Highway Cooroy to Curra (Section C: Traveston to Woondum) Project
TMR	Department of Transport and Main Roads
USC	University of the Sunshine Coast

# 1. Introduction

This report provides details of the research proposal developed as part of the non-direct offset proposal for the Bruce Highway Cooroy to Curra (Section C: Traveston to Woondum) Project (Section C Project) as required by Condition 7 of the *Environment Protection and Biodiversity Conservation Act* (EPBC Act) Approval, reference number EPBC 2014/7394 (EPBC Act Approval). A copy of the final conditions have been provided in Appendix A of this report.

## 1.1 Compliance with EPBC Act Approval

The following table outlines how this research proposal complies with the relevant conditions of the EPBC Act Approval.

**Table 1 Compliance with EPBC Act Approval Conditions**

Condition No	Requirement	Comment
6	To compensate for residual significant impacts to the koala, the approval holder must provide a financial contribution of \$663 000 over a five-year timeframe for research that will contribute to the better protection and long term conservation of the koala. The research must include, but is not limited to:	The procurement for the research program was completed on 3 February 2016.
6 (a)	provision of \$550 000 for a research program that will:  measure the long-term effects of habitat fragmentation on koala health dynamics and how these may be mitigated by the introduction of corridors.  measure the long-term recolonisation patterns of koalas into rehabilitated landscapes to assess whether rehabilitated landscapes can support sustainable populations of koalas.	
	The <b>approval holder</b> must provide the results of the research program to the <b>Department</b> and make them publically available, within twelve (12) months of completion of the research. The results of the research program must be peer reviewed. During the implementation of the research program, research results and progress must be reported to the <b>Department</b> annually.	Not applicable at this stage.
7	The <b>approval holder</b> must submit to the <b>Department</b> for the approval of the <b>Minister</b> , a research proposal detailing how condition 6 will be achieved, within 3 months of the date of the approval decision. The research proposal must address how the research proposal complies with Appendix A of the <b>EPBC Act Environmental Offsets Policy</b> and must include clear timeframes in which the financial contributions described in condition 6 will be paid.	This report comprises the research proposal as required by this condition.

## 1.2 Previous Correspondence with the Department of the Environment

Previous correspondence with the federal Department of the Environment (DoE) with respect to the research proposal is summarised in Table 2 below.

**Table 2 Details of Previous Correspondence**

Date	Item	Appendix
18 June 2015	Preliminary documentation submitted to DoE for approval. The research proposal was included as part of Attachment 3: <i>Bruce Highway (Cooroy to Curra) Upgrade Section C (Traveston Road to Keefton Road) Project Job No. 232/10A/2 Residual Impact Assessment and Federal Environmental Offsets Proposal for the Koala and Grey-Headed Flying-Fox (Residual Impact Assessment and Offsets Proposal)</i>	<ul style="list-style-type: none"> <li>A copy of the research proposal is provided in Appendix B.</li> </ul>
6 July 2015	Approval to publish preliminary documentation received by email from DoE.	
10 July 2015	Public notification period commenced	
7 August 2015	Correspondence sent to DoE summarising public comments and TMR's response. Comments included support for the research proposal.	<ul style="list-style-type: none"> <li>A copy of the letter and associated attachments has been provided in Appendix C.</li> </ul>
13 August 2015	Updated preliminary documentation was submitted to DoE following the public notification period. Changes were not made to Attachment 3 or the research proposal.	
27 August 2015	Approval to publish updated preliminary documentation for information only was received by email from DoE.	
1 September 2015	Public information period commenced	
23 September 2015	Email to DoE providing supporting information that outlines how the research proposal addresses the research priorities outlined in the ' <i>Approved Conservation Advice for Phascolarctos cinereus (combined populations of Queensland, New South Wales and the Australian Capital Territory) (koala Northern Designatable Unit)</i> '	<ul style="list-style-type: none"> <li>An updated copy of the response to the conservation advice is provided in Appendix D.</li> </ul>
29 September 2015	Email was sent to Mr Ross McMillan (DoE) providing a copy of the research proposal submitted as part of Attachment 3 Residual Impact Assessment and Offsets Proposal and summary of potential reporting timelines for the proposal.	<ul style="list-style-type: none"> <li>A copy of the research proposal is provided in Appendix B</li> </ul>
13 November 2015	Draft conditions received from DoE. Research program was included as condition 5.	
24 December 2015	Final approval received from DoE. Research program was included as condition 6. Requirement to submit a research proposal for approval by DoE was provided as condition 7.	
29 January 2016	Correction notice and updated approval received from DoE. Research program was included as condition 6. Requirement to submit a research proposal for approval by DoE was provided as condition 7.	<ul style="list-style-type: none"> <li>A copy of the final conditions is provided in Appendix A.</li> </ul>

## 2. Background

### 2.1 Cooroy to Curra Project

The Queensland Department of Transport and Main Roads (TMR) is currently undertaking the Bruce Highway (Cooroy to Curra) Upgrade (the Cooroy to Curra Project) which involves a 61km upgrade and realignment from Cooroy to Curra. The upgrade is required to address significant safety risks, flooding and capacity constraints and accordingly, the upgrade is classified as a High Priority 1 Project in the Queensland Government's Bruce Highway Action Plan (2012).

The joint state and federal funded Project will be constructed to better meet capacity and efficiency demands for long-term road freight and transport needs in the region, and the highway will be designed to a Q100 flood immunity. It will also provide safe, high-speed travel and improved access to the local road network.

The Cooroy to Curra Project has been divided into the following four designated sections for design and construction purposes:

- Section A: Cooroy Southern Interchange to Sankeys Road;
- Section B: Sankeys Road to Traveston Road;
- Section C: Traveston to Woondum; and
- Section D: Woondum to Curra, including the Gympie bypass.

Detailed design of Section C commenced in July 2014 and has been divided into two components – Section C Early Works (Woondum to Keefton Road) and Section C (Traveston to Woondum). Construction of Section C Early Works (Woondum to Keefton Road) has commenced with construction of Section C (Traveston to Woondum) expected to commence in mid-2016. The EPBC Act Approval is for the Section C (Traveston to Woondum) Project.

### 2.2 Research Proposal

The preliminary research proposal, was presented to the DoE as part of the offset proposal required in the preliminary documentation for the EPBC Act Approval and is provided as Appendix B of this document. The offset was required for impacts to the koala and grey-headed flying-fox as a result of the loss of habitat due to clearing for the Section C Project. The offset proposal comprised two options as follows:

- Option 1 - Non-direct offset proposal comprising the following:
  - Part a - Funding of two koala detection dogs to assist in improving field survey in the identification and presence of koalas within defined locations
  - Part b - Funding a research project at the University of the Sunshine Coast (USC) entitled '*Non-invasive monitoring of fragmented and rehabilitated koala habitats using detection dogs: maximising koala conservation outcomes from mitigation strategies (e.g. offsets)*'.
  - Provision of funding for Gympie Regional Council (GRC) wild dog abatement program.
- Option 2 - Direct land offset and provision of funding for GRC wild dog abatement program.

Condition 7 of the EPBC Act Approval requires TMR as the proponent to provide a detailed research proposal for the project which includes details on how the research complies with Appendix A of the EPBC Act *Environmental Offsets Policy* and identifies when the financial contributions provided in Condition 6 of the EPBC Act Approval will be paid.

## 3. Research Proposal

### 3.1 Background and Aims

#### 3.1.1 Background

The research proposal was developed to offset the impacts of the project to koala and grey-headed flying fox habitat. In the preparation of the offset proposal the following was identified:

- Data on the species was limited to a small number of records on relevant database searches, anecdotal records from local residents and field investigation results. The presence of koala and grey-headed flying-fox and their population health and dynamics within the Section C Project area and immediate surrounds were relatively unknown.
- Direct sightings of koala and grey-headed flying fox were not reported in any of the surveys undertaken for the Section C Project.
- There is no data available about the presence of Chlamydia and Koala retrovirus in local koala populations.
- There is limited data available to inform the selection of suitable offset sites for the protection and rehabilitation of koala and grey-headed flying-fox populations.
- Potential offset sites were fragmented and provided limited connectivity to existing habitat.
- There is limited data available to identify if koala populations re-colonise fragmented habitat.

In this regard alternative options to providing a land-based offset were considered and consultation with the USC was undertaken to determine if koala populations were known to recover in fragmented areas of habitat in this region. The consultation identified that there was limited research in this area and that whilst koalas may utilise fragmented habitat there was limited knowledge on the fine scale population dynamics of the species in this area and if the provision of fragmented habitat as an offset enabled a viable population to survive. A proposal has been developed to research the long term viability of koala populations in fragmented habitat areas and the suitability of these areas for use as an offset.

#### 3.1.2 Significance

As outlined in the research proposal provided in Appendix B, development and urbanisation is inevitable to accommodate the current and projected human population growth and the use of offsets is a mechanism to protect species impacted by clearing of habitat. Offset impacts are a hotly debated biodiversity conservation topic, with suggestions that they can produce perverse incentives and exacerbate biodiversity decline (Walker et al. 2009, Gordon et al. 2015). Conversely, others see offsets as a holistic approach incorporating loss and gain of habitat in an effort to provide the best conservation outcome (Madsen et al. 2010). Notwithstanding this debate, it is agreed that if offsets are to be undertaken, their design is critical to achieving the most efficient conservation outcomes for the impacted species (Quétiér and Lavorel 2011). Surprisingly, no research, to date, has been undertaken about what factors should be considered when choosing koala offsets to ensure the best conservation outcomes for the long-term survival of koalas. This is despite evidence from other species that indicates that evaluating and comparing the benefit of different actions is the most effective strategy in a world of limited conservation investments (McDonald-Madden et al. 2009). In this regard minimising the impact of urbanisation on koalas requires an understanding of how to best mitigate anthropogenic impacts on the fine scale population dynamics of koalas (e.g. genetics, survival, reproductive success and disease).

In the context of the koalas, offsetting land may not result in the best conservation outcomes. For instance, Cristescu et al. (2013) showed that flora rehabilitation did not correlate with koala recolonization of mine sites on Stradbroke Island. This highlights the urgent need to measure whether or not koalas do in fact recolonise rehabilitated offsets and if those provide long-lasting sustainable koala ecosystems. In addition, there is a need to investigate which offset design may be most cost-effective; e.g. is rehabilitating a larger area in lower koala habitat quality or smaller area in higher koala habitat quality more efficient? It is not yet known whether offsets would in fact have better conservation outcomes for the koala than maintaining connectivity between existing fragmented koala habitats. For instance, there are no studies completed to date that have investigated the extent to which koala habitat fragmentation impacts on the fine-scale population dynamics of koalas (genetics, disease and health). While councils and government bodies are trying to build corridors between fragmented koala habitats, there is no research to date that has shown whether the utilisation of these corridors do in fact help maintain genetic diversity. The World Conservation Union (IUCN) recognizes the need to conserve genetic diversity as one of three global conservation priorities (McNeely et al. 1990). This is because populations which can retain high levels of genetic diversity have increased potential for adaptation to changes in habitat, climate change or pathogens (Reed and Frankham 2003, Frankham 2005).

To ensure the future of koala conservation, it is therefore critical that we understand these trade-offs to maximise the benefit of the EPBC Offsets for koalas. Only when we increase our understanding of how fragmentation, connectivity and offset impact fine scale koala population dynamics over time can we ensure our strategies deliver an ecologically defensible mechanism to balance conservation and development (Gardner et al. 2013).

#### 3.1.3 Research Aims

The research project will use detection dogs (1 x koala scat and 1 x koala detection dog) and conduct fine-scale monitoring of koala populations (1) across the study area (see Figure 1), and (2) across rehabilitated habitat (specific sites to be discussed and chosen following a workshop between local environmental groups performing habitat rehabilitation, Gympie Regional Council, USC research team and TMR). The use of detection dogs is a cost-effective and non-invasive methodology to identify koala locations and their scats (Cristescu et al. 2015). From scats, the following ecological information about koalas can be measured: presence / absence of koalas at survey site, utilisation rate, distribution, sex, genetics and disease. Using this information the research project has the following aims:

- Aim 1 - measure the long-term effects of habitat fragmentation on koala health dynamics and how these may be mitigated by the introduction of corridors (underground passages etc).
- Aim 2 - measure the long-term recolonisation patterns of koalas into rehabilitated landscape (including offsets) to assess whether rehabilitated landscapes can support sustainable populations of koalas.
- Aim 3 - conduct a cost-effective analyses of Aim 1 against Aim 2.

The expected outcomes include the following:

- Assess how quickly rehabilitated land can sustain a resident koala population.
- Determine whether offsets and rehabilitated land can provide a safe habitat with a healthy koala population.

- Identify whether there is a fragmentation threshold (tipping point) where koala health and population viability declines.
- Assess whether corridors can maintain genetic connectivity and identify what attributes enhance connectivity (e.g. age, size, etc).

Provide a cost-benefit analysis of management strategies. This evidence will support decisions regarding whether it is better to invest in maintaining adequate connectivity of fragmented landscape or to rehabilitate habitats.

## 3.2 Methodology

### 3.2.1 Survey Area

The research project focuses on the Section C EPBC Project Area (highlighted in yellow in Figure 1 and shown in red in Figure 1 of the EPBC Act Approval in Appendix A). For the purposes of the research project this area has been defined as the 'impact zone'.

The surveys for Aim 1 and Aim 2 will be developed based on a grid pattern and will be undertaken in a series of stages as outlined below.

#### 3.2.1.1 Aim 1 - measure the long-term effects of habitat fragmentation on koala health dynamics and how these may be mitigated by the introduction of corridors

**Stage one** - This initial survey will enable data to be collected before the main construction works commence. The impact zone was surveyed in February and March 2016 before the clearing of vegetation for earthworks commenced, as discussed with DoE prior to the survey commencing. The survey was undertaken using a grid pattern created by plotting survey sites at regular intervals starting at random, as illustrated in Figure 2. The survey comprised 47 sites selected using the grid method illustrated in Figure 1. The number of sites has significantly increased from six that was initially proposed as this was an initial assessment developed as part of the preliminary proposal

**Stage two** – The Stage two survey will be conducted over a five year period and will be extended beyond the impact zone. It will include the following:

- Buffer around the impact zone:
  - A small, 200 meter buffer around the impact zone. Illustrated as the pink line in Figure 1. It is estimated that there will be approximately 40 sites within this zone.
  - A larger, 2 kilometre buffer around the impact zone. The large buffer is illustrated in purple in Figure 1.

The survey sites will be selected using a two-step approach. Step one will comprise an initial field assessment of the survey area for the presence/absence of koalas to identify the zones of koala activity. These zone of activity, or 'koala hot spots', as illustrated by the blue circles in Figure 3, will then become the focus of the long-term monitoring for the remainder of the research program. Until this initial field assessment is completed the number of 'koala hot-spots' is unknown.

- A 10 kilometre zone around the impact zone to incorporate the landscape context. This will enable the research team to determine what koala populations exist around the impact zone and whether these are connected to it. Specific areas to be surveyed within the 'landscape context survey area' will be chosen with consideration of accessibility and tenure including National Parks, Council Reserves, accessible private properties in consultation with local community groups such as MRCCC and the Gympie Koala Action Group. It is proposed that up to 10 areas will be selected within the 'landscape context survey extent'. The number of sites within in the landscape context has not been verified at this stage. The sites within the landscape context zone will be selected with consideration of the following aspects:
  - Known presence of koalas both currently and historically
  - Extent of rehabilitation
  - Land parcel size
  - Proximity to urban areas and infrastructure

During stage two, as far as reasonably practical, the same survey sites will be monitored biannually between 2016 and 2021.

#### 3.2.1.2 Aim 2 - measure the long-term recolonisation patterns of koalas into rehabilitated landscape (including offsets) to assess whether rehabilitated landscapes can support sustainable populations of koalas

For Aim 2, monitoring will be undertaken at sites that have already established koala rehabilitation habitats. Habitat rehabilitation occurring now may not be used by koalas before the end of this project. The selection of suitable sites will occur through a series of workshops held between the USC research team, TMR and other relevant stakeholders such as MRCCC, Gympie Regional Council and private land owners. Some of the rehabilitated areas might be outside the Gympie Regional Council boundaries if deemed to be of relevance to this project.

