2022 COMMUNITY WORKSHOPS IN REPONSE TO EIS SUBMISSIONS

ENGAGEMENT OUTCOMES

The Calvert to Kagaru (C2K) project team undertook a series of workshops with the community this year to gain a deeper understanding of social and environmental matters within the project area. The below is a summary of the learnings and outcomes from those workshops.

SURFACE WATER, HYDROLOGY, FLOODING, GROUNDWATER
26 March 2022, Harrisville

Number of attendees	Key topic	Stakeholder concerns	Outcomes, ARTC commitments and actions
25 (22 in person, 3 online)	Flooding	• ARTC water specialists have not viewed flooding impacts in the local area by sight	• Water modelling consultants and ARTC engagement staff toured local landowner properties and adjoining creeks in the week following the C2K EIS interactive workshop – surface water, hydrology, flooding and groundwater to take photos and gather local information regarding flood levels and impacts.
	Flooding	• Stakeholders concerned about ARTC's flooding modelling and provided photos to ARTC	• ARTC will cross check photos provided with modelling. • Photos will be used to validate future modelling where possible.
	Flooding	• Stakeholders are concerned about flooding and the Inland Rail design. Flooding from Washpool Road impacted their entire paddock (5 acres) that the road will be moved to (on the Eastern side). The inundation lasted 10 days – 2 weeks.	• ARTC actioned stakeholder's request to view the impacts of the flooding on the property in the week following the workshop. • ARTC will cross check photos provided with modelling. • Photos will be used to validate future modelling where possible.

	Flood extents	• The flood extents are greater than modelled and for more frequent floods. There are 3 – 4 days of inundation before access can occur. • There is erosion and deposition post events, especially with sandy soil.	• Stakeholders provided information for ARTC's review/modelling incorporation, including photos of Purga Creek crossing of Washpool Road, showing large amounts of silt on the road. • Washpool Road gets inundated around road chainage Ch 300, up to the T-intersection.
	Surface water quality baseline monitoring	• Stakeholder would like more information around surface water quality as she doesn't believe it is adequate	• Potential further information provided around this topic e.g. during a future CCC meeting.
	Location of unregistered bore	• Stakeholder identified some unregistered bores which are crucial for stock watering	• ARTC created an online interactive map where landowners could drop a pin to identify bore locations. • Stakeholders have signed up to have their bore/s inspected.
	Legacy suggestion (related to flooding)	• Stakeholder commented that a legacy suggestion for ARTC to consider is to bitumen Waters Road (property is located on the cusp of C2K and H2C/spur of link). Stakeholder noted that Google Maps directs all traffic along this route, including ambulances which can be problematic in weather events due to the muddy roads which can cause access and safety concerns.	• ARTC has passed on feedback to Ipswich City Council that residents would prefer bitumen at Water Road. • ARTC to consider this as as a legacy project on consultation with council.
	Stakeholder engagement	• Peak Crossing stakeholders want a more local presence by ARTC Inland Rail in their community, similar to the Gatton office	• ARTC staff to hold community engagement activities near the C2K alignment e.g. in Peak Crossing and Ipswich to encourage more engagement with local stakeholders who may have questions about the project.

FLORA AND FAUNA, SUSTAINABILITY AND OFFSETS 28 April 2022, Peak Crossing			
Number of attendees	**Key issues**	**Stakeholder concerns**	**Outcomes, ARTC commitments and actions**
32 (23 in person, 9 online)	Brush-tailed rock wallabies	• Brush-tailed rock wallaby colony at the peak of Mt Welcome	• Stakeholder identified the area and it will be added to the relevant documentation.
	Frogs	• Frogs at Washpool/Ephemeral wetland/many frogs recorded in other areas of the alignment.	• Environmental Consultant noted that the waterhole was dry during the surveys they undertook. They will undertake another survey re frogs in this area.
	Use of sustainable products on Inland Rail	• Stakeholder represents a biodegradable oils and lubricants products company and queried whether Inland Rail would use their products.	• ARTC contacted stakeholder following the session and shared product information with the sustainability team.
	Re-planting removed trees	• Is there a plan to re-plant trees that have been removed as part of Inland Rail's activities?	• ARTC discussed the work being undertaken as part of the ARTC Inland Rail offsets program.
	Diesel motors used on Inland Rail	• Why is Inland Rail using diesel motors? Can biodiesel be used instead? Why isn't the line electrified? Why can't Inland Rail do anything about this?	• ARTC Inland Rail is not responsible for the selection or operation of specific trains during operation. ARTC Inland Rail is responsible for construction of the rail and maintenance of the track in operation. There may be advancements in technology in the future that allow the use of alternatives to diesel motors.
	Truck numbers on local roads	• Stakeholder stated that "taking trucks off the road" is not a valid justification instead of addressing the environmental impact. Stakeholder	• ARTC Inland Rail will assist Australia in becoming more competitive on a world-scale.