Figure 1 Map of the Impact Zone and Associated Survey Areas

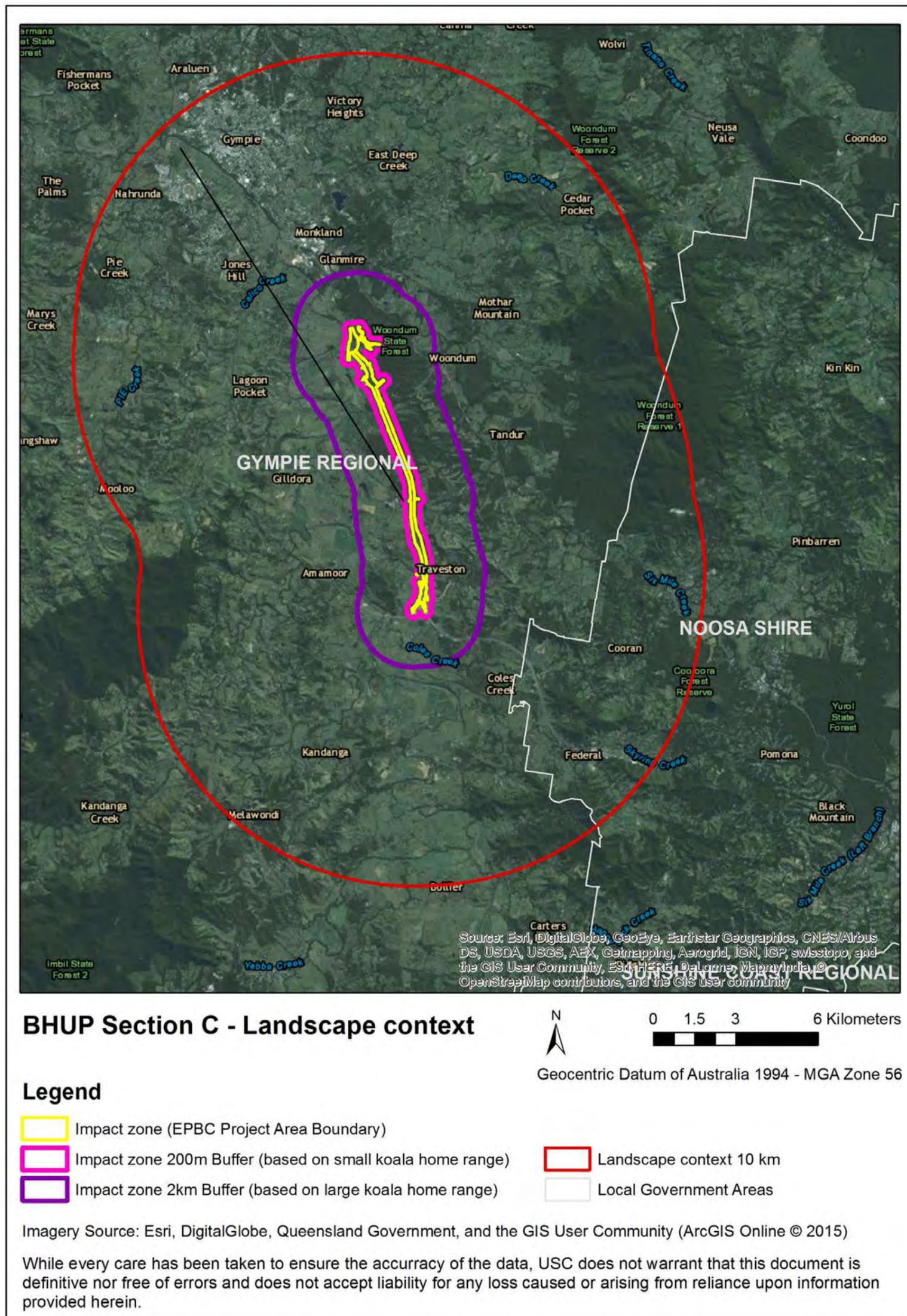
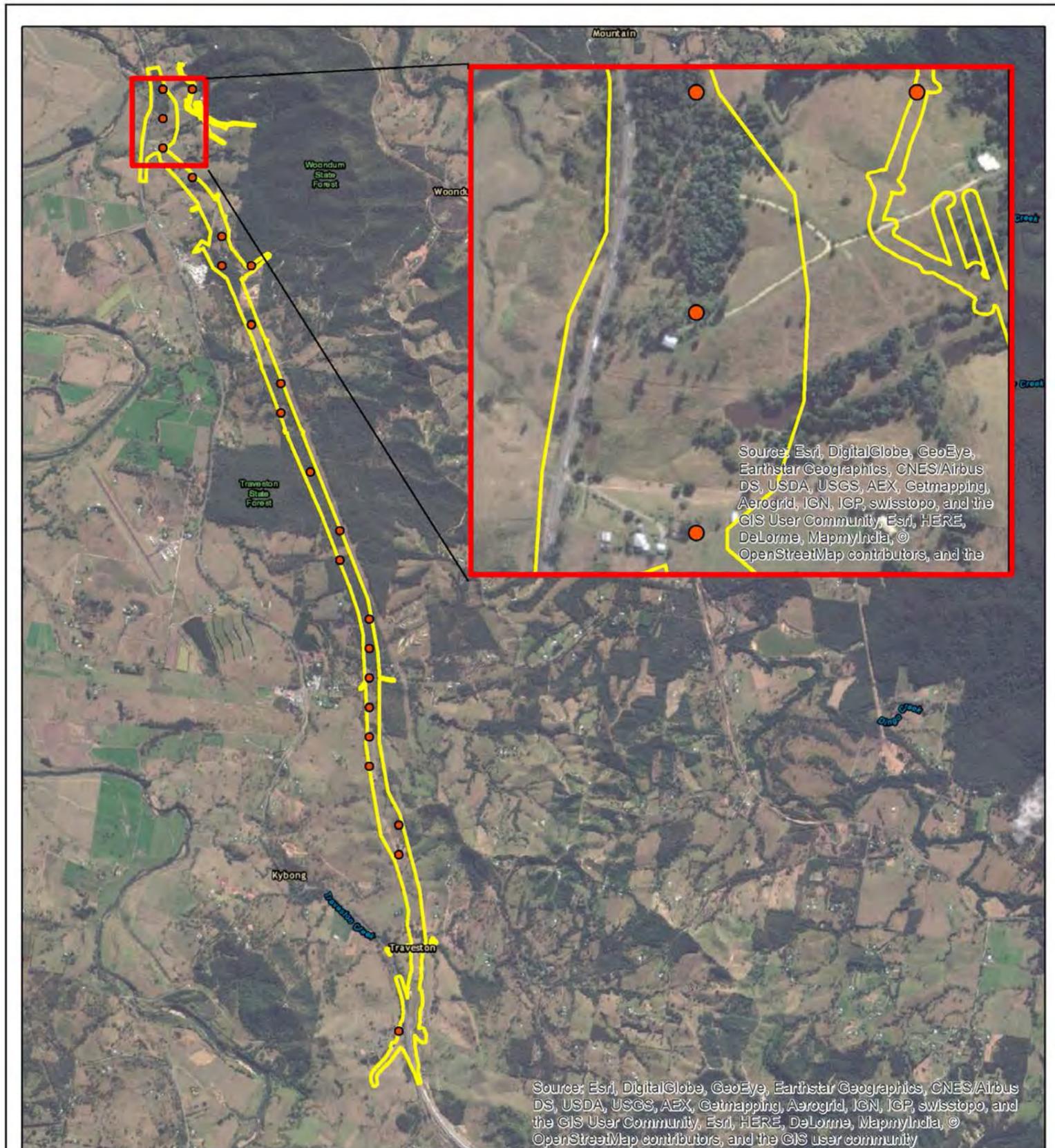


Figure 2 Grid Pattern across the Impact Zone



**BHUP Section C  
Survey sites in the direct impact zone**



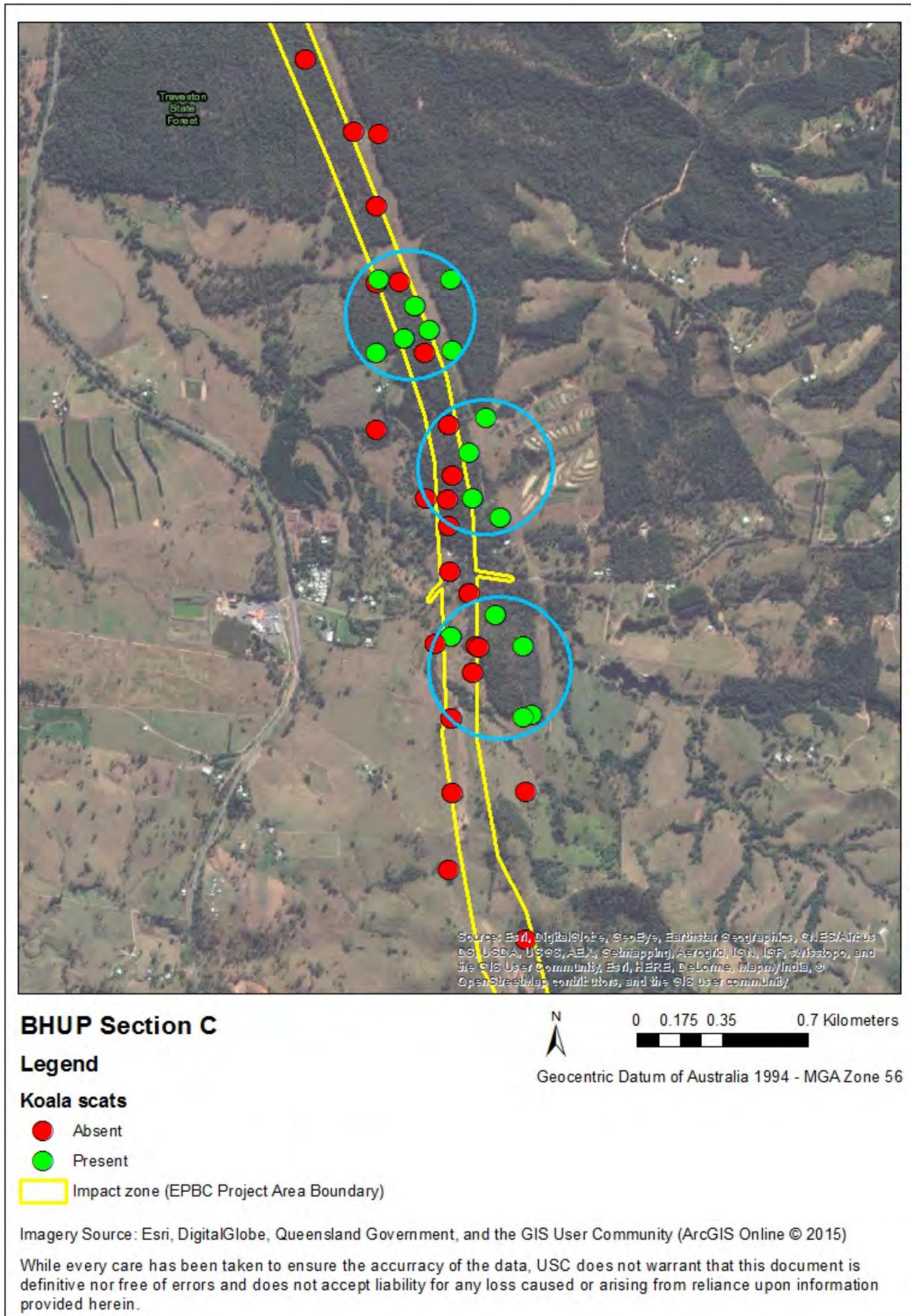
**Legend**

- Survey points
- ▭ Impact zone (EPBC Project Area Boundary)

Imagery Source: Esri, DigitalGlobe, Queensland Government, and the GIS User Community (ArcGIS Online © 2015)

While every care has been taken to ensure the accuracy of the data, USC does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.

Figure 3 Zones of Koala Activity



## 3.2.2 Field Work

### Scat survey protocol

The surveying protocol of sites for koala scats will follow the Koala Rapid Assessment Method (KRAM, Woosnam et al 2012), altered for use with a detection dog (see Cristescu et al. 2015 for details). Thirty trees will be searched for the presence of koala scats. Typical koala scats have the following characteristics (Figure 4 and Figure 5):

Symmetrical and bullet shaped (not jelly bean shaped)

- Generally about 1.5cm by 0.5 (adult koala scat size)
- Even sized but can show differences between animals
- Absence of insect parts (koalas do not eat insects)
- Very compact

Utilisation rates will be calculated by dividing the number of trees with koala scats by the number of trees searched (Phillips & Callaghan 2011).



Figure 4 Koala scats (A) and their different widths (B)

### Koala survey protocol

Koala surveys will be undertaken using the koala scat detection dog which has been trained to locate koala scent (e.g. urine, fur, etc). The koala detection dog will be used to search the survey site only when there is a presence of scats. Finding koalas is important so that the research team can ensure the collection of scats necessary to measure genetics and disease. The searches will be more flexible to allow the dog to lead.

## 3.2.3 Analysis

### 3.2.3.1 Koala Genetic Analyses

Genomic DNA will be extracted from scats collected during this study using the the QIAamp DNA stool kit from Qiagen following the manufacturer instructions. Sex will be determined genetically using sex chromosome-specific primers. Loci SRY (159 bp region of the y chromosome, Watson et al. 1998) and G6PD (175 bp region of the x-chromosome, (Loebel et al. 1995; Loebel & Johnston 1997) will be coamplified in a single polymerase chain reaction (PCR) reaction. PCR products will be run on a 1.5% agarose gel and sex determined based on the number of different fragments amplified. Females will have one band for the X chromosome and males will have two bands one for the X chromosome and one for the Y chromosome.

Patterns of genetic diversity will be measured using 12 microsatellite loci out of the following 15: Phc13, Phc25, Phc4, Phc2 (Houlden et al, 1996), Pcv2, Pcv25.2, Pcv30, Pcv24.2, Pcv6.3, K10.1, K2.1, Pcv6.1, Pcv31 (Cristescu et al, 2009), Phci10, Phci15 (Ruiz-Rodriguez et al, 2014). These 12 microsatellites will be multiplexed in four 10 ml volume using Qiagen Multiplex Kit™ (Qiagen). The PCR products will then be run on an ABI 3730 DNA Sequencer (Applied Biosystems) through Australian Genome Research Facilities (AGRF) located in Melbourne. Alleles will be scored with Genemapper Software 3.7 (Applied Biosystems).

### 3.2.3.2 Chlamydia Analyses (*C. pecorum*)

Chlamydial DNA will be extracted from scats collected during this study using the QIAamp DNA stool kit from Qiagen following the manufacturer instructions. The extracted DNA will then be quantified and the purity assessed using the Thermo Scientific NanoDrop 1000 Spectrometer (Thermo Fisher Scientific, Victoria).

*C. pecorum* infectious load and/or presence will be determined using a *C. pecorum* species-specific qPCR assay targeting 202 bp of 16S rDNA following Marsh et al. 2011 protocol (RT-Pec.sp-F: 5'-AGTCGAACGGAATAATGGCT-3', RT-Pec.sp-R: 5'-CCAACAAGCTGATATCCCAC-3'; Sigma). Samples with < 50 copies *C. pecorum* 16S rDNA will be considered negative as per Marsh et al. 2011.

Standard Curve for Quantitation of PCR Product will be undertaken using DNA from a known strong positive sample (identified by the intense staining of the band via gel electrophoresis) will be amplified using the standard PCR protocol and the 16S Chlamydia primers (as outlined above). The PCR will be electrophoresed as per the standard PCR protocol and the band will be cut out of the gel. DNA will then be purified using the QIAquick Gel Extraction kit (Qiagen). Standards of known concentration of 102, 103, 104, 105 and 106 will be prepared from the purified DNA. The concentration of DNA in the purified dilution preparations will be determined on the Nanodrop and the number of molecules of product will be calculated using Avogadro's formula (Marsh et al. 2011).

### 3.2.3.3 Data Analyses

Presence/absence and utilisation rates will be determined at each site, and mapped in ArcGIS 10.2 to allow a large scale interpretation of the results.

Patterns of genetic diversity within the study area and rehabilitated habitats will be assessed using the following genetic diversity measures: the number of alleles, number of different alleles ( $N_a$ ), number of effective alleles ( $N_e$ ) and number of private alleles ( $N_p$ ). These will be measured using GeneAIEx 6.5 (Peakall & Smouse 2006). Observed ( $H_o$ ) and expected ( $H_e$ ) heterozygosity will be calculated at each loci and population to test for possible departure from equilibrium. This will be done using the Markov chain method using GeneAIEx 6.5.

The extent of genetic connectivity within and between populations will be measured using the following estimates of population differentiation: (1)  $F_{ST}$  using ARLEQUIN (Excoffier et al. 2005) and (2)  $F'_{ST}$  values using SPAGeDI (Hardy & Vekemans 2002) as their combined use with  $F_{ST}$  enables a more robust analyses of population structure (Meirmans & Hedrick 2011). The research team will also calculate the Shannon's index mutual information (Sherwin et al. 2006),  $sH_{ua}$ , in GeneAlex (Peakall & Smouse 2006). In contrast to estimates of population, differentiation such as  $F_{ST}$  &  $F'_{ST}$ ,  $sH_{ua}$  is not dependent on the diversity within populations (e.g.  $F_{ST}$ ) but instead is completely hierarchical resulting in more robust measures of dispersal between populations (Sherwin et al. 2006). The relationship among mtDNA haplotypes were inferred from a median joining network constructed using NETWORK 4.6.11 (Bandelt et al. 1999).



Figure 5 Fresh scats

In order to test for the presence of recent bottleneck or founder effect, we will use BOTTLENECK 1.2.02 to run a step wise mutation model (SMM) as recommended by Cornuet and Luikart (Cornuet & Luikart 1996) with significance assessed using the Wilcoxon sign rank test (Cornuet & Luikart 1996).

Presence and load of Chlamydia will be assessed using the molecular approach detailed above as well as evidence of external infections, such as infected eyes and stained rump, that will be recorded when koalas are found using the koala detection dog.

### 3.2.4 Publications and Reporting

Reporting for the research project will be as follows:

- Reporting to TMR - The research team will present the results and progress to TMR twice per year (refer to Table 2). The team will however be in contact with TMR's Senior Environmental Officer once per month as a minimum.
- Publications - Results will be written up to be submitted to international peer-review journals which allow open-access. These journals will include Biological Conservation, Scientific Reports, PLoS ONE, Journal of Applied Ecology and Methods in Ecology and Evolution. It is anticipated that a minimum of two research papers will be published per year.
- Reporting to DoE - Results of the research will be provided to DoE by TMR, as follows:
  - An update on the progress of the research proposal will be provided in each annual report.
  - Research publications and outputs will be provided a minimum of five working days before release for the duration of the five-year research program.
  - A copy of the bi-annual progress reports prepared by USC will be submitted to DoE for their information.

## 3.3 Detection Dogs

As outlined in Section 3.2 above the field surveys will be undertaken using fully trained koala detection dogs. TMR have provided funding for the training and maintenance of two koala detection dogs as part of the offset proposal for the Section C project. The koala detection dogs will be trained by Sarah Fyffe from Elite K9. On-going training and management will be provided by the Detection Dog for Conservation team at the University of the Sunshine Coast in consultation with Ms Fyffe.

## 3.4 Program of Works

A proposed timeline outlining the delivery of the key components of the research proposal including the payment schedule has been provided in Table 3 below.

**Table 3 Research Proposal Timetable**

Activity	Research Aims	2016											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Payment of funding for the detection dogs	-												
Training detection dogs	-												
Preparation and approval of research proposal in accordance with EPBC Act Approval													
Payment for funding of research program	Aim 1 and Aim 2												
Survey Design	Aim 1												
	Aim 2												
Fieldwork	Aim 1												
	Aim 2												
Molecular Analyses	Aim 1												
	Aim 2												
Data Analyses	Aim 1												
	Aim 2												
Write up of peer-review publications	Aim 1												
	Aim 2												
Reporting	Aim 1												
	Aim 2												
Activity	Research Aims	2017-2022											
Payment for funding of research program	-												
Fieldwork	Aim 1												
	Aim 2												

		2016																				
Molecular Analyses	Aim 1																					
	Aim 2																					
Data Analyses	Aim 1																					
	Aim 2																					
Write up of peer-review publications	Aim 1																					
	Aim 2																					
Reporting	Aim 1																					
	Aim 2																					

## 3.5 Funding

### 3.5.1 Financial Contribution

The total financial contribution for the research project will be paid over the 5-year duration of the project. The funding for the detection dogs will be paid in year one.

## 4. Compliance with Appendix A of *Environmental Offsets Policy*

### 4.1 Appendix A

Appendix A of the EPBC Act *Environmental Offsets Policy* requires the research project to comply with five key criteria as follows:

- Criteria 1 - Improve the viability of the impacted protected matter,
- Criteria 2 - Be targeted toward key research/ education activities,
- Criteria 3 - Be undertaken in a transparent, scientifically robust and timely manner, and
- Criteria 4 – Be undertaken by a suitably qualified individual or organisation in a manner approved by the department
- Criteria 5 - Consider best practice approaches.
- Criteria for research programs

Details of how the research project meets these criteria are provided below.

### 4.2 Criteria 1 - Improve the Viability of the Impacted Protected Matter

The research project will improve koala conservation both locally within the study area (Figure 1) and nationally as outlined below.

#### 4.2.1 Local Impact

The project proposes to develop and deploy an integrated, non-invasive and cost-effective method (utilising two koala scat and two live koala detection dogs) which will result in the collection and analysis of critical key baseline information about koalas in the study area (Figure 1). This information will include population size and density, genetic diversity and connectivity, sex ratio and health measures (including disease presence/absence and load) and study how these change through time. As such this project will have the following local impact:

- Establish baseline data for the study area.
- Develop a comprehensive koala mapping for the study area and how this will change post-disturbance.
- Estimate population density within the defined study area and how this will change post-disturbance.
- Characterise the relationship between gene flow and landscape connectivity within the study area and how this will change post-disturbance.
- Provide crucial information about disease presence (in particular intestinal infection of Chlamydia and parasite load) in koalas in the study area and how this will change post-disturbance.
- Together this information will also provide evidence about whether habitat disturbance correlates with disease prevalence.

Expected outcomes:

- Identification of location(s) of high koala activity within the study area.
- Identification of potential site attributes for designing future offsets within the region.
- Identification of potential suitable locations for re-vegetation/rehabilitation to enhance corridors within the study area.

#### 4.2.2 National Impact

The research project will provide a benefit to the viability of the koala on a national scale as a result of the following:

- The project will develop long-term non-invasive monitoring methodologies to assess koala population trends over time (habitat use, population density, sex ratio, genetic diversity, disease, etc).
- The project will include the following:
  - Assess how quickly rehabilitated and offset land can sustain a resident koala population.
  - Determine whether offset and rehabilitation can provide a safe habitat with a healthy koala population.

- Identify whether there is a fragmentation threshold (tipping point) where koala health and population viability declines.
- Assess whether corridors can maintain genetic connectivity and identify what attributes enhance connectivity (e.g. age, size, etc).
- The project will provide an evidence-based, cost-benefit analysis between two different models of koala and landscape management as follows
  - Measuring the long-term effects of habitat fragmentation on koala health dynamics and how these may be mitigated by the introduction of corridors (underground passages etc).
  - Measuring the long-term recolonization patterns of koalas into rehabilitated landscape (e.g. offsets) to assess whether rehabilitated landscapes can support sustainable populations of koalas.
  - Providing a cost-benefit analyses of the each of the above.

### 4.3 Criteria 2 - Be targeted toward key research/ education activities

Despite their iconic status and economic value (est. \$1.1 billion per annum), koala numbers are in sharp decline in the northern and eastern parts of their range (Queensland, New South Wales and the Australian Capital Territory), where populations have diminished by 68% in less than 20 years (just three koala generations). The species is now listed as vulnerable under the EPBC Act in these areas. Although the reasons for these declines are well known: reduced genetic diversity, infectious disease caused by the bacterial pathogen, *Chlamydia* (which causes blindness and sterility), habitat loss (which reduces genetic diversity) and the risks associated with koala movement in human-altered landscapes including dog attacks and car strikes, large scale evidence about how these factors are impacting specific populations is not available to decision makers. This lack of information has been acknowledged by the Australian Government, which has identified key research priorities in their Conservation Advice for *Phascolarctos cinereus* (combined populations of Queensland, New South Wales and the Australian Capital Territory) (koala Northern Designatable Unit), *Conservation Advice for Koalas*. This research project addresses a large number of the research priorities outlined as provided in Appendix D.

### 4.4 Criteria 3 - Be undertaken in a transparent, scientifically robust and timely manner

The research project will be undertaken in a transparent, scientifically robust and timely manner as outlined below:

#### 4.4.1 Transparent

Transparency will be achieved in the following manners:

1. *Management of data*. All research data will be managed in accordance with policies and procedures outlined in USC's Research Data management policies and Codes of Conduct. This will ensure that all researchers involved in this project manage data under legal, statutory and ethical requirements and in accordance with the *Australian Code for the Responsible Conduct of Research (2007)*.
2. *Data Accessibility*. Data generated from this project will also be made available in USC's data repository which can be accessed on request by other researchers, government agencies and conservation groups. All primary data relating to published papers will be submitted to journals, and/or made publically available immediately upon publication should this be required or requested (e.g. by open access journals).
3. *Communication of results*. The research team will communicate the results of the research directly to TMR and the scientific community through written reports, formal meetings, including national and international conferences. Refer to Section 3.2.4.

#### 4.4.2 Scientifically Robust

The research team has an excellent track record in the research area related to this project with a strong history of publication in high impact journals such as *Nature Communications*, *PNAS*, *Current Biology*, etc. Refer to Section 4.5 below for more information.

The research team holds an animal ethic approval (AN/A/14/91) and scientific permits (Queensland Government: WITK16401215 and WISP1167751) to undertake this project.

#### 4.4.3 Timely Manner

A program of works has been prepared for the project as provided in Section 3.3. The program will be updated in each reporting period.

### 4.5 Criteria 4 - Be undertaken by a suitably qualified individual or organisation in a manner approved by the department

The research project will be led by Dr Celine Frere of USC and undertaken by the primary researcher Dr Romane Cristescu. Curriculum vitae of each of the researchers is provided in Appendix E. A summary of the experience of each of the researchers and the capabilities and resources at USC are provided below.

#### 4.5.1 Dr Celine Frere

##### 4.5.1.1 Experience

Dr Frere has secured more than \$2.1 million in research income and \$316,000 from consultancies to support her research. She is a member of USC's College of Experts, and serves on the Faculty of Science, Health, Education and Engineering's Research Committee. She is also the lead researcher of the Detection Dog for Conservation (DDC). This year, she is also serving as an expert international reviewer for grants submitted under the National Science Foundation's (USA) 'Opportunities for Promoting Understanding through Synthesis' funding stream.

Just six years out from her PhD (not accounting for career disruptions including maternity leave and two international relations), Dr Frere has established a strong, independent research program that supports 1 post-doctoral fellow (2016-2021), 5 PhD candidates, 1 international internship (M.Sc), 1 PhD exchange candidate under the NSF Grow program, and 1 full-time research assistant. She has also supervised to completion: 1 (12month) post-doctoral fellow, 4 M.Sc. students and 3 PhD candidates (co-supervisor).

Dr Frere has 33 publications, including multiple first authorships in top-tier journals. She has published an average of five articles per year since being awarded her PhD, and is first or last (senior) author on more than 60 percent of her publications. She has published with more than 100 researchers, from six government or non-government organisations, seven industry partners and 22 universities across nine countries.

Dr Frere has a high H-index for her career stage (*Scopus* = 9/ *Scholar* = 12). Her most highly cited paper has garnered 53/72 citations (*Scopus/Scholar*), and her research has been cited at total of 520/258 times (*Scholar/Scopus*). Five of her publications which are available via Open Access journals have attracted more than 17,000 views in total, and one of my articles (Cristescu, Rhodes, Banks, Frère 2013) was recommended by the *Faculty of 1000 Prime*.

Dr Frere has peer-reviewed >25 articles for journals including: *Proceedings of the Royal Society B*, *Behavioural Ecology* (IF 3.157), *Animal Behaviour* (IF: 3.068), *Journal of Experimental Marine Biology and Ecology* (IF 2.475), and *Marine Mammal Science* (IF 1.820). Since 2012, she has also provided expert review for grants submitted to the Australian Marine Mammal Centre (Category 1), and the National Science Foundation (USA).

#### 4.5.1.2 Journal Quality

Dr Frere has published 3 articles in the top 1% of journals worldwide (*SCIVAL* 2015), specifically *Nature Communications* (IF:10.742) and *PNAS* (IF: 9.809). She consistently publishes in high-impact journals, with a median publication JIF of 3.534, which is substantially above the median JIF of her ISI fields, including *Evolutionary Biology* (2.836), *Genetics and Heredity* (2.472), *Biodiversity Conservation* (1.249), *Ecology* (1.838), *Marine and Freshwater Biology* (1.422) and *Zoology* (1.019) (Source: *Journal Citation Reports, Web of Science, accessed Jan 2015*).

Dr Frere's excellence in research is clearly reflected in *SCIVAL's* (*Scopus*) metrics (accessed January 2015) which shows that:

- 20 percent of her publications are in the top 10 percent most cited worldwide
- 70 percent of her publications are in the top 10% journals by IPP (Impact per publication)
- 62 percent of her publications are co-authored with international collaborators
- her high field-weighted citation impact is 1.48.

#### 4.5.1.3 Significant research advances and achievements contributing to this proposal

- (1) *Conservation genetics*: Dr Frere has more than 14 years of expertise in the conservation genetics and recently genomics of flora (African mahogany and C4 grasses) and fauna (koalas, inshore dolphins, lizards). In 2008, she lead a watershed genetic investigation (*Marine and Freshwater Research*) which called for a revision of humpback dolphin (*Sousa* spp.) taxonomy, and she provided crucial further evidence for this in 2011 (*Conservation Genetics*). These two papers laid foundational work for the identification of a new species of humpback dolphin, the Australian humpback in 2014. In 2013, she contributed to the first whole genome sequencing of *Sorghum* (*Nature Communications*), which has already been cited 47 times including in *New Phytologist* (IF 7.672) and *Science* (IF 33.61). She was also senior researcher in a team which documented the first case of hybridization between the Australian snubfin and Indo-Pacific humpback (*PloS One*).
- (2) *Koala conservation*: Dr Frere's research in koala conservation in collaboration with Dr Romane Cristescu (other lead researcher on this project) has challenged traditional assumptions that restoring flora (habitat) leads to the recolonization of fauna (using the koala on North Stradbroke Island as a case-study), and provided key evidence in support of direct monitoring of fauna species after rehabilitation. Crucially her work (Cristescu et.al 2012) demonstrated high levels of subjective bias in the detection of koala scat using traditional human survey methods, and provided with the impetus for the development of more reliable koala detection methods (for example, by detection dogs). This work was published in Scientific Report in 2015.
- (3) *Development of non-invasive methods*: In addition to the new method for scat location by detection dogs outlined in this proposal, Dr Frere has headed the development of several key methods which have reduced the impact of scientific research on animals.
  - In 2010, she pioneered the development of a new mode of genetic data collection for cetaceans, showing that genetic material could be extracted from dolphin mucus allowing for non-invasive data collection. (Frere Et. al. 2010). In contrast to dart biopsying, the new method capitalised on the natural breathing behaviour of dolphins. *This method has now been adapted for the collection of genetic material in whales.*
  - In 2014, she developed a cost-reducing, non-invasive, new method for the remote identification of eastern water dragon lizards using open-source software which was initially developed for the identification of manta rays (Gardiner 2014). This new method offers an alternative to invasive mark-recapture methods and has been successfully applied to the study of fine-scale movements of the species.

## 4.5.2 Dr Romane Cristescu

### 4.5.2.1 Experience

Dr Romane Cristescu is an early career scientist (PhD in 2012, industry position 2012-2015) with interests ranging from conservation biology (new methodologies in conservation including detection dogs, remote surveys; applications of GIS technology to conservation biology) to landscape restoration, fauna responses to habitat loss and fragmentation, wildlife/human conflicts, interactions and synergies in threats to endangered species, and emerging infectious diseases in wildlife.

Dr Cristescu holds a veterinarian degree (Ecoles Veterinaire de Maison Alfort) with wildlife specialisation (Ecoles Veterinaire de Nantes), a master in koala conservation (Universite de Tours) and finished her PhD in March 2012 with a project on fauna utilisation of post mining landscape with a particular focus on koala recolonisation patterns in rehabilitated areas of varied age (UNSW). While Dr Cristescu has held a non-research position as a fauna mine site rehabilitation and closure advisor since completing her PhD, she holds an exemplary track-record given opportunities. Indeed, she has published a total of 16 peer-reviewed research articles, has published in high-impact journals such as *Current Biology* and *Scientific Reports* and has an average Journal Impact Factor of 3.99 which is substantially above the median JIF of my ISI fields, including *Biological Conservation* (1.099) and *Zoology* (1.509). Dr Cristescu H-index is 7 (highest citations per paper = 63) and her research has been cited 195 times (Google Scholar).

Dr Cristescu specific fields of research expertise include koala ecology, field survey methods and conservation genetics.

### 4.5.2.2 Significant research advances and achievements contributing to this proposal

- (1) *Koala ecology and conservation* - Dr Cristescu has 10 year experience with koala research. She started investigating heavily-manipulated koala populations in South Australia and Victoria for her Master's thesis. This research, published in *Wildlife Research* in 2009, focused on the effects of several bottlenecks and translocations on koala genetics and disease (cryptorchidism). She then studied the patterns of recolonization by koalas of newly rehabilitated habitat (post mining). She demonstrated that the commonly-used mine closure completion criteria, focusing mainly on flora, and adopted by most mining companies, do not necessarily reflect fauna; thus challenging the "build it and they will come" paradigm (*Journal of Applied Ecology*).

She also investigated whether rehabilitated areas could constitute ecological traps for koalas (e.g. by luring them with new growth but not providing adequate protection from predators, *PLoS ONE*). Her recommendations allowed a \$350,000 koala research program to be sponsored by the mine.

Finally, she spent a large part of her PhD catching and radio-tracking koalas, which allowed her to gain a good understanding of koala behaviour in the wild as well as the need for development of less invasive field work methodologies.

- (2) *Field work methodologies* - Dr Cristescu has a strong interest for testing the accuracy and biases of commonly used methodologies with the aim to create better and more accurate methodologies. She tested the decay and detectability biases of koala scat surveys and found that both are large enough to introduce severe biases in survey results (*International Journal of Zoology*). This led to the publication of a more scientifically robust survey technique for scats which included not being limited by time (as a time limit can strongly bias detectability, the more complex ground cover necessitating longer searches, *Australian Zoologist*).

She also demonstrated how low detectability in human surveys of koala scats can be improved by changing the detection method to use odour and not sight, using a specifically trained detection dog. She proved the method was not only 150% more accurate, but also 20 times quicker, than current human-only methods, the new detection dog method thus allowing more robust and larger-scale data collection (*Scientific Reports*).

- (3) *Conservation genetics* - Dr Cristescu genetic work includes studying the impact of an Ebola outbreak on the genetic variability of gorillas using DNA from gorilla scats, as well as the effect of genetic bottlenecks, inbreeding and health in koalas (*Current Biology, Journal of Animal Ecology*). She also published a methodology paper on the importance of choosing the right microsatellite structure to increase the chances of detecting genetic bottlenecks in wild populations (*Conservation Genetics*).

### 4.5.3 University of the Sunshine Coast

USC has made several strategic appointments to enhance koala research capabilities in *Chlamydia* (Timms, Polkinghorne & Frere) and ecology (Frere & Cristescu). These strategic appointments have led to the formation of the Centre for Animal Health Innovation (CAHI) and Detection Dogs for Conservation (DDC) to enhance koala research. CAHI and DDC is comprised of a successful group of 20 academics, research fellows and HDR students developing innovative solutions to animal health problems. The DDC, which includes training and research on the use of detection dogs in tackling important ecological questions, is currently working on several koala mapping projects including with: Sunshine Coast Regional Council, Gympie Regional Council, Fraser Coast Regional Council and Noosa Shire Council.

USC also has state-of the art molecular facilities relevant to the proposed research such as advanced molecular biology, microbiology and immunology laboratories (PC2 and PC1) with excellent supporting equipment and bioinformatics facilities for data analyses (e.g. Linux Server Ubuntu 12.04 LTS with 64 cores, 1TB RAM, 8 TB hard drive, 2 x Win7 high spec hot-desk workstations Dell T5610, 24 cores, 36 GB RAM, 1TB hard drive and VM machines with up to 128 GB RAM available on request to host OS on campus in USC's private cloud).

## 4.6 Criteria 5 - Consider best practice approaches.

Koala conservation has been significantly hindered by the prohibitively expensive field costs (animal monitoring). For example, finding, catching, extracting blood samples and implementing GPS/radio trackers on a single koala costs around \$1,000. Furthermore, wild animals are susceptible to stress during handling by humans which, in the case of the koala, may compound the chronic physiological stresses associated with urban growth. As part of this project, non-invasive methodologies (scat and koala detection dogs) will be used to collect fresh scats to measure key health predictors (genetic diversity and disease).

While koala scats have been previously used to measure gene-flow and diet, their utility has been limited because measures can be affected by the age and degradation of samples, and collection methods are often biased or ad-hoc in nature because scats are small and difficult to find in the wild. The use of specifically trained detection dogs to accurately and quickly locate fresh scat, not only overcomes these limitations, **but** allows for the measurement of health indicators which are more relevant to species conservation (genetic diversity and disease load) and which can't be measured from aged scat.

Dr Frere and Dr Cristescu have already made substantial progress toward achieving these aims by training and testing dogs able to locate fresh koala scats; dogs were 153% more accurate and 19x faster in locating wild koalas than traditional methods representing significant savings in monitoring costs (see Cristescu et al. 2015). Dr Frere in collaboration with Dr Polkinghorne have also established that *Chlamydia* can be detected in the scats of infected animals.

## 4.7 Criteria for Research Programs

Compliance with the criteria for research programs has been provided in Table 4 below.

**Table 4 Compliance with Criteria**

	Criteria	Compliance
	<b>The proponent is required to</b>	
1	select an institutional or individual host (for the purpose of executing the program) through an internationally available open tender process or provide evidence that the program can be successfully undertaken in-house. The department will not be responsible for processing tenders. Where appropriate, the tender should complement an existing research institution's (e.g. National Environmental Research Program Hub) work program as it relates to the matter of national environmental significance. This will be the responsibility of the proponent; however, the department will require that proponents follow the department's guidelines	TMR identified a gap in the knowledge of koala populations in the area and a suitable approach to designing offsets for this species in this location. Proposals from USC were reviewed and the approach using the Detection Dogs was selected as the most suitable for this project.

Criteria		Compliance
<b>The proponent is required to</b>		
2.	provide updates on progress and key findings to the department through periodic reporting	Results of the research will be provided to DoE by TMR, as follows: <ul style="list-style-type: none"> <li>An update on the progress of the research proposal will be provided in each annual report.</li> <li>Research publications and outputs will be provided a minimum of five working days before release for the duration of the five-year research program.</li> <li>A copy of the progress reports prepared by USC will be submitted to DoE for their information.</li> </ul>
3.	ensure that funds are managed appropriately and that auditable financial records are kept and maintained	The funds have been allocated specifically for this project and a dedicated purchase order number will be raised in TMR's financial accounting system. The invoices will be paid annually in accordance with the contract with USC. A record of all invoices and subsequent payments will be documented in SAP (TMR's main financial accounting system), Projman (TMR's subsidiary financial accounting system) and an electronic and physical copy of all invoices and documentation will be kept on TMR's filing systems. This documentation can be provided promptly if auditing is required. A copy of the payment history can also be provided on request from DoE.
4.	apply a 'no-surprises' policy to the publication, whereby research publications and outputs are provided to the department at least 5 working days before release.	Research publications and outputs will be provided to DoE a minimum of five working days before release for the duration of the five-year research program.
<b>Research programs:</b>		
1.	will be tailored to at least a postgraduate education level; however, there will be scope to engage other educational levels in educational programs (see below)	The proposed research project will be conducted at the highest postgraduate education level and will throughout its duration involve a minimum of two PhD students. It will fund the support of one postdoctoral fellow (Dr Romane Cristescu) and two PhD students. Dr Celine Frere has secured the commitment of USC to allocate two PhD student scholarship towards this project.
2.	will present findings that can be peer-reviewed	Dr Celine Frere and Dr Romane Cristescu track record in the publication of peer-reviewed article is of very high standard as described in detail in Section 4.5 of the research proposal. Dr Celine Frere and Dr Romane Cristescu aim to publish a minimum of 4 peer-reviewed articles from this project.
3.	will publish findings in an internationally recognised peer-reviewed scientific journal or be of a standard that would be acceptable for publication in such a journal. Publications should be submitted to free open access journals. Data and information collected should have creative commons licensing and be free and accessible	The broad application of the new and innovative methodology proposed here addresses significant questions of both national and international importance in conservation (e.g. whether and how species recover from habitat fragmentation and ways to mitigate these impacts; can offsets be of significant conservation gain; can rehabilitated landscape provide lead to sustainable populations; etc) and such will lead to the publication in high ranking international peer-reviewed journals. In addition, the research team has an excellent track record in the research area related to this project with a strong history of publication in high impact journals such as <i>Nature Communications</i> , <i>PNAS</i> , <i>Scientific Reports</i> , etc.
4.	research outputs should inform future management decisions on the protected matter and, where possible, be readily applicable to other similar matters (species groupings etc).	Research outputs will be made available to relevant stakeholders to inform management decisions such as: <ul style="list-style-type: none"> <li>Improving koala mapping accuracy. This will be done in collaboration with Gympie Regional Council.</li> <li>Potential locations for rehabilitation project. This will be done in collaboration with community groups such as MRCCC, Gympie Koala Action Group, WWF.</li> <li>Identification of koala habitat connectivity. This will inform the locations for corridors to maintain connectivity.</li> <li>Identification of potential offset sites to maximise conservation outcome. For instance, offsets close to existing koala populations, offset sites to act as corridor, etc.</li> </ul>