		stated that the project should “take trucks off local roads”.	• Reduction in truck volume and local air pollution in more than 20 regional towns. Moving freight on to rail will see 750,000 tonnes of carbon emissions cut per year by 2050.
	Additional ecology workshop requested	• External feedback received that the C2K EIS interactive workshop - Flora and Fauna, Sustainability and Offsets was very ARTC content heavy which didn’t allow for effective outcomes/learnings to help improve the content of the EIS.	• Additional ecology workshop will be held where key environmentally focused stakeholders will be asked to provide information regarding sightings of fauna, fauna movements during floods and other key information. • A separate engagement session for the Koala Management Plan will also be held to engage with landholders, community members and stakeholders to understand the current level of knowledge and awareness of koalas and threatening processes associated with the C2K project via local inputs.

SOCIAL PERFORMANCE AND BUSINESS OPPORTUNITIES **18 May 2022, North Ipswich**			
Number of attendees	**Key issues**	**Stakeholder concerns**	**Outcomes, ARTC commitments and actions**
17 (9 in person, 8 online), including 6 First Nation attendees (4 in person, 2 online)	First Nations people training	• Training in rail and construction activities sought, including for people who have been in jail previously. • Training for young Indigenous women in rail • Literacy and numeracy support for First Nation peoples	• ARTC Program First Nations & Training Advisor will follow up with stakeholders regarding their feedback/enquiries and provide more information on training and work opportunities. • First Nations & Training Advisor to attend future Indigenous BBQ to discuss training/work opportunities.

	Noise mitigation in Peak Crossing	• Nearly 50% of Peak Crossing residents have been identified as being vulnerable - how will noise impacts be mitigated for community members? Counselling is hardly an effective response to persistent and high noise levels.	• ARTC is still working with Regionerate Rail on the design and EIS development and will work with impacted residents in Peak Crossing and along the alignment regarding anticipated noise impacts. • Noise mitigation will be offered on a case-by-case basis where exceedances apply.
	Mental health services provided	• Stakeholder discussed a group program which he ran to support Indigenous Men in the area and wanted to know what other mental health support services may be available.	• Team discussed the New Access program – anonymous calls can be made to receive mental health support. Details were exchanged to promote mental health referrals in the area. Discussion on ways to support mental health in the areas serviced and building communication networks.
	Living in Place survey	• What is the purpose of the Living in Place survey and why is ARTC Inland Rail information not included until the end of the survey?	• The survey is an independent measure of community values. It is owned by a consultancy group (ID Consultancy) and will be administered across local government areas that Inland Rail traverses. It is a way for baseline data to be provided. • Commitment to share the Living in Place survey programme with SRICCC members as well as the results, when available.
	Becoming a supplier	• Stakeholders wanting to ensure they know what is required to supply to the project.	• Outlined a list of items that suppliers will need to have to work on Inland Rail. • Demonstrated the ICN Gateway information, including how to register interest in working with Inland Rail.

ECOLOGY 30 July 2022, Peak Crossing			
Number of attendees	**Key issues**	**Stakeholder concerns**	**Outcomes, ARTC commitments and actions**
13 (11 in person, 2 online)		• The Sticky Gully nature reserve is at the corner of Churchbank Weir road and Middle Road, Peak Crossing, which contain koala populations. Koalas move between Sticky Gully reserve and Purga nature reserves.	• ARTC Inland Rail have been in consultation with Queensland Trust for Nature and Department of Environment and Science about surveys and koala populations in Sticky Gully and Purga reserve and possible connection corridors. The data, reports and information will be utilised in the revised draft EIS.
		• Concerns over the level crossings on Middle Road and other nearby crossings. There are safety concerns for all 100 km/hr traffic plus early morning fog, cyclists' events and heavy haulage.	• ARTC has removed the level crossing at Middle Road. • Seven out of eight level crossings have been removed with one still under review.
		• Stakeholder provided a list of uncommon and rare birds observed in a variety of habitats in the Sandy Creek and Amaroo campsite area over the years (chiefly during September and April), focusing on passerines and near-passerines. They omitted the more common birds, unless observed on/in their nests. Stakeholder is concerned that all could be threatened or eliminated from the vicinity by noise/vibration/volatile organic compounds etc. from trains.	• List of uncommon and rare birds stakeholder has observed to the ARTC environmental teams for further distribution and inclusion in the revised draft EIS.
		• Stakeholder provided context on their Koala Rehabilitation program in the Scenic Rim (Teviot Range)	• Passed information onto the ARTC environmental teams for further distribution and inclusion in the revised draft EIS.

		• Stakeholder noted that there is significant koala movement along Sandy Creek/Purga Creek/Flinders Peak section of Teviot Range – most significant area for koala habitat restoration investment in SEQ. Planchorella eerwah, Boonah tuckeroo, BTRW – all in Teviot Range.	• Passed information onto the ARTC environmental teams for further distribution and inclusion in the revised draft EIS.
		• Stakeholder noted they believe the most common local species are the koala, Boonah Tuckeroo and Swamp tea tree.	• Passed information onto the ARTC environmental teams for further distribution and inclusion in the revised draft EIS.
		• Identification of quolls in proximity to the project area by stakeholder.	• Passed information onto the ARTC environmental teams for further distribution and inclusion in the revised draft EIS.
		• Local landholder identified quolls at Wild Pig Creek Road, near the Logan boundary.	• Passed information onto the ARTC environmental teams for further distribution and inclusion in the revised draft EIS.
		• Local landholder identified swift parrot (Lathamus discolor) at Spring Mountain (Red Bloss)	• Passed information onto the ARTC environmental teams for further distribution and inclusion in the revised draft EIS.
		• Indigenous site in a rock basin at the bottom of hill 70 metres from a house to be resumed (off Wild Pig Creek Road)	• The site identified by the stakeholder was not originally in ARTC Inland Rail project footprint and therefore has not been surveyed by ARTC Cultural Heritage (CH) team. The CH team will have a more detailed survey in this area.
		• Stakeholder said they had seen a regent honey eater in the Kagaru area. One was also seen around the Rosewood area. They noted that there are quite a lot of endangered animals east of the Teviot Range.	• Passed information onto the ARTC environmental teams for further distribution and inclusion in the revised draft EIS.

KOALA WORKSHOP
18 August, 2022, Rosewood

Number of attendees	Key issues	Stakeholder concerns	Outcomes, ARTC commitments and actions
19 (17 participants and 2 observers – no online dial in).	Koala – related information	• Meeting minutes are attached below and the reference documents for Appendix D. ○ OBJ C2K KMP Community Consult ○ Peak Crossing Koala Project Final R ○ OWAD Survey report - Aratula Koal ○	• Workshop participants provided information relating to a regional and rural context and located areas of interest on maps. Images, maps and emails were shared citing concerns regarding koala populations in areas where it was considered that previous mapping was inadequate. All 3 local government Councils representatives participated in the workshop.

SOCIAL PERFORMANCE COMMUNITY WELLBEING AND LEGACY ACTIVITY PLUS COMMUNITY SAUSAGE SIZZLE

10 September, 2022 Peak Crossing

Number of attendees	Key issues	Stakeholder concerns	Outcomes, ARTC commitments and actions
15 people attended the event -2 Council reps -1 elected member rep - Local landowners and business owners. Online form completion by 8 people as part of RSVP process for event	Social Performance	**Written feedback for Legacy activity:** • Desire to see ARTC Inland Rail build two tracks through populated areas in order to mitigate noise • Koala land preservation – can be co-existing with bike/track areas. Land allocated as offsets. • Housing – lack of rentals. • Employment – lack of workforce available for existing businesses in area so ARTC are going to reduce the already limited pool available to local businesses. Very negative social performance, not a positive as promoted by ARTC. • Roads – already daily issues with volume of traffic – dual lanes frequently for passing essential along Ipswich-Boonah Road. • Community involvement in decision making – not token consultation – locals know the area and what the issues are. • To reduce flooding issues such as Grantham 2011 Railway Culverts.	• Written feedback – noted and passed on to Project and EIS team. • Noted for consideration in Social Impact Management Plan refinement.

		Need more pipes not less. Able to be cleaned with Bobcats so need height. • "Un-interruption" & preservation of the existing surrounding nature which celebrates Australia's unique legacy, ancient Aboriginal areas & defining flora & fauna. • Avoid koala land-not possible, trains do not respect anything on their tracks, not even cars • Plant more vegetation for koalas, native birds and bees • In Peak Crossing mobile coverage is patchy and limited and there are no NBN fibre connections. Improvements in both of these would enhance digital connectivity and provide a real benefit to the community. • 'Living green sound barriers' installed on the route which would provide wildlife corridors, and noise and pollution reduction as well as visual amenity.	
	Social Performance	**Written feedback for Community Wellbeing Plan NEW Initiatives – AMENITY:** • Graded separations to be visually appealing, not ugly structures. Vegetation barriers along rail line to hide it. • Horse trails/bike tracks.	• Written feedback – noted and passed on to Project and EIS team. • Noted for consideration in Community Wellbeing Plan development.