## 5. References

- Cristescu R, Cahill V, Sherwin WB, Handasyde K, Carlyon K, Whisson D, Herbert C, Carlsson BLJ, Wilton AN, Cooper DW. 2009. Inbreeding and testicular abnormalities in a bottlenecked population of koalas (*Phascolarctos cinereus*). *Wildlife Research* 36: 299-308.
- Cristescu R, Emily Foley, Anna Markula, Gary Jackson, Darryl Jones, Céline Frère, 2015. Accuracy and efficiency of detection dogs: a powerful new tool for koala conservation and management, *Scientific Reports*
- Cristescu R, Klaartje Goethals, Frank Carrick, Peter Banks, Céline Frere, 2012. Experimental evaluation of koala scat persistence and detectability with implications for pellet-based fauna census, *International Journal of Zoology*
- Houlden BA, England P, Sherwin WB. 1996. Paternity exclusion in koalas using hypervariable microsatellites. *Journal of Heredity* 87: 149-152.
- Loebel DA, Longhurst TJ, Johnston PG. 1995. Full-length cDNA sequence of X-linked G6PD of an Australian marsupial, the wallaroo. *Mammalian Genome* 6: 198-201.
- Loebel DA and Johnston PG. 1997. Analysis of the intron-exon structure of the G6PD gene of the wallaroo (*Macropus robustus*) by polymerase chain reaction. *Mammalian Genome* 8: 146-147.
- Marsh J, Kollipara A, Timms P, Polkinghorne A. Novel molecular markers of *Chlamydia pecorum* genetic diversity in the koala (*Phascolarctos cinereus*). *BMC Microbiol.* 2011;11(1):77
- Phillips & Callaghan, 2011. The Spot Assessment Technique: a tool for determining localised levels of habitat use by Koalas *Phascolarctos cinereus*, *Australian Zoologist*, 35 (3) 774-780
- Romane H. Cristescu, Emily Foley, Anna Markula, Gary Jackson, Darryl Jones, Céline Frère, Accuracy and efficiency of detection dogs: a powerful new tool for koala conservation and management, 2015, *Scientific Reports*, 5 : 8349
- Ruiz-Rodriguez C, Ishida Y, Greenwood A, Roca A. 2014. Development of 14 microsatellite markers in the Queensland koala (*Phascolarctos cinereus adustus*) using next generation sequencing technology. *Conservation Genetics Resources* 6(2): 429-431.
- Wan C, Loader J, Hanger J, Beagley KW, Timms P, Polkinghorne A. 2011. Using quantitative polymerase chain reaction to correlate *Chlamydia pecorum* infectious load with ocular, urinary and reproductive tract disease in the koala (*Phascolarctos cinereus*). *Aust. Vet. J.* 89: 409–412.
- Watson CM, Margan SH, Johnston PG. 1998. Sex-chromosome elimination in the bandicoot *Isodon macrourus* using Y-linked markers. *Cytogenetics and Cell Genetics* 81: 54.
- Wedrowicz F, Karsa M, Mosse J, Hogan FE. 2013. Reliable genotyping of the koala (*Phascolarctos cinereus*) using DNA isolated from a single faecal pellet. *Molecular Ecology Resources*. DOI: 10.1111/1755-0998.12101
- Woosnam O, Cristescu R, Dique D, Ellis B, Beeton R, Simmonds J, Carrick F, 2012. What faecal pellet surveys can and can't reveal about the ecology of koalas *Phascolarctos cinereus*, *Australian Zoologist*, 36 (2): 192- 200

# Appendix A EPBC Act Approval Conditions



## CORRECTION NOTIFICATION

### **Bruce Highway upgrade and realignment – Cooroy to Curra – Section C, south of Gympie, Queensland (EPBC 2014/7394)**

The Approval, Bruce Highway upgrade and realignment – Cooroy to Curra – Section C, south of Gympie, Queensland (EPBC 2014/7394) was signed on 24 December 2015 and contained the following errors.

Condition 7 reads: The **approval holder** must submit to the **Department** for the approval of the **Minister**, a research proposal detailing how condition 5 will be achieved, within 3 months of the date of the approval decision. The research proposal must address how the research proposal complies with Appendix A of the **EPBC Act Environmental Offsets Policy** and must include clear timeframes in which the financial contributions described in condition 5 will be paid.

Condition 7 should read: The **approval holder** must submit to the **Department** for the approval of the **Minister**, a research proposal detailing how condition 6 will be achieved, within 3 months of the date of the approval decision. The research proposal must address how the research proposal complies with Appendix A of the **EPBC Act Environmental Offsets Policy** and must include clear timeframes in which the financial contributions described in condition 6 will be paid.

Condition 9 reads: In the event that the research proposal referred to in condition 6 is not submitted within 12 months of the approval date, and approved; or the approved research program is not delivered to the satisfaction of the **Minister** within five (5) years of entering into the agreement set out in condition 5, the **approval holder** must secure an appropriate direct offset to compensate for the loss of 45.9ha of habitat critical to the survival of the koala, in accordance with the **Department's EPBC Act Offsets Policy** and to be secured by a legally binding conservation protection mechanism.

Condition 9 should read: In the event that the research proposal referred to in condition 7 is not submitted within 12 months of the approval date, and approved; or the approved research program is not delivered to the satisfaction of the **Minister** within five (5) years of entering into the research program set out in condition 6, the **approval holder** must secure an appropriate direct offset to compensate for the loss of 45.9ha of habitat critical to the survival of the koala, in accordance with the **Department's EPBC Act Offsets Policy** and to be secured by a legally binding conservation protection mechanism.

The approval decision notice did not clearly reference that there were conditions attached to the approval of the action. This has now been amended.

A corrected version of the notice is at Annexure 1.

**Person making correction**

**Name and position**

Deb Callister  
Assistant Secretary  
Assessments (Queensland, Victoria, Tasmania) and Policy  
Implementation Branch

**Signature**



**date of correction**

21/1/16



**Approval**

Bruce Highway upgrade and realignment – Cooroy to Curra – Section C, south of Gympie, Queensland (EPBC 2014/7394)

This decision is made under sections 130(1) and 133 of the *Environment Protection and Biodiversity Conservation Act 1999*.

**Proposed action**

**person to whom the approval is granted** Queensland Department of Transport and Main Roads

**proponent's ABN** ABN:39 407 690 291

**proposed action** To upgrade and re-align approximately 11.5 km of the Bruce Highway between the Traveston Road interchange and Woondum, south of Gympie, Queensland [See EPBC Act referral 2014/7394 and Notification of Variation to Proposal of 14 September 2015].

**Approval decision**

Controlling Provision	Decision
Listed threatened species and communities (sections 18 & 18A)	Approved

**Conditions of approval**

This approval is subject to the conditions specified below.

**Expiry date of approval**

This approval has effect until 13 November 2025.

**Decision-maker**

**name and position** Deb Callister  
Assistant Secretary  
Assessments (Queensland, Victoria, Tasmania) and Policy  
Implementation Branch

**signature**

**date of decision**

21 January 2016

---

## Conditions attached to the approval

For the protection of **Matters of National Environmental Significance**

1. The **approval holder** must not **clear** more than 45.9 hectares of **habitat for Matters of National Environmental Significance** located inside the **project area**.
  2. To prevent **impacts to water quality** the **approval holder** must ensure that during **normal flow events**:
    - a) water quality monitoring is conducted in accordance with the **Erosion and Sedimentation Control specifications**, including the location of **water sampling points**, weekly for the duration of **construction**, and quarterly for five (5) years after the completion of **construction**;
    - b) there must be no **construction** related **impacts to water quality** between upstream and downstream **water sampling points** during **construction** and for five (5) years after the completion of **construction**;
    - c) during **construction** any water released from sediment basins must not contain less than 50% dissolved oxygen.
  3. During **construction** there must be no **koala** or **grey-headed flying-fox** mortality attributable to **construction** activities within the **project area**, monitored daily.
  4. For the ongoing protection of the **koala**, the **approval holder** must implement protection measures including fencing and passages that must be designed, placed, maintained and actively monitored (at least monthly), to ensure that no **koala** mortality from vehicle strike occurs within the **project area** and that the ability for **koalas** to cross safely is maintained where the road passes through Traveston State Forest, for the life of the approval.
  5. If monitoring results indicate that outcomes in conditions 2-4 have not been achieved or are not likely to be achieved, the approval holder must:
    - a. investigate why the outcomes will not be achieved and determine if it is a result of the action, failure to maintain fencing and passages, or other circumstances;
    - b. where caused by the action, or failure to maintain fencing and passages, advise the **Department** within 14 days of receiving the monitoring results; and
    - c. develop and implement corrective actions, revised management measures and/or compensation measures in consultation with a **suitably qualified expert** and the **Department**.
  6. To compensate for residual significant impacts to the **koala**, the **approval holder** must provide a financial contribution of \$663 000 over a five-year timeframe for research that will contribute to the better protection and long term conservation of the **koala**. The research must include, but is not limited to:
    - a. provision of \$550 000 for a research program that will:
      - i. measure the long-term effects of habitat fragmentation on **koala** health
-

---

dynamics and how these may be mitigated by the introduction of corridors.

ii. measure the long-term recolonisation patterns of koalas into rehabilitated landscapes to assess whether rehabilitated landscapes can support sustainable populations of **koalas**.

b. provision of \$88 000 for the training of **koala** detection dogs to be used in the study.

The **approval holder** must provide the results of the research program to the **Department** and make them publically available, within twelve (12) months of completion of the research. The results of the research program must be peer reviewed. During the implementation of the research program, research results and progress must be reported to the **Department** annually.

7. The **approval holder** must submit to the **Department** for the approval of the **Minister**, a research proposal detailing how condition 6 will be achieved, within 3 months of the date of the approval decision. The research proposal must address how the research proposal complies with Appendix A of the **EPBC Act Environmental Offsets Policy** and must include clear timeframes in which the financial contributions described in condition 6 will be paid.
8. For the protection of the **koala**, the **approval holder** must provide \$25 000 to the Gympie Regional Council to be used for the management of feral dogs within the council area within three (3) months of the date of this approval decision. Within ten (10) business days of provision of the funds the **approval holder** must advise the **Department** in writing that this has occurred.
9. In the event that the research proposal referred to in condition 7 is not submitted within 12 months of the approval date, and approved; or the approved research program is not delivered to the satisfaction of the **Minister** within five (5) years of entering into the research program set out in condition 6, the **approval holder** must secure an appropriate direct offset to compensate for the loss of 45.9ha of habitat critical to the survival of the koala, in accordance with the **Department's EPBC Act Offsets Policy** and to be secured by a legally binding conservation protection mechanism.
10. Within 10 days after the **commencement** of the action, the **approval holder** must advise the **Department** in writing of the actual date of **commencement** of the action.
11. The **approval holder** must maintain accurate records substantiating all activities associated with or relevant to the conditions of approval and make them available upon request to the **Department**. Such records may be subject to audit by the **Department** or an independent auditor in accordance with section 458 of the EPBC Act, or used to verify compliance with the conditions of approval. Summaries of audits will be posted on the **Department's** website. The results of audits may also be publicised through the general media.
12. Within one (1) month of every 12 month anniversary of **commencement**, the **approval holder** must publish a report on their website addressing compliance with each of the conditions of this approval, including implementation of any management plans as specified in the conditions and effectiveness of fencing and passages in preventing koala mortality due to vehicle strike. Documentary evidence providing

---

proof of the date of publication and non-compliance with any of the conditions of this approval must be provided to the **Department** at the same time as the compliance report is published.

13. Upon the direction of the **Minister**, the **approval holder** must ensure that an independent audit of compliance with the conditions of approval is conducted and a report submitted to the **Minister**. The independent auditor must be approved by the **Minister** prior to the commencement of the audit. Audit criteria must be agreed to by the **Minister** and the audit report must address the criteria to the satisfaction of the **Minister**.
14. If, at any time after two (2) years from the date of this approval, the **approval holder** has not **commenced** the action, then the **approval holder** must not **commence** the action without the written agreement of the **Minister**.
15. Unless otherwise agreed to in writing by the **Minister**, the **approval holder** must publish all reports and agreements referred to in these conditions of approval on their website. Each report and agreement must be published on the website within one (1) month of being approved by the **Minister**.

---

#### **Definitions:**

**Approval Holder** means the person to whom the approval is granted, or any person acting on their behalf, or to whom the approval is transferred under section 145B of the EPBC Act.

**Clear/Clearing** includes but is not limited to the cutting down, felling, thinning, logging, removing, killing, destroying, poisoning, ringbarking, uprooting or burning of native vegetation.

**Commencement** (including commenced) includes any preparatory works required to be undertaken for the purpose of breaking the ground or buildings or infrastructure, including the erection of any fences, signage or on-site temporary structures and the use of construction or excavation equipment on site.

**Construction** includes, but is not limited to, clearing of vegetation, the erection of any onsite temporary structure and the use of heavy duty equipment for the purpose of breaking ground for infrastructure or earthworks. This does not include maintenance or use of existing tracks, erection or construction of security fencing and signage, or investigating activities such as accessing the site for surveying or planning purposes.

**Department** is the Australian Government Department administering the EPBC Act.

**EPBC Act** means the *Environment Protection and Biodiversity Conservation Act 1999*.

**EPBC Act Offsets Policy** means the Australian Government policy document titled: *EPBC Act environmental offsets policy*.

**Erosion and Sedimentation Control specifications** means the Department of Transport and Main Roads *MRTS 52 Erosion and Sedimentation Control Technical Specification*, dated January 2015, and including State approved and published updates or revisions to this document.

**Grey-headed flying-fox** means the flying fox species *Pteropus poliocephalus*, listed as vulnerable under the **EPBC Act**.

**Habitat** means areas containing species of trees and vegetation that provide food and shelter for **Matters of National Environmental Significance**. See lists of identified species habitat prepared by state and local government and non-government organisations. Note that food trees may vary spatially and temporally, and information specific to the local area is likely to be most accurate.

**Impacts to water quality** includes: a change of 1.0 pH unit; a 10% increase in turbidity; a 50% reduction in dissolved oxygen, a 20% change to electrical conductivity; and any waste or visible hydrocarbons.

**Koala** means *Phascolarctos cinerus* (combined populations of Qld, NSW and the ACT), listed as vulnerable under the **EPBC Act**.

**Matters of National Environmental Significance** means matters protected under Part 3 of the EPBC Act; for this proposed action, including the white-throated snapping turtle (*Eseya albagula*), Mary River turtle (*Elusor macrurus*), Mary River cod (*Maccullochella mariensis*), koala (*Phascolarctos cinereus*) (combined populations of Queensland, New South Wales and the Australian Capital Territory) and grey-headed flying-fox (*Pteropus poliocephalus*).

**Minister** is the Minister administering the *Environment Protection and Biodiversity Conservation Act 1999* and includes a delegate of the **Minister**.

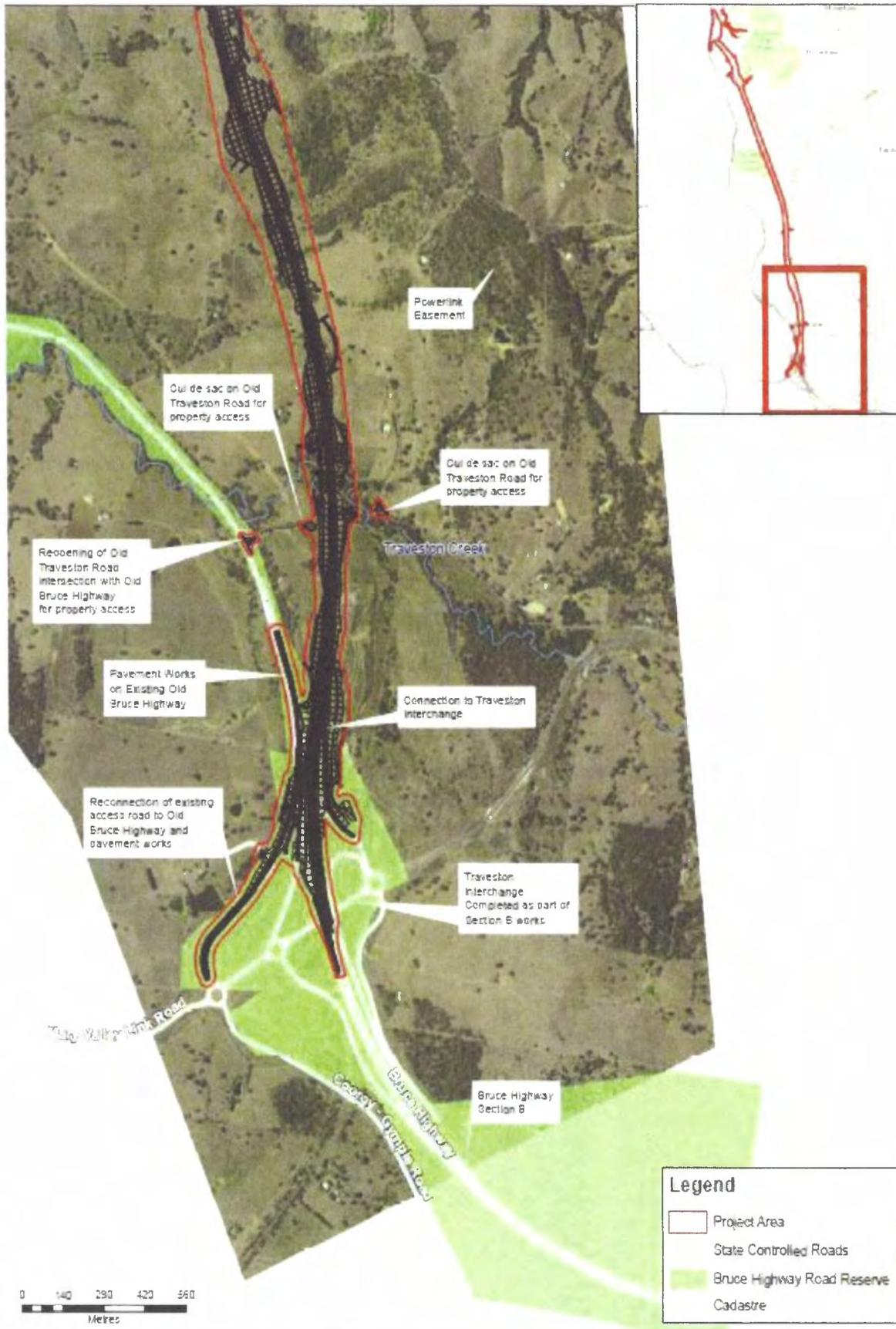
**Normal flow event** means any stream flow from rainfall up to and including a 5 day rain event resulting in 44.6mm of rainfall.