		• Properties not well maintained, decreases visual amenity and value of area	
	Social Performance	**Written feedback for Community Wellbeing Plan NEW Initiatives – CHARACTER:** • Railway Infrastructure takes away from the character – more vegetation to decrease impact • Agree with structures need to be pleasing to the eye and blend into surroundings • Include suggestions from Indigenous folk. (Ivory's Rock, Peaks Crossing, surrounding areas of undisturbed, preserved nature & quiet habitats.)	• Written feedback – noted and passed on to Project and EIS team. • Noted for consideration in Community Wellbeing Plan development.
	Social Performance	**Written feedback for Community Wellbeing Plan NEW Initiatives – COHESION**: • Resumed properties not maintained – weed/feral animals burden spreads to neighbours • Koala and wildlife corridors needed • Koala corridors need to be preserved/enhanced and TMR land donated to Council to preserve • Inland Rail should meander through the landscape to lessen impact on community and private properties. (Existing populated areas for Inland Rail corridor)	• Written feedback – noted and passed on to Project and EIS team. • Noted for consideration in Community Wellbeing Plan development.

		• Sponsorship of an annual event/festival of some type (Peak Crossing).	
	Social Performance	**Written feedback for Community Wellbeing Plan NEW Initiatives – CONNECTIVITY:** • Purga School Road, Road and Bridge Upgrade – the money wasted grading after each rain event could have paid for a road. • Ipswich Boonah Road very dangerous, not enough speed signage, not enough passing lanes, will only be exacerbated by construction traffic. • Boonah road upgrade, overtaking lanes, nowhere to overtake, more road rage and accidents happening.	• Passed on to Project and EIS team. • Noted for consideration in Community Wellbeing Plan development.
	Social Performance	**Written feedback for Community Wellbeing Plan EXISTING Initiatives:** • *Land/environment projects (linking skills and training opportunities)* • *Art installation / signage reflecting local or Aboriginal heritage* • *Support for local community/tourism events* • *Peak Crossing community coordinated strategy for projects* • *Ipswich Boonah Trail Upgrades/Missing Links* • *Improvement to green spaces/parks:* tree planting along vacant area of rail, DTMR land to be	• Noted and passed on to Project and EIS team. • Noted for consideration in Community Wellbeing Plan development.

		maintained weed/pest free so the burden doesn't cross over on to neighbours; Land near or around a road or train line, is not conducive to safe habitat for our native friends no matter how many trees we replant; Ensure the sanctity & tranquillity of nature in the area is honoured, celebrated & preserved. This includes the habitats of Indigenous animals & birds which should never be interrupted nor intruded upon. • *Cycle Paths/Bikeway extensions and improvements:* include walking/horses	
	Social Performance	• Stakeholder asked if Inland Rail would support purchase of trees for Koala habitat.	• Encouraged submission to Sponsorships and Donations Program • Provided business card and asked to include ARTC Social Performance in application process.

REVISED REFERENCE DESIGN WORKSHOP, INCLUDING RESULTS FROM UPDATED FLOODING ASSESSMENTS AND NOISE AND VIBRATION STUDIES

23 November 2022, Purga

Number of attendees	Key issues	Stakeholder concerns	Outcomes, ARTC commitments and actions
19	Flooding, road design, property acquisition, noise and visual amenity.	• Dam near property overflows past nature reserve and passes into property. • Stakeholders are interested in land resumption relating to road changes re Middle Rd overpass. Stakeholders are concerned regarding the encroachment on the property. • Stakeholders have received a letter but have not yet been consulted regarding any land resumption. • Stakeholders are concerned with who pays for fences, driveways, surveys etc. • Stakeholder query regarding how much the new alignment will impact the floodwaters. • Stakeholders have noise concerns regarding the road impact. • Stakeholders have visual impact concerns.	• ARTC technical subject matter expert showed stakeholders a visualisation of Middle Road, which will now be a rail bridge over the road. • ARTC property subject matter expert answered land resumption queries. Property fact sheets are on the Inland Rail website. • ARTC to contact landholder with acquisition process. • ARTC to contact stakeholders regarding the partial land resumption process relating to road corridor. • ARTC to contact stakeholders regarding the appearance of the road embankment. • ARTC to contact stakeholders regarding train light impacts. • ARTC to contact stakeholders regarding the recent noise monitoring placement of loggers and why the locations were chosen. • ARTC to provide results of road noise modelling to stakeholders when available.