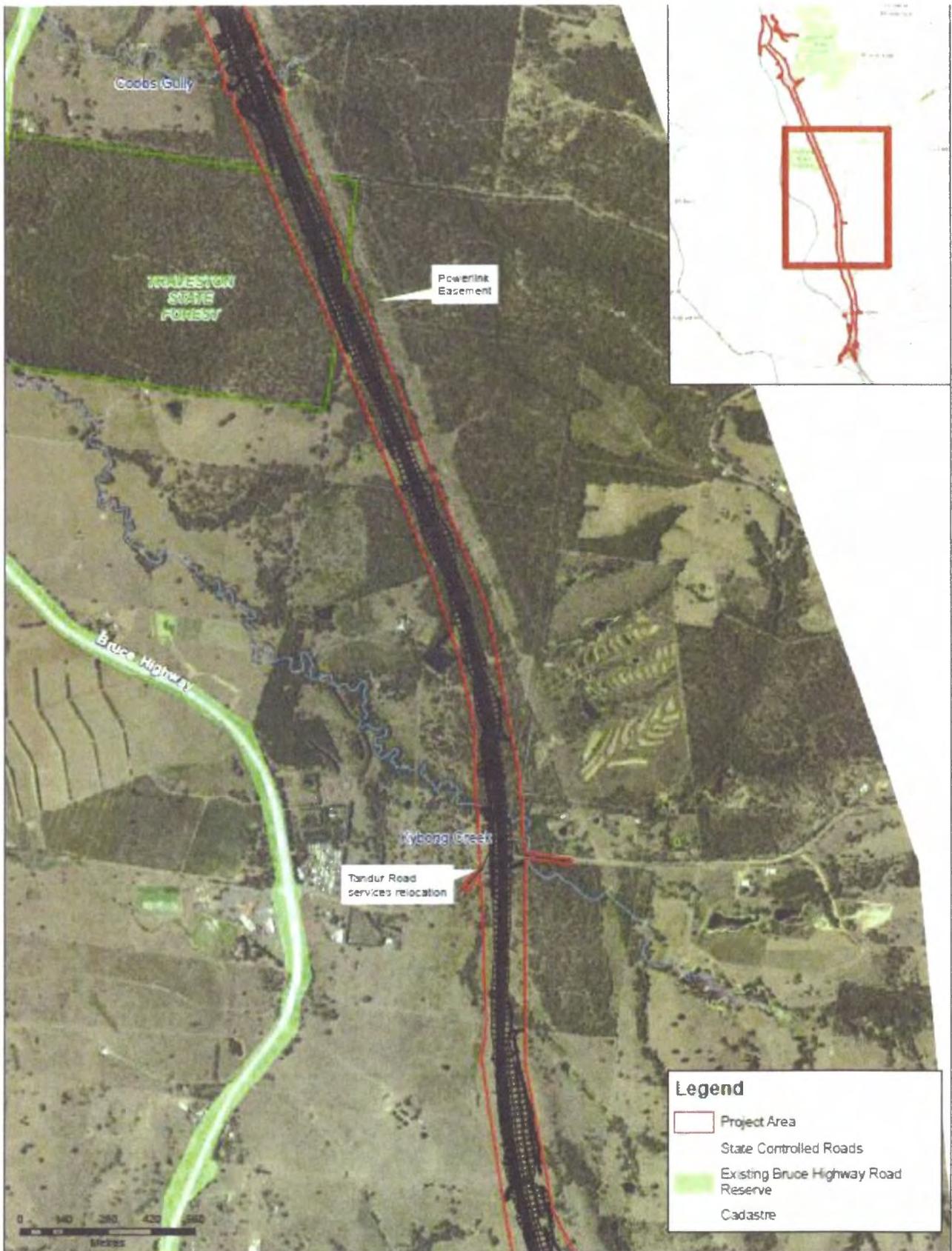
**Project area** means the boundary of the proposed action as defined at **Figure 1**.

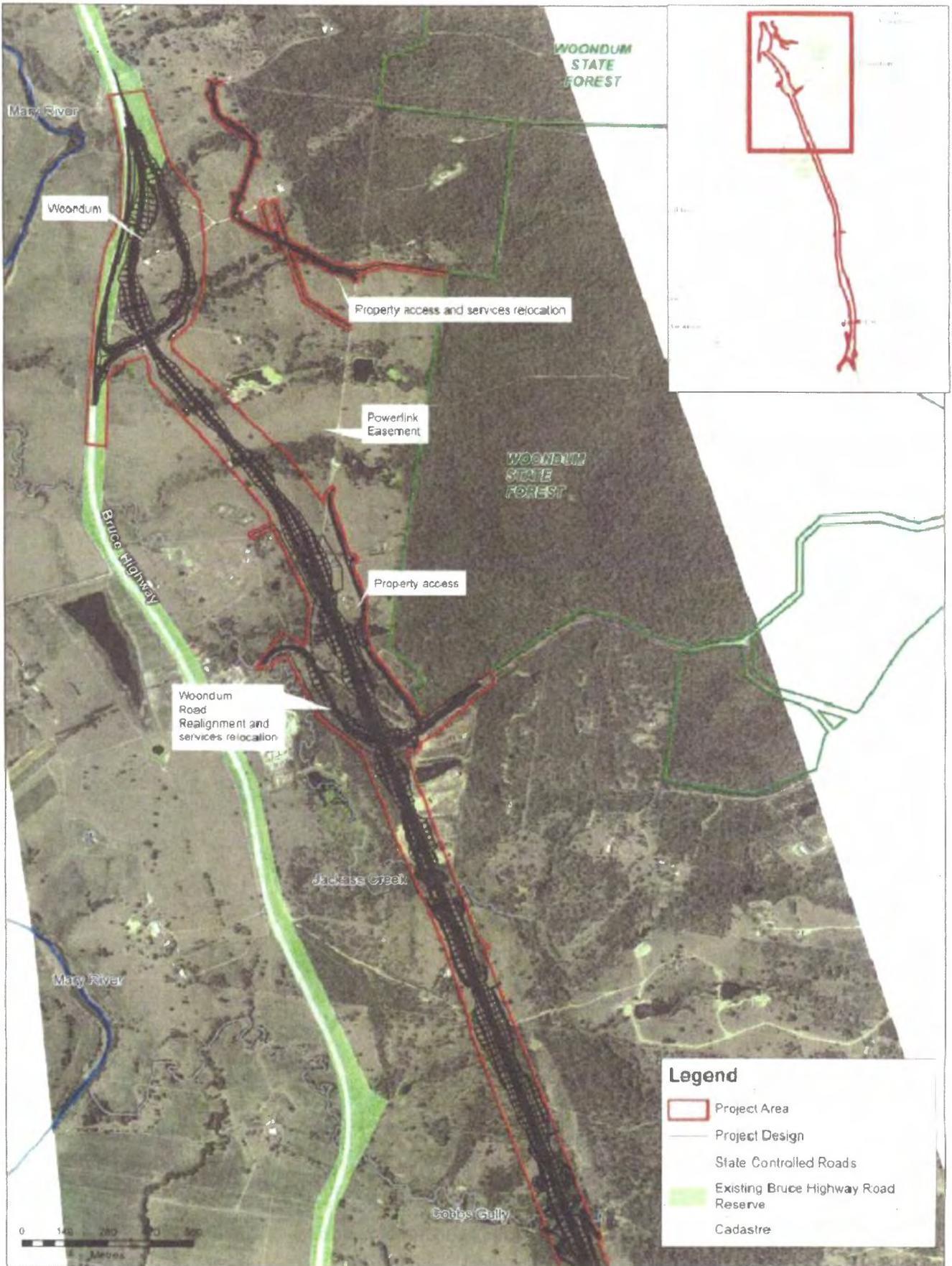
**Suitably qualified expert** means a person with qualifications in environmental science, biology or ecology and/or suitable experience in relevant species management, agreed to in writing by the **Department**

**Water sampling points** means positions located up- and down-stream of the proposed in-stream **construction** works at Traveston Creek, Kybong Creek, Jackass Creek and Cobbs Gully, where water quality is monitored in accordance with the **Erosion and Sedimentation Control specifications**.

Figure 1.







# Appendix B Preliminary Research Proposal

## Non-invasive monitoring of fragmented and rehabilitated koala habitats using detection dogs: maximising koala conservation outcomes from mitigation strategies (e.g. offsets).

Authors: Dr Celine Frere & Dr Romane Cristescu (The University of the Sunshine Coast).

### Significance & Aims

Koala numbers are declining across much of the remaining free-living populations in Queensland and are now listed as vulnerable. It is well known that koalas struggle alongside urban expansion and factors such as habitat destruction, habitat fragmentation, chlamydial disease and additional anthropogenic mediated threats (vehicle collision and canine attacks) are causing major population decline (Preece 2007, Cristescu R. 2011). To top this, climate change will further force koalas to contract their distribution toward cooler coastal areas where urbanisation is predicted to increase most significantly (Nations 2012). Minimising the impact of urbanisation on koalas will therefore require an understanding about how to best mitigate anthropogenic impacts on the fine scale population dynamics of koalas (e.g. genetics, survival, reproductive success and disease).

Development is inevitable to accommodate the current and projected human population growth. As such, the EPBC Act requires that when development occurs in koala habitat, it needs to be offset. Offset impacts are a hotly debated biodiversity conservation topic, with suggestions that offsets can produce perverse incentives and exacerbate biodiversity decline (Walker et al. 2009, Gordon et al. 2015). Conversely, others see offsets as a holistic approach incorporating loss and gain of habitat in an effort to provide the best conservation outcome (Madsen et al. 2010). All will agree that if offsets are to be undertaken, their design are critical to achieving the most efficient conservation outcomes (Quétier and Lavorel 2011). Surprisingly, no research, to date, has been undertaken about what factors should be considered when choosing koala offsets to ensure the best conservation outcomes for the long-term survival of koalas. This is despite evidence from other species that evaluating and comparing the benefit of different actions is the most effective strategy in a world of limited conservation investments (McDonald-Madden et al. 2009).

In the context of the koalas, offsetting land may not result in the best conservation outcomes. For instance, Cristescu et al. (2013) showed that flora rehabilitation did not correlate with koala recolonization of mine sites on Stradbroke Island. This highlights the urgent need to measure whether or not koalas do in fact recolonise rehabilitated offsets and if those provide long-lasting sustainable koala ecosystems. In addition, we need to investigate which offset design may be most cost-effective;

rehabilitating a larger area in lower koala habitat quality or smaller area in higher koala habitat quality more efficient? We do not even know whether offsets would in fact have better conservation outcomes for the koala than maintaining connectivity between existing fragmented koala habitats. For instance, no studies to date have investigated the extent to which koala habitat fragmentation impacts on the fine-scale population dynamics of koalas (genetics, disease and health). While councils and government bodies are trying their best to build corridors between fragmented koala habitats, no research to date has shown 1) whether these corridors are used and 2) whether the utilisation of these corridors do in fact help maintain genetic diversity. The World Conservation Union (IUCN) recognizes the need to conserve genetic diversity as one of three global conservation priorities (McNeely et al. 1990). This is because populations which can retain high levels of genetic diversity have increased potential for adaptation to changes in habitat, climate change or pathogens (Reed and Frankham 2003, Frankham 2005).

To ensure the future of koala conservation, it is therefore critical that we understand these trade-offs to maximise the benefit of the EPBC Offsets for koalas. Only when we increase our understanding of how fragmentation, connectivity and offset impact fine scale koala population dynamics over time can we ensure our strategies deliver an ecologically defensible mechanism to balance conservation and development (Gardner et al. 2013).

Studies on the fine-scale population dynamics of koalas have to date been limited by their behavioural ecology. Koalas are generally found at low density, low activity and cryptic, nocturnal habits (Cristescu et al 2012). Here, we will use new, innovative and non-invasive methodologies (detection dogs, (Cristescu et al. 2015)) to allow for the fine-scale population dynamic monitoring of fragmented and rehabilitated koala habitats across three a number of replicates within the Cooroy to Curra Project and surrounding area where appropriatereplicates (section A, B and C of the Cooroy to Curra project) to:

- 1. Measure the long-term effects of habitat fragmentation on koala health dynamics and how these may be mitigated by the introduction of corridors (underground passages etc).**
- 2. Measure the long-term recolonization patterns of koalas into rehabilitated landscape to assess whether rehabilitated landscapes can support sustainable populations of koalas.**
- 3. Cost-effective analyses of 1 against 2.**

To do so, we will combine our expertise in koala ecology, genetics and disease to measure the following ecologically relevant traits (Table 1) from fresh faecal samples collected for the next five years across fragmented and rehabilitated habitats along the section A, B and C of the Cooroy to Curra project. Across the length of these three sections (~60 kms), we will select 6 fragmented non-connected sites, 6 fragmented connected by corridors sites, 6 rehabilitated and 6 control sites (n = 24). From these we will locate and collect fresh scats from a maximum of 20 koalas and measure the following individual/population traits:

Table 1. Traits that will be measured from fresh scats.

Population density	Sex ratio
Genetic diversity and connectivity	Reproductive hormones
Disease presence and load (intestinal infection of Chlamydia)	Parasitic load

To locate koalas, we will use two specially trained detection dogs, and walk transects across each site. Transects will be spaced to ensure the dogs can detect all koalas present within each study area in an accurate and cost-effective manner.

From this data, we will establish the distribution of koalas and monitor their trends (recolonization, extinction) based on a spot assessment method adapted to detection dogs (Cristescu et al. 2015). The sites for spot assessment will follow a grid pattern. At each site, 30 trees will be searched for the presence of koala scats, giving an indication of utilisation rate.

**Habitat fragmentation monitoring.** We will sample the 6 fragmented non-connected sites and the 6 fragmented connected by corridors sites in year 1, year 3 and year 5. We will aim to collect fresh scats from 20 koalas per site (n=240) per sampling year, totalling 720 koalas across the three sampling years.

**Habitat rehabilitation monitoring.** We would want to monitor the rehabilitated sites every year for five years for the distribution and trend component of the research. We will again aim to collect fresh scats from 200 koalas per site every year in year 1, year 3 and year 5 – and follow the same sampling methodology in the control sites.

**Landscape context.** All sites will go through a thorough landscape context analysis, with the objective to understand the larger scale influences on our sites. This analysis will include for example the amount and shape of high, medium and low value habitat as well as the length and speed of roads in the surroundings of our sites.

#### Expected outcomes.

1. Assess how quickly can rehabilitation and offset sustain a resident koala population.
2. Determine whether offset and rehabilitation can provide a safe habitat with a healthy koala population.
3. Identify whether there is a fragmentation threshold (tipping point) where koala health and population viability declines.
4. Assess whether corridors can maintain genetic connectivity and identify what attributes enhance connectivity (e.g. age, size, etc).
5. Optimisation and cost-benefit analysis of management strategies. Is it better to invest in maintaining adequate connectivity of fragmented landscape or rehabilitating habitats, etc.

## References:

- Cristescu R., E. W., Devilliers.D, Lee.K, Woosnam-Merchez.O, Frere.C, Banks. P.B., Dique.D, Hodgkison.S, Carrick.H, Carter. D., Smith. P, Carrick.F., Smith.P, Carrick, F, . . 2011. North Stradbroke Island: an Island Ark for Queensland's Koala population. *Proceedings of the Royal Society of Queensland*:309-335
- Cristescu, R. H., E. Foley, A. Markula, G. Jackson, D. Jones, and C. Frère. 2015. Accuracy and efficiency of detection dogs: a powerful new tool for koala conservation and management. *Sci. Rep.* 5.
- Cristescu, R. H., J. Rhodes, C. Frère, and P. B. Banks. 2013. Is restoring flora the same as restoring fauna? Lessons learned from koalas and mining rehabilitation. *Journal of Applied Ecology*:n/a-n/a.
- Frankham, R. 2005. Genetics and extinction. *Biological Conservation* 126:131-140.
- Gardner, T. A., A. Von Hase, S. Brownlie, J. M. M. Ekstrom, J. D. Pilgrim, C. E. Savy, R. T. T. Stephens, J. O. Treweek, G. T. Ussher, G. Ward, and K. Ten Kate. 2013. Biodiversity Offsets and the Challenge of Achieving No Net Loss. *Conservation Biology* 27:1254-1264.
- Gordon, A., J. W. Bull, C. Wilcox, and M. Maron. 2015. FORUM: Perverse incentives risk undermining biodiversity offset policies. *Journal of Applied Ecology* 52:532-537.
- Madsen, B., N. Carroll, and K. Moore Brands. 2010. State of Biodiversity Markets Report: Offset and Compensation Programs Worldwide.  
<http://www.ecosystemmarketplace.com/documents/acrobat/sbdmr.pdf>.
- McDonald-Madden, E., A. Gordon, B. A. Wintle, S. Walker, H. Grantham, S. Carvalho, M. Bottrill, L. Joseph, R. Ponce, R. Stewart, and H. P. Possingham. 2009. "True" Conservation Progress. *Science* 323:43-44.
- McNeely, J. A., K. R. Miller, W. V. Reid, R. A. Mittermeier, and T. B. Werner. 1990. *Conserving the world's biological diversity*. Washington, DC: IUCN, World Resource Institute, Conservation International, WWF-US and the World Bank.
- Nations, U. 2012. *World urbanization prospects: The 2011 revision*.
- Preece, H. 2007. *Monitoring and modelling threats to koala populations in rapidly urbanising landscapes: Koala Coast, South East Queensland, Australia*. The University of Queensland.
- Quétier, F., and S. Lavorel. 2011. Assessing ecological equivalence in biodiversity offset schemes: Key issues and solutions. *Biological Conservation* 144:2991-2999.
- Reed, D. H., and R. Frankham. 2003. Correlation between fitness and genetic diversity. *Conservation Biology* 17:230-237.
- Walker, S., A. L. Brower, R. T. T. Stephens, and W. G. Lee. 2009. Why bartering biodiversity fails. *Conservation Letters* 2:149-157.

## **Appendix C    Response to Public Notification**



Our ref  
Your ref  
Enquiries Helen Stevenson

Department of  
**Transport and Main Roads**

7 August 2015

Mr Ross McMillan  
Assessment Officer  
VIC/TAS QLD Section  
Assessments (VIC/TAS QLD) and Policy Implementation  
Environment Standards Division  
Department of the Environment  
GPO Box 787  
Canberra ACT 2601

ross.mcmillan@environment.gov.au

Dear Ross

This letter serves to provide formal advice with regard to the public comments received by the Department of Transport and Main Roads (TMR) with respect to the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) referral (EPBC 2014/7394) for the Bruce Highway (Cooroy to Curra) Upgrade Section C (Traveston Road to Keefton Road) Project.

The public notification period of ten business days closed at 5pm on 23 July 2015. Three submissions were received, each of which is summarised below. A copy of the submissions have been attached for your reference.

- Submission 1 - received from Ms McCombe by email dated 21 July 2015  
The submission was in relation to a future purchase of TMR land described as Lot 1382 on M371313. This property is required for the Bruce Highway Upgrade (Cooroy to Curra) Section C – Traveston to Keefton Road Project. This land is currently not for sale.

- Submission 2 - received from the Koala Action Group Gympie Region (KAG Gr) by email dated 23 July 2015  
The submission was concerned with the management and mitigation measures proposed in the Preliminary Documentation to minimise impacts to the koala. The concerns were as follows:  
Item 1 - Potential for fragmentation of koala populations.  
Item 2 - Identification and management of koalas during vegetation clearing for the Project.

Item 3 - Incorporation of habitat rehabilitation in the research program to be delivered as part of Option 1 in the Offset Proposal.

Item 4 - Provision of a direct land offset as part of future works for the Cooroy to Curra Project.

Item 5 - Availability of a koala detection dog to be based in the Gympie Region.

Item 6 - Funding for the Sunshine Coast Koala Rescue Service.

Item 7 - Provision of ongoing opportunities to be informed of and involved in, environmental mitigation activities associated with Section C.

A letter has been written to KAG Gr addressing each of their concerns and has been attached for your reference.

- Submission 3 – received from the Mary River Catchment Co-ordinating Committee (MRCCC) by email dated 23 July 2015

The submission from MRCCC had a number of comments with regard to the Offsets Proposal and were concerned with the impact of the Project to the White-throated Snapping Turtle (*Elseya albagula*) and other aquatic species. In summary their concerns were as follows:

Item 1 - MRCCC supports the comments submitted on this matter by the KAG Gr.

Item 2 - Selection of suitable sites for use in the research program

Item 3 - Use of the results of the research program to inform future offset proposals

Item 4 - Potential impact of the Project on the White-throated Snapping Turtle other aquatic species

A letter has been written to MRCCC in reply to their comments and has been attached for your reference. With respect to the White-throated Snapping Turtle a significant impact assessment has been prepared and will be included in an updated version of *Attachment 2 – Impact Assessment and Erosion and Sediment Control Plan – Mary River Turtle and Mary River Cod* of the Preliminary Documentation. It is anticipated that the revised documentation will be submitted to the Department of the Environment no later than 14 August 2015.