		• Stakeholders have concerns about re-selling at a reduced acreage.	
	Noise and offsets	• Stakeholder is concerned about airborne noise from trains. • Stakeholder query why land access is required and why we are investigating for offsets. • Stakeholder is concerned with rail noise impact regarding their property.	• ARTC subject matter expert discussed the noise and vibration assessment in relation to the stakeholder's property. • ARTC property subject matter expert talked to stakeholder regarding initial land access request.
	Hydrology and flooding queries.	• Stakeholders wanted an update on the flood modelling at their property. • Stakeholders wanted to know about the 2013 flood event and what the modelling showed as this event had a big impact on their property. • Stakeholder was concerned that the rail line will cause worse flooding at their property. • Stakeholder wanted "more assurances" that the rail line will be designed properly. • Stakeholder was concerned about the Warrill Creek bridge structural configuration and potential flooding impacts. • Stakeholder also raised concerns about lack of explanation for request for her to sign a land access agreement.	• ARTC subject matter expert indicated that the 2013 event was modelled as part of the previous EIS assessment and ran through the other calibration events ARTC are running. • ARTC subject matter expert ran through all the other updates required by the FIood Impact Objectives and the expert Panel recommendations. Any adverse flood impacts would be limited in accordance with the updated FIood Impact Objectives. • ARTC subject matter expert indicated that ARTC will be engaging in further dialogue and consultations in the new year. • ARTC subject matter expert indicated that all updates and works will be done according to relevant guidelines and standards. • ARTC to contact stakeholder and respond to their queries.

		• Stakeholder questions regarding offsets. • Stakeholder concerns about contaminated water run-off.	
	Revised reference design, future train numbers, property-related queries.	• Middle Road landowner asked about laydown area • Said we should buy her property as trains will be coming every 15 minutes.	• Showed stakeholder map including Middle Road and the road north of the alignment. • Talked to the stakeholder about laydown areas and why they are required. • Discussed the TMR land acquisition process with the stakeholder. • Discussed the future predicted train numbers with stakeholder – 33 at operation opening and 47 at the year 2040, 24 hours a day.
	Revised reference design, future train numbers, property-related, noise and environmental-related queries.	• Stakeholder is interested in Middle Road changes. • Noted issues with floods on property. • Stakeholder is interested to know about noise in relation to her property. • Stakeholder believed trains would be coming every 15 minutes – also as loud and frequent as jets.	• ARTC discussed the Middle Road grade separation with the stakeholder and talked about the road east of Middle Road. • Discussion regarding laydown areas and that some property-related decisions would have to be made by/discussed with TMR. • Discussed that areas of threatened ecological communities were avoided. • Discussed the future predicted train numbers with the stakeholder – 33 at operations and 47 at the year 2040, 24 hours a day. • ARTC subject matter expert discussed the noise and vibration assessment in relation to the stakeholder's property. • ARTC environmental subject matter expert explained the Environment Impact Assessment process to the stakeholder.
	Road alignment and noise	• Curious about the Middle Road design. Asked about the map showing the Middle Road closure. • Noise concerns	• ARTC showed stakeholder the Middle Road visualisation. Discussed the Middle Road closure and that part of the existing road will stay open. • Discussed the road east of the rail re accessing Warrill Creek. • Discussed the laydown areas with stakeholder.

			• Discussed that areas of threatened ecological communities were avoided.
	Hydrology and flooding queries.	• Stakeholder wanted an update on the flood modelling at the property. Stakeholder is currently experiencing frustrating and odd flooding behaviour around the property. • Stakeholder indicated that they may have additional information pertinent to the historical events.	• ARTC subject matter expert explained that ARTC will be looking to maintain the existing flowpaths and ensure that proposed culverts in the area of the house will be appropriately sized to ensure minimal adverse hydraulic impacts in line with the updated Flood Impact Objectives. • ARTC subject matter expert explained that the modelling works will seek to minimise disruptions and hydraulic impacts around the property in line with the Flood Impact Objectives. • ARTC subject matter expert indicated that any photographic information would be greatly beneficial and if any information could be sent through would be invaluable to testing the veracity of ARTC's models.
	New property owner, noise.	• Stakeholder was not aware of the Inland Rail Project and bought the property two months ago. • Stakeholder was interested in the project and said this project is about progress. • Stakeholder has concerns about noise.	• ARTC subject matter expert discussed the noise and vibration assessment in relation to the stakeholder's property.
	Specific information relating to revised reference design, noise and vibration and hydrology and flooding queries.	• Stakeholders have direct impact concerns. • Interested in hydrology and flooding. • Stakeholders have noise and vibration concerns. • Stakeholders are unconcerned by road changes but are interested in future road and rail noise levels.	• ARTC technical subject matter experts discussed the revised reference design with the stakeholder. Further design refinement may occur which will be discussed with the stakeholders. • ARTC subject matter expert discussed the noise and vibration assessment in relation to the stakeholders' property. • ARTC subject matter expert discussed the hydrology and flooding assessment changes. • ARTC subject matter expert indicated that localised drainage assessments associated with the grade separation crossing works would identify and assess localised flooding issues.

		• Stakeholders are interested in land compensation. • Stakeholder wanted general information about flooding behaviour in the area and how the works proposed around their property might impact on local drainage. • Stakeholder described flooding impacts at the property including local runoff.	• ARTC subject matter expert outlined that design and mitigation measures were required to ensure minimised hydraulic impacts in line with the updated Flood Impact Objectives. • ARTC to provide results of the road noise modelling to stakeholders when this is available.
	Specific information relating to noise and construction traffic.	• Stakeholder lives on Ipswich Boonah Road and is concerned about noise but is not directly impacted by Inland Rail. • Stakeholder noted there is already lots of traffic and Ipswich Boonah Road has seen a rise in construction traffic.	• ARTC subject matter expert answered stakeholder queries about construction traffic and noise queries specific to their property.
	Specific information relating to Noise and property-related information.	• Stakeholder thought the noise modelling would be higher. • Stakeholder believes that they will experience airborne noise from trains and would like some compensation.	• ARTC subject matter expert discussed the noise and vibration assessment in relation to the stakeholder's property. • ARTC property subject matter expert talked to stakeholder regarding property-related queries.
	Specific information relating to Hydrology and flooding queries	• Stakeholder wanted to know more about the bridge and how the water will interact with the structure and impact property. • Stakeholder was worried embankment will be very near his property.	• ARTC subject matter expert indicated that local drainage assessments would ensure the area would be drained and mitigated appropriately. • ARTC subject matter expert explained that all modelling would be undertaken and satisfy the Flood Impact Objectives and all impacts on current flood behaviours and water courses would be

		• Stakeholder wanted to know how we can be certain about models, i.e. the topography ARTC are using and how aspects have been appropriately captured.	minimised as much as possible in line with these Flood Impact Objectives. • ARTC subject matter expert explained that the modelling is based on the most up to date LiDAR topography and that has been incorporated into the model.
	Specific information relating to revised reference design.	• Stakeholder was interested in Ipswich Boonah Trail impacts	• ARTC subject matter experts discussed the revised reference design with the stakeholder - explained changes to level crossing improvements in the design.
	Specific information relating to environmental, noise and general queries.	• Stakeholder interested in Middle Road area. • Koala corridor in their property • Stakeholder concerns about noise and how this impacts wildlife and properties • Stakeholder query about wildlife and how they are being assessed • Stakeholder query regarding tank water impacts – air quality and pollution concerns • Query regarding impacts to local business	• ARTC subject matter experts talked to the stakeholder about their environmental queries. • ARTC subject matter expert provided information on the EIS process and studies • ARTC subject matter expert explained the ecological assessments, air quality assessments and noise modelling criteria. • ARTC subject matter expert discussed the noise and vibration assessment in relation to the stakeholder's property.
	Specific information relating to revised reference design and traffic impacts.	• Road usage in the area, are they going to be heavily impacted by construction traffic? • Connectivity concerns regarding schools and property around Waters Road. • Did the ALCAM count take into consideration traffic impact from both projects? (H2C and C2K)?	• ARTC team will follow up with stakeholders regarding their queries.

		• Traffic impacts on Rosewood – Laidley Road Crossing and Lane Road.	
	Specific information relating to hydrology and flooding queries.	• Regions of inundation around the western part of their property. • Stakeholder wished to know what hydraulic risks were on their property extents. • Stakeholder wished to clarify that no worsening of existing flood conditions could occur near their property. • Stakeholder wanted to know about risks with construction works, including water quality and environmental/wildlife issues. • Stakeholder still sceptical of the value and validity of the modelling as great concern due to the number and nature of the creeks and the amount of water that was observed flowing down during flood events.	• ARTC subject matter expert provided an explanation of the processes that have been currently been undertaken as part of the updated EIS works. • ARTC subject matter expert emphasised that additional consultation will be undertaken once results had been updated and the updated EIS report was released. • ARTC subject matter expert outlined the Flood Impact Objectives s as prescribed by the Expert panel. • ARTC subject matter expert provided further explanations about the elimination, mitigation and consultation pyramid approach to impacts. • ARTC subject matter expert explained that from a hydraulic modelling point of view, new fencing would be taken into account during detailed design.
	Revised reference design, hydrology and flooding and general queries.	• Stakeholder query regarding whether the construction of Mt Forbes Bridge would result in changing the road level in front of their house? • Stakeholders have visibility concerns of traffic coming from Mt Forbes Road Bridge as they exit their driveway.	• ARTC subject matter expert advised that there is not a major change in the road level anticipated as a result of the new design. • The stakeholders' driveway will be reinstated to the current condition by Inland Rail if impacted by the construction work. • The new design should meet the local authority road design standards which should take into consideration clearance issues. • ARTC team will follow up with stakeholders regarding their queries.