If you have any questions in relation to the above please do not hesitate to contact Ms Helen Stevenson on 4181 1354.

Yours sincerely



Scott Whitaker

**District Director (Wide Bay / Burnett)**

Enc Public submissions and TMR's formal reply.

## Madeleine X Page

---

**To:** Helen A Stevenson  
**Subject:** RE: EPBC submission

---

**From:** A2Z Property Development [<mailto:allan@a2zpropertydevelopment.com.au>]  
**Sent:** Monday, 20 July 2015 2:22 PM  
**To:** TMR Wide Bay\_Burnett  
**Subject:** traveston to woondum

Regarding the 2 options about koala bears/ flying foxes.

We live at 308 Burrige Road , we have not seen or heard any koalas on our property.

We would like to buy and add to our property along back boundary any land left between us and new highway.

Gympie Koala action group propose to get this land for koalas which we feel is not right as it is along side the new h/way.

Regards

Shelley McCombe



Our ref  
Your ref  
Enquiries      Madeleine Page

Department of  
**Transport and Main Roads**

7 August 2015

Ms Shelley McCombe  
A2Z Property Development  
308 Burrigge Road  
Kybong Qld 4570

allan@a2zpropertydevelopment.com.au

Dear Ms McCombe

Thank you for your email dated 20 July 2015 to Ms Helen Stevenson with regard to the Offsets Proposal included as part of the Preliminary Documentation submitted for the Environment Protection and Biodiversity Conservation (EPBC) Act Approval for the Bruce Highway Upgrade (Cooroy to Curra) Section C – Traveston to Keefton Road Project. The Department of Transport and Main Roads (TMR) has reviewed and considered your correspondence and provide a response below.

It is understood from your email that you are referring to a future purchase of TMR land described as Lot 1382 on M371313. This property is required for the Bruce Highway Upgrade (Cooroy to Curra) Section C – Traveston to Keefton Road Project.

The disposal of surplus TMR land will be managed in accordance with the Queensland Government Land and Asset Transaction Policy. Further information can be found at <http://www.statedevelopment.qld.gov.au/economic-development/land-and-asset-management.html> or by emailing [property.disposals@tmr.qld.gov.au](mailto:property.disposals@tmr.qld.gov.au).

If you have any questions in relation to the above please contact Madeleine Page on 0476 812 678.

Yours sincerely

A handwritten signature in black ink, appearing to be "S. Whitaker", written over a light blue horizontal line.

Scott Whitaker

**District Director (Wide Bay / Burnett)**

**Attention: Helen Stevenson**

**Re Bruce Highway (Cooroy to Curra) Upgrade Section C (Traveston Road to Keefton Road) Project Job No. 232/10A/2  
Residual Impact Assessment and Federal Environmental Offsets Proposal for the Koala and Grey-headed Flying-fox.  
EPBC 20147394**

**Submission from Koala Action Group Gympie Region (KAG Gr)**

**Dated 23/7/15.**

We have examined the documents relating to the proposed action, given the expected loss of 45.9 ha of koala habitat in Section C.

We want to comment specifically on the offset proposals. We preface this by stating that we believe the impacts on koalas will be greater than suggested in the impact statement.

**Impacts:**

We do not accept that the Project will not lead to a decline in the species, or that it will not interfere with the recovery of the koala. Nor can we agree that with the mitigating features incorporated into the design that the road will not fragment the population into two or more populations. In reality, we do not really know. We have witnessed locally the impact of stress on koala health leading to hospitalizations for chlamydia, so we also do not accept that there is no residual impact to address regarding disease.

The Gympie region lies just outside the SEQ protected zone for koalas. The region's koalas have had little focus, and virtually no protection. With the formation of our Koala Action Group, and the Council commencing a koala mapping exercise a few months ago, we are trying to turn that around.

We would like to be closely informed and involved in the Section C project as it pertains to koalas eg In the near future, to have the opportunity to look closely at and comment on the adequacy of the fencing, furniture, crossings, and the identification and management of koalas when clearing proceeds. We will seek a future meeting with TMR re this.

## **The offsets:**

We have examined Options 1 and 2, and had a meeting with TMR and the USC research team. The views of our local koala conservation group (KAG Gr) are as follows:

While we support the concept of the research project in Option 1, we would have preferred an option that included both this indirect offset together with a direct offset. We believe that when habitat is lost it needs to be replaced. (However we do not accept that the direct offset proposed in Option 2 as an appropriate, adequate or viable offset. We can provide detailed comment and analysis on this if required).

However given we have been presented with an either/or:

We can see value in the research project, and commend TMR for supporting research that can inform not just TMR decisions re optimum koala offsets in the future, but that can also inform ALL players who are doing koala offsets, both public and private. If the research delivers the expected outcomes, and the findings are widely shared and utilized, we can accept that Option 1 can deliver an overall conservation outcome for koalas both locally and broadly.

Given we will not in the immediate have the habitat replaced in a physical sense, we request (and have requested this verbally at our meeting) that the research team incorporate some habitat rehabilitation in the Gympie region as part of the study. This needs to be done in conjunction with the near-complete Koala Mapping exercise the Gympie Regional Council is doing, and with which our group has been closely associated to get the very best outcome for mapping the species and its habitat in this region.

We also request that TMR make a commitment that in the absence of habitat replacement at this stage, that over the life of the Cooroy to Curra Project there WILL be a physical offset in Section C and/or D that would be of higher value than if the research project were not to proceed. This will be an optimum site(s) as it will be informed by the research. This means that in the long term the benefit to koalas in our region would be significant.

We also support the training of koala detection dogs and have asked for consideration of the viability of one of those being based in the Gympie region in the interests of accessibility, responsiveness and a sense of community ownership and pride in helping the region's koalas.

As identified by TMR in 2.3 (Significant Impact Assessment) Section C will potentially increase the likelihood of vehicle strike, wild dog predation and stress-induced disease. The Koala Action Group has first-hand knowledge of wild dogs and disease in the koalas in this locale.

TMR proposal includes funding (\$25,000) the local Council to locate and capture wild dogs in the project area and surrounds. They have not nominated any offset for the other factors. (vehicle strike and disease). We are requesting that the same amount is granted to the Sunshine Coast Koala Rescue Service (SCKR). This is a not-for-profit 24 hour rescue service that is unfunded and relies on donations and small grants. This service has done many rescues in the Gympie region, including along the Bruce Highway, and in the locale of Section C with sick and stressed koalas. Our group expect that with an increased focus on the koalas in Section C, and with their movement during and after construction, this service will be called upon. (We are aware of a case last year where they went out at night to locate a reported dead koala at Federal, in Section B-hours were spent in travel and search time, however a Gympie local had in meantime collected and delivered the dead koala to a Gympie vet). A condition of the grant would entail SCKR reporting all rescues to the research team for incorporation into their close examination of impacts in Section C.

<http://www.sckoalarescue.com.au/>

Thank you for considering our comments, and we look forward to your response.

Michelle Daly

**Michelle Daly** Co-Ordinator, Koala Action Group Gympie Region



Phone: (07) 54835242

Mobile: 0437549252

Email: [corserdaly@spiderweb.com.au](mailto:corserdaly@spiderweb.com.au)





Our ref  
Your ref  
Enquiries      Madeleine Page

Department of  
**Transport and Main Roads**

7 August 2015

Mrs Michelle Daly  
Co-ordinator  
Koala Action Group Gympie Region  
corserdaly@spiderweb.com.au

Dear Mrs Daly

Thank you for your email dated 23 July 2015 to Ms Helen Stevenson regarding the Offsets Proposal included as part of the Preliminary Documentation submitted for the *Environment Protection and Biodiversity Conservation (EPBC) Act* approval for the Bruce Highway Upgrade (Cooroy to Curra) Section C – Traveston to Keefton Road Project.

The Department of Transport and Main Roads (TMR) has reviewed and considered your correspondence. It is understood from your email that the key concerns of the Koala Action Group Gympie Region (KAG Gr) include:

1. Potential for fragmentation of koala populations.
2. Identification and management of koalas during vegetation clearing for the Project.
3. Incorporation of habitat rehabilitation in the research program to be delivered as part of Option 1 in the Offset Proposal.
4. Provision of a direct land offset as part of future works for the Cooroy to Curra Project.
5. Availability of a koala detection dog to be based in the Gympie Region.
6. Funding for the Sunshine Coast Koala Rescue Service.
7. Provision of ongoing opportunities to be informed of and involved in, environmental mitigation activities associated with Section C.

Please find details of how these concerns are being addressed overleaf.

### **Item 1 – Potential fragmentation of koala populations**

Provision of fauna passage is a key mitigation measure included in the design of the highway upgrade to maintain habitat connectivity, counter the effect of habitat fragmentation and reduce the risk of vehicle strike. In this regard fauna fencing, furniture and underpasses will be provided at the following locations:

- Fauna fencing
  - Fauna fencing will be installed along the majority of both sides of the new highway.
- Fauna crossings:
  - Fauna crossings will be provided at the four major creek bridges - Traveston Creek, Kybong Creek, Cobbs Gully and Jackass Creek.
  - Dedicated fauna underpasses will also be located at Traveston State Forest and north of Kybong Creek.
- Furniture
  - Furniture, including refuge poles and horizontal logs, will be included in the dedicated fauna culverts.

Rehabilitation of the creek crossings/ fauna underpasses will be undertaken as quickly as possible to restore habitat connectivity and cover, and re-establish habitat connections to enable koalas and other fauna to move between the east and west. Further details of these measures are provided in Section 2.6 of *Attachment 1 Fauna Management Plan Koala and Grey-headed Flying Fox* included as part of the Preliminary Documentation.

### **Item 2 - Identification and management of koalas during vegetation clearing**

A number of management measures will be implemented to minimise impacts to koalas during the clearing stages of the Project as detailed in Section 2.6 and Table 6 of *Attachment 1 Fauna Management Plan Koala and Grey-headed Flying Fox*. These measures include the following:

- Pre-clearing surveys - Prior to clearing in each stage, a fauna spotter/catcher will undertake a pre-clearing survey to identify any species present in the Project area. These surveys will be required to be documented and a report provided to TMR's representative prior to any works commencing.
- Fauna spotter/catcher – A suitably qualified fauna spotter/catcher will be required to be present during clearing activities to identify, monitor and implement control measures to minimise impacts to koalas and other fauna. Specific roles of the fauna spotter/ catcher are included in Section 2.6 of the Fauna Management Plan.

- Clearing will be limited to the disturbance area required for the Construction and Operation phases of the Project only. This will be managed throughout the Construction phase through the requirements of the contract.
- Clearing will be undertaken in a staged and sequential process along the Project area to provide the best opportunity for resident fauna to move on their own accord prior to clearing activities commencing.

### **Item 3 - Incorporation of habitat rehabilitation in the research program to be delivered as part of Option 1 in the Offset Proposal**

As far as reasonably practical, the research proposal will be undertaken in areas of differing stages of rehabilitation. From preliminary discussions with the KAG Gr and the Mary River Catchment Co-ordinating Committee (MRCCC) it is anticipated that rehabilitated areas within close proximity to the new highway will be available for use in the research program. At this stage the research areas have not been confirmed as the EPBC Act approval application for this Project is currently in the assessment phase. If the offset proposal is accepted by the Federal Department of the Environment, more specific details of the research program, including the location of the research areas will be confirmed.

### **Item 4 - Provision of a direct land offset as part of future works for the Cooroy to Curra Project.**

One of the aims of the research project is for the findings to be used to inform the design of future offset proposals. Should the Bruce Highway – Cooroy to Curra (Section D: Woondum to Curra) Project proceed to Detailed Design and an offset be required, the outcomes of the research proposal will be applied. Furthermore it is proposed that the research area will encompass appropriate locations along the proposed alignment of Section D.

As noted in your email, this approach is likely to result in the identification of more suitable sites for koala offsets with a greater long term benefit for regional koala populations.

### **Item 5 - Availability of a koala detection dog to be based in the Gympie Region.**

The koala detection dogs will be managed by the Koala Detection Dog Centre at the University of the Sunshine Coast (USC) and will be available for use in surveys by the public in a manner similar to how the current resident dogs are employed. The permanent location of the two new koala detection dogs will need to be discussed with the Koala Detection Dog Centre and will likely be dependent on the availability of a suitable home and carer. TMR is happy to continue these discussions with USC.

### **Item 6 - Funding for the Sunshine Coast Koala Rescue Service**

TMR made a commitment to the Gympie Regional Council to provide funding for their wild dog abatement program, which will assist in the prevention of wild dog attacks on koalas and other wildlife. TMR understands there are many worthy wildlife protection and carer groups that would also benefit from additional funding, however at this stage we are unable to provide funding to any additional groups.

**Item 7 – Provision of ongoing opportunities to be informed of and involved in, environmental mitigation activities associated with Section C**

TMR understands and appreciates the valuable work of local interest groups in advocating on behalf of, and actively preserving, Queensland native fauna. We recognise that KAG Gr are already working with council to develop an improved knowledge of the local koala populations and we feel strongly that KAG Gr can contribute positively to the Section C and Section D projects.

To this end, the highway upgrade project team will be maintaining close contact with KAG Gr and looking at ways we can work together to achieve the delivery of the new highway with minimal impact to local wildlife.

TMR will continue to keep KAG Gr informed of the progress of the EPBC referral and will contact you to further discuss the scope of the research proposal and opportunities for KAG Gr to be directly involved, if approved by the Department of the Environment. In the meantime, if you have any questions in relation to the proposed environmental controls for Section C, please contact Madeleine Page on 0476 812 678.

Yours sincerely



Scott Whitaker

**District Director (Wide Bay / Burnett)**

Copy to: Mary River Catchment Co-ordinating Committee



Resource Centre 25 Stewart Terrace, Gympie  
Postal PO Box 1027, Gympie, Qld. 4570  
Telephone (07) 5482 4766  
Fax (07) 5482 5642  
E-mail [admin@mrccc.org.au](mailto:admin@mrccc.org.au)  
Website [www.mrccc.org.au](http://www.mrccc.org.au)

---

**Working towards a sustainable and productive catchment**

---

27 July 2015

Helen Stevenson  
Locked Mail Bag 786  
Bundaberg Qld 4670  
[bundaberg.office@tmr.qld.gov.au](mailto:bundaberg.office@tmr.qld.gov.au)

Dear Ms Stevenson

**Re Bruce Highway (Cooroy to Curra) Upgrade Section C (Traveston Road to Keefton Road)  
Project Job No. 232/10A/2 Residual Impact Assessment and Federal Environmental Offsets  
Proposal for the Koala and Grey-headed Flying-fox June 2015**

For over twenty years, the Mary River Catchment Coordinating Committee (MRCCC) has been actively encouraging improved land management and recovery of threatened species in the Mary River catchment. We wish to provide comment regarding the Offsets proposal put forward by the Department of Transport and Main Roads regarding the upgrade of Section C of the Bruce Highway. Our comments draw on our knowledge of the environmental assets of the region and an understanding of the ecology of the catchment. We have also had a long working relationship with the Department of Transport and Main Roads and appreciate the opportunity to meet with staff of the department to discuss the Offsets proposal.

In the first instance, the MRCCC would like to endorse the points made in submission by the Koala Action Group Gympie Region regarding the Offsets Proposal.

As we expressed in our recent meeting with University of Sunshine Coast researchers and Department of Transport and Main Roads staff, in principle we believe that offsets should include provision of habitat to compensate for the habitat destroyed by infrastructure development. However, not all habitat is equal and we recognise that there is a lack of research regarding how best to compensate for habitat loss. Offset Option 1 proposed by the Department of Transport and Main Roads has the potential to improve the way this compensation is conducted. While it would be our preference for a combination of direct and indirect offset, the MRCCC sees the potential for the proposed research to have wider benefits of improving investment in rehabilitation of habitat for koalas and grey head flying fox. The outcomes of the research project could be applied more widely if the research project were to include a suite of study sites that reflect a spectrum of levels of rehabilitation and protection. The MRCCC has knowledge of, and existing information on, sites covering this spectrum and we would be willing to assist the research team to identify appropriate sites and establish new trial sites. In our view this inclusion is necessary to enable this research project to have the best possible conservation outcomes for our region and to the effected species.

---

*The MRCCC gratefully acknowledges the support of  
The Sunshine Coast Council, Noosa Council and Gympie Regional Council,  
the Australian Government Department of Environment, the Department of Transport and Main Roads,  
the Burnett Mary Regional Group, the Queensland Department of Environment and Heritage,  
and landholders throughout the Mary River Catchment.*

**DONATIONS TO THE MARY CATCHMENT PUBLIC FUND ARE TAX DEDUCTIBLE**



Resource Centre 25 Stewart Terrace, Gympie  
Postal PO Box 1027, Gympie, Qld. 4570  
Telephone (07) 5482 4766  
Fax (07) 5482 5642  
E-mail [admin@mrccc.org.au](mailto:admin@mrccc.org.au)  
Website [www.mrccc.org.au](http://www.mrccc.org.au)

---

**Working towards a sustainable and productive catchment**

---

It is our understanding that the lessons learned from the research project will inform future offset strategies for Section D of the Bruce Highway upgrade. We ask that the Department be mindful of the opportunity for the upgrade of the highway to have a net positive impact on affected species' habitat through careful selection of offsets for Section D. The MRCCC would certainly encourage this approach to be taken once funding for Section D is secured and planning and detailed design of this phase of the upgrade commences.

As a final comment, we note that it has been proposed that no offsets are required to address impacts on aquatic threatened species in the footprint of Section C because all of the impacts can be mitigated. Whilst erosion and sediment control is essential to protect these species we wish to highlight that the health of streambanks (wide vegetated buffers, shade on the water, etc), good aquatic habitat (instream logs, deep pools, riffles etc) and absence of instream barriers to movement are also very important for these species and could be impacted by this project. Furthermore, potential nesting habitat for the critically endangered white throated snapping turtle could exist within the footprint of the project. We therefore request that these potential risks be taken into account in the detailed design of the project, and that consideration be given to development of a fauna management plan that addresses threatened aquatic species' use of and movement along the creeks impacted by the project.

If you have any further clarification of the points raised above please contact this office at your convenience.

Yours sincerely,

**Ian Mackay**  
**Chair**  
**MRCCC**

---

*The MRCCC gratefully acknowledges the support of  
The Sunshine Coast Council, Noosa Council and Gympie Regional Council,  
the Australian Government Department of Environment, the Department of Transport and Main Roads,  
the Burnett Mary Regional Group, the Queensland Department of Environment and Heritage,  
and landholders throughout the Mary River Catchment.*

**DONATIONS TO THE MARY CATCHMENT PUBLIC FUND ARE TAX DEDUCTIBLE**

---

*The MRCCC gratefully acknowledges the support of  
The Sunshine Coast Council, Noosa Council and Gympie Regional Council,  
the Australian Government Department of Environment, the Department of Transport and Main Roads,  
the Burnett Mary Regional Group, the Queensland Department of Environment and Heritage,  
and landholders throughout the Mary River Catchment.*

***DONATIONS TO THE MARY CATCHMENT PUBLIC FUND ARE TAX DEDUCTIBLE***



Our ref  
Your ref  
Enquiries      Madeleine Page

Department of  
**Transport and Main Roads**

7 August 2015

Mr Ian Mackay  
PO Box 1027  
Gympie, 4570

By Email: [admin@mrccc.org.au](mailto:admin@mrccc.org.au)

Dear Mr Mackay

Thank you for your letter dated 23 July 2015 to Ms Helen Stevenson with regard to the Offsets Proposal included as part of the Preliminary Documentation submitted for the Environment Protection and Biodiversity Conservation (EPBC) Act Approval for the Bruce Highway Upgrade (Cooroy to Curra) Section C – Traveston to Keefton Road Project.

The Department of Transport and Main Roads (TMR) has reviewed and considered your correspondence. It is understood from your letter that the Mary River Catchment Co-ordinating Committee (MRCCC) support the comments submitted on this matter by the Koala Action Group Gympie Region (KAG Gr) and we have therefore attached a copy of TMR's response to KAG GR's submission for your information.

As discussed in your recent meeting with departmental representatives, the research team from the University of the Sunshine Coast (USC) and the KAG Gr, it is proposed that the research program will be undertaken at a number of different sites each with a different set of characteristics. These characteristics may include size of the land parcel, topography, stage of rehabilitation, proximity to developed areas and proximity to waterways as examples. At such time that the Offset Proposal is approved by the Department of the Environment, TMR and USC will work with MRCCC to identify suitable land parcels for use in the research program.

One of the aims of the research program is to provide valuable data to inform the development of offset proposals for future projects. With respect to the Bruce Highway – Cooroy to Curra (Section D: Woondum to Curra) Project, should this Project proceed to the Detailed Design Phase and an offset be required, it is anticipated that the results of the research program will be used to develop the offsets package.

We note your concern with regard to the potential for aquatic fauna to be present within the Project area and a number of measures are in progress to address this.

TMR has been in consultation with the Department of the Environment with regard to the recent listing of the White-throated Snapping Turtle (*Eseya albagula*) and are preparing a significant impact assessment and identifying suitable mitigation measures to minimise any residual impact to the species during the construction of the Project. This information will be included in the revised Preliminary Documentation, specifically in *Attachment 2 – Impact Assessment and Erosion and Sediment Control Plan – Mary River Turtle and Mary River Cod*. TMR has also been in consultation with Dr. Col Limpus, Chief Scientist of the Threatened Species Unit for the Queensland Department of the Environment and Heritage Protection with regard to management requirements for this and other turtle species during the Construction phase of the Project.

Finally, in addition to the erosion and sediment control plan prepared as part of the Preliminary Documentation, requirements for rehabilitation for inclusion in the contract documents have been prepared for each of the four major waterways intersected by the highway alignment, Traveston Creek, Kybong Creek, Cobbs Gully and Jackass Creek. The rehabilitation requirements were identified as part of the Environmental Risk Assessment included in *Attachment 2 – Impact Assessment and Erosion and Sediment Control Plan – Mary River Turtle and Mary River Cod*.

I trust the information above provides you with the necessary details to address your concerns.

TMR appreciates the important contribution MRCCC is making to the preservation and recovery of threatened species in the Mary River. We understand MRCCC have a strong interest in the highway upgrade project and we will keep you informed of the progress of the EPBC referral and will contact you to further discuss the scope of the research proposal if approved by the Department of the Environment. In the meantime, if you have any questions in relation to the proposed environmental controls for Section C, please contact Madeleine Page on 0476 812 678.

Yours sincerely

A handwritten signature in black ink, appearing to read 'S. Whitaker', with a long horizontal flourish extending to the right.

Scott Whitaker  
District Director (Wide Bay / Burnett)

Enc – Letter to Koala Action Group, Gympie Region

## Appendix D Compliance with Australian Government's Conservation Advice for *Phascolarctos cinereus*

Dr Frere and Dr Cristescu's project proposal addresses a large number of the research priorities outlined in the Australian Government's approved Conservation Advice for *Phascolarctos cinereus* (combined populations of Queensland, New South Wales and the Australian Capital Territory) (koala Northern Designatable Unit). The table below outlines how the proposal addresses each research priority.

RESEARCH PRIORITY	HOW THE PROPOSAL ADDRESSES THE PRIORITY
Develop and implement an integrated program of koala population monitoring and abundance estimates across the koala's range, with particular focus on those regions for which population size and trends are currently least known. Targeting regions where there were previous surveys but where there are no recent estimates will enable trends to be determined over a broader range of the species.	<p>The project proposes a non-invasive and cost-effective method (utilising koala scat detection dogs and a live koala detection dog) which will result in the collection and analysis of key baseline information about koalas in the greater Gympie region with a particular focus on the Cooroy to Curra project area. This information will include population size and density, genetic diversity and connectivity, sex ratio and health measures (including disease presence and load, parasite load and reproductive hormone levels). Previous research shows that the scat detection dogs offer a 100% success rate and are 153% more effective than human-only detection methods (Cristescu et al. 2015). The proposed methods also decrease false negatives and survey time, thus significantly improving the quality and quantity of data collected.</p> <p>This project will therefore contribute to:</p> <ol style="list-style-type: none"> <li>(1) The establishment of baseline data for the study area</li> <li>(2) The development of a comprehensive koala mapping for the study area</li> <li>(3) Population density estimates within the study area</li> <li>(4) Developing long-term non-invasive monitoring methodologies to assess koala population trends over time</li> </ol>
Develop landscape-scale population models, to provide a framework for the assessment of relative threat risk and management intervention cost-effectiveness.	<p>The research will provide an evidence-based, cost-benefit analysis between two different models of koala and landscape management:</p> <ol style="list-style-type: none"> <li>(1) Measuring the long-term effects of habitat fragmentation on koala health dynamics and how these may be mitigated by the introduction of corridors (underground passages etc).</li> <li>(2) Measuring the long-term recolonization patterns of koalas into rehabilitated landscape (e.g. offsets) to assess whether rehabilitated landscapes can support sustainable populations of koalas.</li> <li>(3) Providing a cost-benefit analyses of 1 and 2.</li> </ol> <p>In particular, the proposed research will:</p> <ul style="list-style-type: none"> <li>• Assess how quickly rehabilitated and offset land can sustain a resident koala population.</li> <li>• Determine whether offset and rehabilitation can provide a safe habitat with a healthy koala population.</li> <li>• Identify whether there is a fragmentation threshold (tipping point) where koala health and population viability declines.</li> <li>• Assess whether corridors can maintain genetic connectivity and identify what attributes enhance connectivity (e.g. age, size, etc).</li> <li>• Provide a cost-benefit analysis of management strategies. This evidence will support decisions regarding whether it is better to invest in maintaining adequate connectivity of fragmented landscape or to rehabilitate habitats (e.g. offsets).</li> </ul>
Develop understanding of gene flow and landscape connectivity.	<p>The project will characterise the relationship between gene flow and landscape connectivity within the study area.</p> <p>This proposed project will monitor changes in gene flow and landscape connectivity in action across the study area. This is because the research team will be able to monitor and record koala population trends (genetic diversity, density, gene flow, disease, sex ratio) pre and post disturbance. This provide the first evidence about the extent to which habitat fragmentation alters:</p> <ul style="list-style-type: none"> <li>• Population density</li> <li>• Disease</li> <li>• Gene flow</li> <li>• Genetic diversity</li> <li>• Population sex ratio</li> </ul>
Identify and delineate key populations.	Researchers will identify and delineate populations in the study area.
Maintain or enhance research programs directed at the assessment of the incidence and consequences to populations of disease, and of mechanisms to reduce the impacts of disease;	This project will provide crucial information about disease presence (in particular intestinal infection of <i>Chlamydia</i> and parasite load) in koalas in the study area. It will also provide evidence about whether habitat disturbance correlates with disease prevalence.
Maintain or enhance research programs directed at the assessment of the incidence and consequences to populations of koala mortality or injury due to dogs and traffic, and of mechanisms to reduce the impacts of these threatening factors;	<p>The utilisation of a live koala detection dog will allow researchers to identify and record koalas showing signs of injury (inflicted by vehicle or canines).</p> <p>Researchers will also provide thorough landscape context analysis for each site, to increase understanding of the larger scale influences on each site. For example, researchers will measure habitat quality, elevation, as well as the length and speed of roads in the surroundings of each site. This data could be correlated with koala mortality data for each site.</p>

<p>Determine the ability of inland koala populations to persist after, or recover from, drought and evaluate the likely influence of climate change on these processes.</p>	<p>The methods optimised in this project could easily be deployed to address this research priority in the future.</p>
<p>Determine the social and economic benefits of costs of and barriers to implementing effective management interventions to conserve the koala across its range, including the governance arrangements.</p>	<p>This project will provide the first evidence regarding the efficacy and cost-effectiveness of two land and wildlife management approaches which are typically deployed when koala habitat is destroyed for development: 1) the introduction of corridors (underground passages etc.) to maintain connectivity between fragmented landscapes, and 2) rehabilitating land (e.g. via offsets) in the hope they will support sustainable populations of koalas.</p> <p>Evidence generated will enable decision-makers to determine appropriate strategies to maximise koala conservation outcomes.</p>

## Appendix E Curriculum Vitae

GeneCology Research Centre  
 University of the Sunshine Coast  
 Locked Bag 4  
 Maroochydore DC QLD 45

[cfrere@usc.edu.au](mailto:cfrere@usc.edu.au)  
[www.celinefrerelab.com](http://www.celinefrerelab.com)

## OVERVIEW

Dr CH Frere's research focuses on genetic and non-genetic inheritance interactions in driving phenotypic evolution in natural populations, how genes evolve within social environments, fauna recolonisation of disturbed landscapes, and how animals adapt to urbanisation. She has developed new methods to test evolutionary theory using rare, long-term, empirical datasets on multiple taxa.

Dr CH Frere's research contributes to a growing appreciation that vertically transmitted sources of phenotypic variation can include more than the (additive) genetic processes that have dominated evolutionary models to date, and answers a growing call for a more inclusive and unified synthesis of evolution which would incorporate multiple mechanisms of inheritance, both genetic and non-genetic. Dr CH Frere's leads a research team comprising 1 post-doctoral fellow (2016-2021), 5 PhD candidates, 1 international internship (M.Sc), 1 PhD exchange candidate under the NSF Grow program, and 1 full-time research assistant.

She has a total of 33 publications, including first authorships in top-tier journals including *Nature Communications*, *PNAS* and *Proc. R. Soc. B*. Dr CH Frere has published an average of five articles per year since completing her PhD, and is either first, corresponding or senior author on more than 60 percent of her publications. Dr Frere has strong international collaborations and has co-authored papers with over 100 researchers, from 6 government or non-government organisations, 7 industry partners and 22 universities.

Dr CH Frere also holds current adjunct positions at the University of Queensland (Research Fellow) and Murdoch University (Senior Lecturer).

## EDUCATIONAL QUALIFICATIONS

- PhD (Evolutionary Biology), Dec 2009. University of New South Wales, Australia.
- First Class Honours, Bachelor of Science, Dec 2002. University of Queensland, Australia.
- Bachelor of Science Awarded Dec, 2001. University of Queensland, Australia.

## APPOINTMENTS

### ACADEMIC AND RESEARCH

University of the Sunshine Coast. Early Career Research Fellow. 2013 – current.

University of Exeter, UK. Lecturer. College of Life and Environmental Sciences, 2012 – 2013.

Maternity leave, Jan 2012 – August 2012.

University of Queensland. Postdoc Researcher. 2009 – 2012.

University of Queensland. Postdoc Researcher. 0.5 FTE 2009.

### ADJUNCT APPOINTMENTS

Murdoch University. Adjunct Senior Lecturer Cetacean Research Unit, 2013 – 16 (current).

University of Queensland. Adjunct Research Fellow. School of Biological Sciences, 2013-16 (current).

University of New South Wales School. Adjunct Research Fellow. Biological, Earth and Environmental Sciences, 2009-2011.

## AWARDS AND FELLOWSHIPS

- L'Oreal Women in Science Fellowship 2014 – Shortlisted 2014.
- UQ Postdoctoral Research Fellowship for Women 2013 (declined in favour of USC Fellowship).
- Prize - Best Presentation: Postgraduate Research Forum Awards (University of New South Wales) 2008.
- Post-graduate Scholarship Award (Sherwin Lab, University of New South Wales) 2006.

## COMPETITIVE, INDUSTRY AND PARTNERSHIP FUNDING

CH Frere has attracted more than 2.1million in research income, including 3 category 1 research grants from the Australian Government.

## CONFERENCES & ORAL PRESENTATIONS

- Invited speaker. Australian National University. School of Biology seminar series, 2016 (forthcoming).
- Oral presentation. Behaviour Conference. Australia, 2015.
- Keynote speaker. Oral presentation. Behaviour International conference. Cairns, Australia. August 2015
- Keynote speaker. FoSHEE Research Week, University of Sunshine Coast May 2014.
- Invited speaker. ComBio International Conference, Cairns, Australia 2011.
- Oral presentation. International Society of Behavioural Ecology Conference. Perth, Australia 2010.
- Invited speaker. Department of Ecology and Evolution, University of Lausanne, Switzerland, 2010.
- Oral presentation. Evolution-The Experience. Melbourne Australia, 2009.
- Oral presentation. National Humpback & Snubfin Dolphin Research workshop. Brisbane, Australia, 2009.
- Invited speaker. School of Veterinary Sciences, University of Queensland. Brisbane Australia, 2006.
- Oral presentation. Anthropological Institute & Museum, University of Zurich. Switzerland, 2005.
- Oral presentation. Marine Biocomplexity: Brisbane, Queensland, 2003.

## PUBLIC/COMMUNITY PRESENTATIONS

- Oct – Dec 2015. University of the Third Age. Nambour, Caloundra, Coolum and Maleny.
- August 2015. Invited Speaker “Parks Alive Festival”, Roma Street Parkland.
- May 2015. Invited Speaker “Diversity Week” University of the Sunshine Coast.
- Feb 2015. University of the Third Age.
- October 2014. Community Lecture Series.
- August 2014. Invited Speaker “Parks Alive Festival”, Roma Street Parkland.
- Nov 2013. Invited presentation. Brisbane City Council Environment, Parks & Sustainability Committee.
- October 2012. Invited presentation: “Science in the Square” Kids Festival. Falmouth UK.

## POPULAR SCIENCE MEDIA

- My research website ([www.celinefrerelab.com](http://www.celinefrerelab.com)) has received more than 59,000 visits from people in 88 countries in three years.
- My publications have generated 184,000 twitter impressions (*Impactstory*).
- *Totally Wild* - Conservation of eastern water dragons. Channel 10, Australia 2012.
- *Totally Wild* – Social lives of eastern water dragons. Channel 10, Australia 2012.
- My research (as first author) has generated more than 80 national and international media articles including in *BBC News*, *Australian Geographic*, *USA Today*.

## RESEARCH COLLABORATORS

- **Eastern Water Dragons**  
Associate Professor Martin Whiting (Macquarie University) - (genomics).  
Associate Professor Robbie Wilson (UQ) – Eastern water dragons (animal performance)  
Dr Daniel Ortiz-Barrientos (UQ) – Eastern water dragons and in-shore dolphins (genomics).
- **Giraffes**  
Associate Professor Anne Goldizen (UQ) – (sociality).
- **Shark Bay Research Project**  
Professor Janet Mann (Georgetown University, USA) - (Bottlenose dolphin behavior and genetics).  
Associate Professor Alastair Wilson, University of Exeter (Maternal Inheritance)

## PROFESSIONAL ACTIVITIES

### ACADEMIC COMMITTEES

- College of Experts (University of the Sunshine Coast)
- Faculty of Science, Health, Education and Engineering Research Committee (University of the Sunshine Coast).

### FORMAL MENTORING

- Science Mentor: Secondary School enrichment program UNSW 2006.
- Academic Mentor (to 2 post-doctoral researchers): University of Exeter 2012-13.

### PEER REVIEWER

- 2015: Invited Review Editor. *Frontiers in Marine Megafauna*. Open Access
- 2009-2015: I have peer-reviewed >20 articles for journals including: *Behavioural Ecology* (IF 3.157), *Animal Behaviour* (IF: 3.068), *Journal of Experimental Marine Biology and Ecology* (IF 2.475), and *Marine Mammal Science* (IF 1.820).

## PUBLICATIONS

### Scholarly Book Chapters

1. Prentis P, Gilding E, Pavasovic A, **Frère CH**, and Godwin I (2012) Molecular Markers in Plant Improvement. *Molecular Markers in Plants*, First Edition. Edited by Robert J. Henry.

### Refereed Journal articles

2. \*Smith H, Frère CH, Kobryn H, Bejder L. (accepted 7/1/2016). Seasonal cyclicity of associations, calving and distribution by adult female bottlenose dolphins: Informing management. *Animal Conservation*.
3. **Frère CH**, Nugent D, Littleford-Colquhoun B, Strickland K (2015). *Intelligama lesueurii* Eastern water dragon: Cannibalism. *The Herpetological Bulletin*. 133.
4. Sexton G, **Frère CH**, Kalinganire A, Uwamariya A, Lowe AJ, Godwin ID, Prentis PJ, Dieters MJ. (2015) Influence of putative forest refugia and biogeographic barriers on the level and distribution of genetic variation in an African savannah tree, *Khaya senegalensis* (Desr.) A. Juss. *Tree Genetics & Genomes*. 11 (5).
5. Kosanic K, Anderson K, **Frère CH**, Harrison S. (2015) Regional vegetation change and implication for local conservation on example from West Cornwall (United Kingdom). *Global Ecology and Conservation*. Vol 5, pg 405-13.
6. **Frère, CH.**, Chandrasoma, D. and Whiting, M. J. (2015) Polyandry in dragon lizards: inbred paternal genotypes sire fewer offspring. *Ecology and Evolution*. 5 (8).
7. Cristescu R, Foley E, Markula A, Jackson G, Jones D, **Frère CH** (2015) Accuracy and efficiency of detection dogs: a powerful new tool for koala conservation and management. *Scientific Reports* 5. Article number: 8349.
8. Strickland K; Gardiner R; Schultz AJ; **Frère CH** (2014). The social life of eastern water dragons: sex differences, spatial overlap and genetic relatedness. *Animal Behaviour* 97: 53-61.
9. \*Lin W, **Frère CH**, Karczmarski L, Xia J, Gui D, Wu Y(2014) Phylogeography of the finless porpoise (genus *Neophocaena*): testing the stepwise divergence hypothesis in the northwestern Pacific. *Scientific Reports*. 4: 6572.
10. \*Brown AM, Kopps AM, Allen SJ, Bejder L, Littleford-Colquhoun B, Parra GJ, Cagnazzi D, Thiele D, Palmer C, **Frère CH**. (2014). Population differentiation and hybridisation of Australian snubfin

(*Orcaella heinsohni*) and Indo-Pacific humpback (*Sousa chinensis*) dolphins in north-western Australia. *PLoS ONE* 9(7): e101427.