		• Stakeholders have current issues with drainage (they use pumps to pump water from their veranda) – would the proposed works adjacent to their property aggravate the issue? • Maintenance responsibility on adjacent property which is owned by ARTC. The grass is high and requires immediate action.	
	Specific information relating to revised reference design and hydrology and flooding and property-related queries.	• Stakeholder requested current water movement information • Stakeholder is concerned that none of the proposed culverts are feeding the dam • Stakeholder concerns about the inconsistent messages they have been receiving from different people • Stakeholder concerns that they only spoke to 'PR' people who were not able to provide them with accurate information. • Stakeholder is concerned about the 9m embankment. • Stakeholder requires information regarding the construction duration.	• ARTC technical subject matter expert discussed the revised reference design with the stakeholder and answered the stakeholder's queries. • ARTC subject matter expert discussed the hydrology and flooding assessment changes. • ARTC team member discussed her communications concerns. • ARTC environmental subject matter expert responded to her queries about the embankment and confirmed that details regarding the construction duration will be confirmed in due course.
	Specific information relating to noise queries.	• Stakeholder is concerned with airborne noise from trains. Stakeholder is concerned about noise break-in.	• ARTC subject matter expert discussed the noise and vibration impacts to the property. • ARTC to follow up with stakeholder regarding the request for baseline noise logging at the property.

		• Stakeholder said that they have asked for noise logging of existing noise levels to establish a baseline. • Stakeholder is sceptical of the noise modelling and believes the real train noise will be much louder. • Stakeholder is concerned with sleep disturbance from train pass-by max noise levels.	
	Specific information relating to hydrology and flooding queries.	• Stakeholder's concerns were in relation to the groundwater processes. • Stakeholder wanted to know information about drainage of the aquifer in the area and how this groundwater may permeate into his property. • Stakeholder and the neighbours currently require groundwater flows for their livelihood including livestock needs.	• ARTC subject matter expert talked about how surface water is impacted within his area of interest and how the floodwater impacts would be mitigated to acceptable levels, in line with the FIood Impact Objectives. ARTC subject matter expert indicated that any questions about groundwater would need to be directed to that team. • ARTC to follow up with stakeholder regarding his questions.
	Specific information relating to noise and general queries.	• Stakeholders are concerned about airborne noise from trains. • Stakeholders are sceptical of the noise modelling presented and though it might be louder. • Stakeholders are concerned with the number of and length of trains.	• ARTC subject matter expert discussed the noise and vibration impacts to the properties. • ARTC to provide results of road noise modelling to owners when available.

	Specific information relating to hydrology and flooding queries.	• Stakeholder was concerned about access in and out of their property. • Stakeholder wanted to know if the impact of the design works would results in excessively deep floodwaters. • Stakeholder wished to see extent of inundations around access route, and was satisfied with the results.	• ARTC subject matter expert indicated that ARTC's purpose is to ensure hydraulic impacts are minimised in line with the updated FIood Impact Objectives. • ARTC subject matter expert assured stakeholder that any hydraulic impacts would not adversely impact their access above the recommendations of the updated FIood Impact Objectives. • Stakeholder was content that limited adverse impacts would be experienced along their access route.

REVISED REFERENCE DESIGN WORKSHOP, INCLUDING RESULTS FROM UPDATED FLOODING ASSESSMENTS AND NOISE AND VIBRATION STUDIES

24 November 2022, Peak Crossing

Number of attendees	Key issues	Stakeholder concerns	Outcomes, ARTC commitments and actions
28	Specific information relating to revised reference design, noise	• The stakeholder's gate and fence line are directly impacted. There is a new road earthworks cutting. • Stakeholder query regarding what compensation they will get for their property being directly impacted and fence etc being impacted.	• ARTC discussed the revised reference design with the stakeholder and answered their technical queries. • ARTC property subject matter expert discussed the land compensation process. Property-related fact sheets were also available for more information regarding processes. • ARTC to contact stakeholder regarding fencing replacement.

	and hydrology and flooding.	• Stakeholder query regarding whether access to the 3D fly-through was available.	• ARTC to contact stakeholder regarding the availability of the updated 3D fly through for the C2K project.
	Specific information relating to noise and vibration,	• Stakeholders have noise and vibration concerns, including whether the horn will be used on the crossing loop. The stakeholders would like a recording of what this will actually sound like. • Stakeholders have dust concerns, especially with empty coal trains' return journeys. • Stakeholder have concerns about spill – derailment around the edge of Washpool Bridge. • Stakeholders advised that TMR advice keeps changing if their land is impacted. • Stakeholders noted that there is not enough information with the map received in the mail. It is not clear what the EIS Disturbance Footprint is and they have uncertainty around what will be impacted.	• ARTC subject matter expert discussed the noise and vibration assessment modelling for their property. • ARTC discussed the revised reference design with the stakeholder and answered their technical queries, including queries about the Washpool Bridge and the embankment. • The stakeholder was advised that prevention measures to reduce the chance of spill were included in the management plan eg reducing speeds. • ARTC to follow up with stakeholder regarding their queries.
	Specific information relating to hydrology and flooding queries.	• Stakeholders wanted to know about flood impacts at property and what has been done with the flood modelling since last meeting in Harrisville.	• ARTC subject matter expert explained that the expert panel had made a number of recommendations, including additional calibration events, updated design rainfall depths and FIood Impact Objectives. • ARTC subject matter expert advised this included using the flooding information that was provided in early 2022 to support the validation event modelling of Feb/Mar 2022 event.