11. Gardiner R, Doran E, Strickland K, **Frère CH** (2014) A face in the crowd: a non-invasive and cost effective photo-identification methodology to understand the fine scale movement of eastern water dragons. *PLoS One*. 9 (5), e96992.
12. Cristescu R, Carrick F, Banks P, **Frère CH** (2013) Potential 'Ecological Traps' of restored landscapes: koalas (*Phascolarctos cinereus*) re-occupy a rehabilitated mine site. *PLoS One* 8 (11), e80469.
13. \*Mace E, Tai S, Gilding E, Li Y, Prentis P, Bian L, Campbell B, Hu W, Innes D, Han X, Cruickshank A, Dai C, **Frère CH**, Zhang H, Hunt C, Wang X, Shatte T, Wang M, Su Z, Li J, Lin X, Godwin I, Jordan D, Wang J. (2013) Whole genome sequencing reveals untapped genetic potential in Africa's indigenous cereal crop Sorghum. *Nature Communications* 4: 2320.
14. Cristescu R, Rhodes J, Banks P, **Frère CH** (2013) Is restoring flora the same as restoring fauna? Lessons learned from koalas and mining rehabilitation. *Journal of Applied Ecology*. 50 (2), 423-431.
15. \*Carter K, Seddon J, **Frère CH**, Carter J, Goldizen A (2013) Fission-fusion dynamics in wild giraffes may be driven by kinship, spatial overlap and individual preferences. *Animal Behaviour*. 85: 385–394.
16. \*Gilding E and **Frère CH** (equal first authors) Cruickshank A, Rada A, Prentis P, Mudge A, Mace E, Jordan D, Godwin I. (2013) Allelic variation at a single gene increases food value in a drought tolerant staple cereal? *Nature Communications* 4:1483.
17. Lambrides C, Zhou Y, Fukai S, Jewell M, Loch D, Godwin I, Holton T, Innes D, **Frère CH**, Hanna W, Ye C, Van Tran T, Le T, Cao N, Al Dabbagh H, O'Brien C, Roche M, Fullelove G, Ballard E, Kearns R, Pearce W, Hacker A, Puachuay M, Shelton M, Dalzell S, Anderson B, Harris-Shultz K, Cremer J (2013) Ecoturf-a case study on genetic variation and agronomic potential of bermudagrass (*Cynodon* spp.) germplasm collected from Australian biodiversity. *International Turfgrass Society Research Journal*. 12: 263-266.
18. \*Jewell M, **Frère CH**, Harris-Shultz K, Anderson W, Godwin I, Lambrides C (2012) Phylogenetic analyses reveals multiple introductions of *Cynodon* species into Australia. *Molecular Phylogenetics and Evolution*. 65 (2), 390-396.
19. Cristescu R, Goethals K, Banks P, Carrick F, **Frère CH** (2012) Experimental evaluation of koala scat persistence and detectability with implication for pellet-based fauna census. *International Journal of Zoology*. 2012: 1-12.
20. Cristescu R, **Frère CH**, Banks P (2012) A review of fauna in mine rehabilitation in Australia: Current state and future directions. *Biological Conservation*. 149: 60-72. Lin W, Chang L, Zhou R, Mo D, **Frère CH**, Chen J, Chen X, Wu Y (2012) Differentiated or not? An assessment of current knowledge of genetic structure of *Sousa chinensis* in China. *Journal of Experimental Marine Biology and Ecology*. 416: 17-20.
21. Cristescu R, Ellis W, de Villiers D, Lee K, Woosnam-Merchez O, **Frère CH**, Banks P, Dique D, Hodgkison S, Carrick, H, Carter D, Smith P and Carrick F (2012) North Stradbroke Island: an island ark for Queensland's koala population? *Proceedings of the Royal Society Queensland*. 117:309-333.
22. \***Frère CH**, Prentis P, Ezaz T, Georges A (2011) Isolation and characterisation of novel microsatellite and mitochondrial DNA markers for the Eastern Water Dragon (*Physignathus lesueurii*). *Conservation Genetics Resources*. 4 (1), 113-116.
23. \***Frère CH**, Seddon J, Palmer C, Porter L, Parra G (2011) Multiple lines of evidence for an Australasian geographic boundary in the Indo-Pacific humpback dolphin (*Sousa chinensis*): population or species divergence? *Conservation Genetics*. 12 (6), 1633-1638.

24. \*Frère CH, Prentis P, Gilding E, Mudge A, Cruikshank A and Godwin I (2011) Lack of low frequency variants masks patterns of non-neutral evolution following domestication. *PLoS ONE* 6(8): e23041.
25. \*Frère CH, Mann J, Krützen M, Connor R, Bejder L, Sherwin WB (2011) Nature and nurture: A step towards investigating their interactions in the wild. *Communicative and Integrative Biology*. 4(2), 192-193.
26. \*Frère CH, Krützen M, Mann J, Connor R, Bejder L, Sherwin WB (2010) Social and genetic interactions drive fitness variation in a wild population of bottlenose dolphin. *Proceedings of the National Academy of Sciences, USA*. 107(46), 19949-19954.
27. \*Sexton G, Frère CH (equal first author), Dieters M, Godwin I, Prentis P (2010) Development and characterisation of microsatellite loci of *Kahya senegalensis*. *American Journal of Botany*. 97: e111-e113.
28. \*Jewell M, Frère CH, Prentis P, Lambrides C, Godwin I (2010) Characterisation and multiplexing of EST-SSR primers in *Cynodon (Poaceae)* species. *American Journal of Botany*. 97: e99-e101.
29. \*Frère CH, Krützen M, Mann J, Watson-Capps JJ, Tsai YJ, Patterson EM, Connor R, Bejder L, Sherwin WB, (2010) Home Range Overlap, matrilineal and biparental kinship drive female associations in bottlenose dolphins. *Animal Behaviour*. 80, 481-486.  
JIF: 3.137
30. \*Frère CH, Patterson EM, Krzyszczyk E, Mann J (2010) Thar she blows! A novel method for DNA collection from cetacean blow. *PLoS ONE*. 5(8) e12299  
JIF 3.234
31. \*Frère CH, Krützen M, Kopps AM, Ward P, Mann J, Sherwin WB (2010) Inbreeding tolerance and fitness costs in wild bottlenose dolphins (*Tursiops* sp.). *Proceedings of the Royal Society, London: Biological Sciences*. 227, 2667-2673.
32. \*Frère CH, Hale PT, Porter L, Cockcroft VG, Dalebout ML (2008) Phylogenetic analysis of mtDNA sequences suggests revision of humpback dolphin (*Sousa* spp.) taxonomy is needed. *Marine and Freshwater Research*. 59, 259-268.

### Conference Submissions

33. \*Frere, C; Hale, P; Ross, G. (2003) Molecular taxonomy and population genetic processes in the genus *Sousa*. *Marine Biocomplexity: The 2003 Annual Conference of the Australian Marine Sciences Association*. Australian Marine Sciences Association. Pg. 77.

## Dr Romane CRISTESCU

rcristes@usc.edu.au

### BIOSKETCH

---

I am an early career scientist with interest ranging from conservation biology (new methodologies in conservation including detection dogs, remote surveys; applications of GIS technology to conservation biology) to landscape restoration, fauna responses to habitat loss and fragmentation, wildlife/human conflicts, interactions and synergies in threats to endangered species, and emerging infectious diseases in wildlife.

Four years out from my PhD, and with no research position, I have 14 publications, and I am first author on more than half of my publications. I have published in high-impact journals (average JIF of 3.99 - which is substantially above the median JIF of my ISI fields, including Biological Conservation (1.099) and Zoology (1.509)). My H index is 6, with a highest citations score per paper of 51.

### ACADEMIC BACKGROUND

---

**2007 - 2012** PhD (University of New South Wales, Sydney)

**Thesis:** Fauna recolonisation of mine rehabilitation through the example of arboreal marsupials, with a particular focus on the koala *Phascolarctos cinereus*

**2005 - 2006** Research Masters in Biology 'Ecology, Evolution, Population Management' (University of Tours, France)

**Literature review:** The management of overabundant species through the examples of Australasian marsupials

**Thesis:** The importance of genetic issues in koala conservation

**Sept 2005** Veterinary degree with highest honours

**Thesis:** A study of western lowland gorilla populations (*Gorilla gorilla gorilla*) following a demographic crash in the Odzala National Park, Republic of Congo

**2004 – 2005** Wildlife specialisation (National Veterinary School of Nantes, France)

**2000 - 2004** Veterinarian degree (National Veterinary School of Alfort, France)

### AWARDS

---

- Endeavour International Postgraduate Research Scholarship
- Endeavour Europe Award
- Silver Medal (Veterinary Thesis Prize Competition)

### WORK EXPERIENCE – Synopsis

---

**2014 - Present** Adjunct Research Fellow, GeneCology Research Centre, University of the Sunshine Coast.  
Co-supervising PhD student and Honours students.

- 2011 - 2015** Mine closure and Fauna Advisor, responsibility include GIS, fauna and flora monitoring, Sibelco, North Stradbroke Island, Australia
- 2008 - 2011** Research assistant for koalas in mine rehabilitation project on North Stradbroke Island  
The University of Queensland, Brisbane, Australia
- 2006 - 2007** Consultant in charge of developing biodiversity indicators for French overseas territories, Countdown 2010, Ecology and Sustainable Development Ministry of France, Paris
- 2005** Consultant in charge of training a research team for a gorilla study  
Odzala National Park, Republic of Congo

## **PUBLICATIONS AND PUBLIC SPEAKING**

---

### **Published**

1. **Romane H. Cristescu**, Emily Foley, Anna Markula, Gary Jackson, Darryl Jones, Céline Frère, Accuracy and efficiency of detection dogs: a powerful new tool for koala conservation and management, 2015, *Scientific Reports*, 5 : 8349 | DOI: 10.1038/srep08349. **IF 5.078.**
2. Céline Genton, Amandine Pierre, **Romane Cristescu**, Florence Lévréro, Sylvain Gatti, Jean-Sébastien Pierre, Nelly Ménard, Pascaline Le Gouar, How Ebola impacts social dynamics in gorillas: a multistate modelling approach, 2014, *Journal of Animal Ecology*, doi: 10.1111/1365-2656.12268. **IF 4.726.**
3. Alistair Melzer, **Romane Cristescu**, William Ellis, Sean FitzGibbon, Gabriella Manno, The habitat and diet of koalas (*Phascolarctos cinereus*) in Queensland, 2014, *Australian Mammalogy*, 36(2): 189-199 <http://dx.doi.org/10.1071/AM13032>
4. **Romane Cristescu**, Jonathan Rhodes, Céline Frere, Peter Banks, Is restoring flora the same as restoring fauna? Lessons learned from koalas and mining rehabilitation, 2013, *Journal of Applied Ecology*, doi: 10.1111/1365-2664.12046. **IF: 4.74, Cit: 6.**
5. **Romane Cristescu**, Peter B. Banks, Frank N. Carrick, Céline Frere, Potential ‘ecological traps’ of restored landscapes: koalas *Phascolarctos cinereus* re-occupy a rehabilitated mine site, 2013, *PloS One*, 8(11). **IF: 3.73, Cit: 1.**
6. **Romane Cristescu**, Celine Frere and Peter Banks, A review of fauna in mine rehabilitation: current state and future directions, 2012, *Biological Conservation*, 149: 60–72. **IF 3.794, Cit: 12.**
7. **Romane Cristescu**, Klaartje Goethals, Frank Carrick, Peter Banks, Céline Frere, Experimental evaluation of koala scat persistence and detectability with implications for pellet-based fauna census, 2012, *International Journal of Zoology*, doi:10.1155/2012/631856. **Cit: 3.**
8. Céline Genton\*, **Romane Cristescu\***, Sylvain Gatti, Florence Levréro, Elodie Bigot, Damien Caillaud, Jean-Sébastien Pierre, Nelly Ménard (\***These authors contributed equally to this work**). Population recovery after a major ebola outbreak: a ten year study of western lowland gorillas, 2012, *PloS One*, 7(5), e37106 **IF 3.73.**
9. Olivia Woosnam-Merchez, **Romane Cristescu**, David Dique, Bill Ellis, Robert J.S. Beeton, Jeremy Simmonds, Frank Carrick, What faecal pellet surveys can and can’t reveal about the ecology of koalas *Phascolarctos cinereus*, 2012, *Australian Zoologist*, 36 (2): 192- 200 **Cit: 4.**
10. **Romane Cristescu**, William Ellis, Deidré de Villiers, Kristen Lee, Olivia Woosnam-Merchez, Céline Frere, Peter Banks, David Dique, Simon Hodgkison, Helen Carrick, Dan Carter, Paul Smith and Frank Carrick, 2011. North Stradbroke Island: an island ark for Queensland’s koala population? *Proceedings of the Royal Society of Queensland*, 117: 309–333. **Cit: 7.**
11. **Romane Cristescu**, William Bruce Sherwin, Kathrine Handasyde, Valma Cahill and Desmond W. Cooper, 2010, Detecting bottlenecks using BOTTLENECK 1.2.02 in wild populations: the

importance of the microsatellite structure, *Conservation Genetics*, 11:1043-1049 **IF 1.846, Cit: 33.**

12. **Romane Cristescu**, Valma Cahill, William B. Sherwin, Kathrine Handasyde, Kris Carlyon, Desley Whisson, Catherine A. Herbert, Britt Louise J. Carlsson, Alan N. Wilton, and Des W. Cooper, 2009, Inbreeding and testicular abnormalities in a bottlenecked population of koalas (*Phascolarctos cinereus*), *Wildlife Research*, 36: 299-308 **IF 1.194, Cit: 21.**
13. Mark M. Tanaka, **Romane Cristescu** and Desmond W. Cooper, 2009, Effective population size of koala populations under different population management regimes including contraception, *Wildlife Research*, 36: 1-9, **IF 1.194, Cit: 6.**
14. Damien Caillaud, Florence Levréro, **Romane Cristescu**, Sylvain Gatti, Maeva Dewas, Mélanie Douadi, Annie Gautier-Hion, Michel Raymond, Nelly Ménard, 2006, Spread of Ebola virus in a population of western lowland gorillas in Congo, *Current Biology*, 16(13): 489-491. **IF 9.916, Cit: 51.**

### **Selected conference and community talks**

**Romane Cristescu**, Maya the koala poo dog, Dunwich State School, May 2014, North Stradbroke Island

**Romane Cristescu**, Mining and rehabilitation on North Stradbroke Island, *Museum talk March 2013*, North Stradbroke Island

**Romane Cristescu**, Koala conservation on an Island paradise, *WPSQ Science in the Pub February 2013*, Cleveland

**Romane Cristescu**, Mining and Koalas: Fauna as a legal requirement on Stradbroke Island, *WDA Conference*, 26 September 2012, North Stradbroke Island

William Ellis, Sean FitzGibbon, Kristen Lee, Frank Carrick, **Romane Cristescu**, High benchmarks and complex assessment: rehabilitating mine sites for koala habitat, *Enviromine2011 – November 2011*, Santiago, Chile

**Romane Cristescu**, Frank Carrick, Paul Smith, Fauna criteria for mine closure, *MCA Sustainable Development Conference SD2011 – October 2011*, Mackay

**Romane Cristescu**, Minjerribah koalas: characteristics and relation with mine rehabilitation, *Moreton Bay Research Station Open Day 2009*, North Stradbroke Island

**Romane Cristescu**, Peter Banks, Frank Carrick, Criteria influencing fauna recolonisation of mine rehabilitation, *CMLR seminars, University of Queensland – November 2009*, Brisbane

**Romane Cristescu**, Valma Cahill, William B. Sherwin, Kathrine Handasyde, Kris Carlyon, Desley Whisson, Catherine A. Herbert, Britt Louise J. Carlsson, Alan N. Wilton, Des W. Cooper and Frank N. Carrick, Koala populations on Southern Australian islands, *ARKS conference 2009*, Whitsundays.

**Romane Cristescu**, Frank Carrick, William Ellis, Catherine Herbert, Des Cooper and Paul Smith, Minjerribah Koalas: a unique population, *ARKS conference 2009*, Whitsundays

**Romane Cristescu**, Mine rehabilitation and its use by a key species: the Koala, *Moreton Bay Research Station Research Talks 2009*, North Stradbroke Island

**Romane Cristescu**, Frank Carrick, William Woodward, William Ellis, Catherine Herbert, Des Cooper, Myuki Tanizaki, David Bowen and Paul Smith, Mine rehabilitation and its use by a key species, the Koala, *Australasian Wildlife and Management Society 2008 conference*, Perth

**Romane Cristescu**, Mark Tanaka, Cathy Herbert, Kris Carlyon, Alan Wilton, Bill Sherwin, Desley Whisson, Kathrine Handasyde, Valma Cahill & Des Cooper, Genetic variation in koalas on French Island and Kangaroo Island and the likely effect of fertility control methods on its retention, *GSA 2007*, Sydney

**Romane Cristescu**, Maeva Dewas, Damien Caillaud, Florence Levréro, Sylvain Gatti, Mélanie Douadi, Annie Gautier-Hion, and Nelly Ménard, Study of a demographic crash of western lowland gorillas (*Gorilla gorilla gorilla*), *Australasian Wildlife and Management Society 2007 conference*, Canberra

**Romane Cristescu**, Mark Tanaka, Cathy Herbert, Kris Carlyon, Alan Wilton, Bill Sherwin, Desley Whisson, Kathrine Handasyde, Valma Cahill & Des Cooper, Genetic variation in koalas on French Island and Kangaroo Island and the likely effect of fertility control methods on its retention, *Australasian Wildlife and Management Society 2006 conference*, Auckland

## **Media**

### *Selected articles in the press*

**Canine instincts lead conservation**, Fraser Coast News, November 2015

**Maya joins the hunt for koalas**, Wynnum Herald, Octobre 2015

**Maya tracks down region's hidden koalas**, Gympie Times, Octobre 2015

**Teaching an OCD dog its new tricks**, Noosa Times, June 2015

**Koalas. Un recensement plus efficace grâce à des chiens renifleurs**, Science et Avenir, February 2015

**Sherlock Hound**, PETS Magazine, January 2015

**Auf der Suche nach Koala-Häufchen**, Neues Deutschland, January 2015

**Oscar and Maya, canine pioneers in koala detection**, Click Magazine, August 2014

**Council enlists dog to sniff out koala habitats**, ABC Science Online, April 2014

**Meet the latest recruit in the fight to help save Queensland koalas: Maya, a poo sniffing pooch**, Courier Mail, April 2014

**Koala poop dog enlisted by Logan Council to follow scent of droppings sniff out habitats**, 7 News, April 2014

**OCD dog with a nose for poo helps koalas**, Nine News, May 2014

**OCD dog with a nose for poo helps koalas**, The West Australian, May 2014

**Koalas happy to hang out in rough**, February 2013, Courier Mail

**Koalas reject rehab field of dreams**, February 2013, ABC Science Online

**Koalas return to rehabilitated mine sites**, December 2010, The Redland Times

**Island koalas too close for comfort**, Thursday, 4 June 2009, ABC Science Online

**Australia's koalas at risk from inbreeding, warn experts**, June 2009, The Telegraph

**CRL helps island koala research**, October 2008, The Redland Times

### *Articles in community papers*

**Gliders live here too!**, 2010, Sandtimes

**Sugar gliders play possums**, 2010, Stradbroke Island News

**UNIMIN's koala research goes high-tech**, 2010, Sandtimes

**Minjerribah koalas**, 2011, Stradbroke Island News

**Koala on track**, December 2009, Stradbroke Island News

**Koalas research on NSI**, 2009, Sandtimes

**From Seuss to Science**, December 2009, Stradbroke Island News

**Radio Koala**, December 2009, Stradbroke Island News

**How much can a koala bear?**, December 2008, Stradbroke Island News

## **TV**

"Elstners Journeys – Koala rescuers", Elstners Reisen - Die Retter der Koalas (3<sup>rd</sup> Jan 2016)

Totally Wild, Channel 10 (27<sup>th</sup> May 2014)

Maya the koala poop detector, Channel 9 11am news national, Channel 9 3pm news national, Channel 9 News State bulletin, Channel 10 News state bulletin, Channel 7 News state bulletin, Channel 10 Wake Up national breakfast, Albert and Logan News (2014)

Port Macquarie, koala's country, TF1 (2012)

Stradbroke Island Koalas, Stateline (2010)

Nature's guardian: Australia, Ushuaia TV (2009)

## **Radio**

Interview, **ABC 612** ABC Brisbane (2014)

Interview, Breakfast with Ann Jones on **ABC 639AM** North and West (2013)

## **VOLUNTEERING - current**

---

Wildcare Straddie: animal rescues

Creator / Editor at Wildhelpers, Wildlife Conservation Website <http://www.wildhelpers.com/>

Founding member of the Feral Animal Management Working Group

Glossy Black Cockatoos annual count (coordinator for North Stradbroke Island)