		• Stakeholder wanted to know about EIS process in the coming months.	• ARTC subject matter expert explained the process involved in identifying mitigation measures, including removing impact, mitigating impacts, consultations etc. • ARTC subject matter expert advised stakeholder that community consultation activities would be organised in the new year to communicate the outcomes of the latest results to the community.
	Specific information relating to noise and hydrology and flooding queries.	• Stakeholder query whether ARTC have engaged with Willowbank about the noise impacts on CMC Rocks at the Raceway. • Stakeholder wanted to know how the railway would affect flooding in the area. • Stakeholder raised concerns about how the previous highway works may have caused a dam near the property and how proposed construction works may exacerbate this problem. • Stakeholder also raised concerns about dams in the area and how a number of them were full, meaning all runoff in a storm event would continue on unimpeded.	• ARTC to confirm whether engagement has been undertaken with the Willowbank Raceway for their events, particularly for music events. • ARTC subject matter expert discussed the hydrology and flooding assessment changes. • ARTC subject matter expert discussed the modelling works done to date, the Expert Panel's recommendations and what ARTC are doing going forward. • ARTC subject matter expert explained that modelling works have involved optioneering measures that ARTC are looking at to mitigate hydraulic behaviour including levels and time of durations. • ARTC subject matter expert also explained that dams were modelled as full throughout the assessment extents. • ARTC subject matter expert explained that further community consultation would be undertaken with the release of the updated draft EIS in the new year.
	Specific information relating to revised reference design and hydrology and flooding.	• Stakeholder has concerns with borehole being taken plus land and access to the creek. • Stakeholder is unhappy but understands that the project is coming and that he will be compensated. It is a very scenic	• ARTC discussed the revised reference design with the stakeholder and answered their design and access queries. • ARTC subject matter expert discussed the facets of the hydrology and flooding modelling works including the Flood Impact Objectives.

		location and other people use his property. • Stakeholder is interested in the potential areas of inundation around the property and are there any buffer areas. • Stakeholder is interested in the area (widths) of the proposed rail line design extents, as this may impact the property.	
	Specific information relating to revised reference design - access routes and construction methodology, noise and vibration, dust and environmental concerns.	• Stakeholder works from home and is directly impacted. • Stakeholders have been let-down by ARTC by not being kept informed (enough). • The stakeholders have noise and vibration concerns and are also concerned about construction noise. Stakeholder was not interested in noise mitigation treatments and thought they wouldn't work. • Stakeholder has dust concerns and associated health issues and enquired about remediation options. • Stakeholder has questions about construction methodology eg use of blasting. • The stakeholder had queries regarding access to their house as it is being cut off by the rail corridor.	• ARTC subject matter expert discussed the noise and vibration assessment modelling and potential mitigation treatments for their property. • ARTC technical subject matter expert advised that it will be likely that a new road access will need to be provided. It is not part of the design thus far. • ARTC meeting arranged in person at their property. • Project manager and Stakeholder Engagement Advisor discussed property access routes, noise mitigation activities and construction methodology and answered stakeholders' questions.

		• Stakeholder was not seeking early acquisition at this stage as they currently don't want to move. • Stakeholder has concerns about koalas. • Stakeholder requested a meeting in person during a specified date.	
	Specific information relating to revised reference design and general queries.	• Stakeholder query regarding whether the existing Undullah Bridge will be upgraded to include double-stacked containers? If so, noise modelling will be required for the Interstate line and double-stacked containers. • Stakeholder is concerned that the noise will increase if double-stacked trains run past her property. • Stakeholder requested construction (haulage) route.	• ARTC technical subject matter experts discussed the revised reference design and noise queries with the stakeholder. • ARTC to follow up with stakeholder regarding their queries.
	Specific information relating to revised reference design, noise and hydrology and flooding queries.	• Stakeholder is raising for the second time that this will affect their water source for their property. • Stakeholder would like to be reassured that their concerns are on file. • ARTC is resuming part of the dam and are now taking more than stakeholder was initially told as part of the C2K revised reference design.	• ARTC technical subject matter expert discussed the revised reference design with the stakeholder and that during this phase the design may be revised. • ARTC to confirm how much of their dam will be impacted. • ARTC to email stakeholder to confirm that we have noted the water source on their back fence is critical to their property. • ARTC to send stakeholder a link to the updated noise modelling information when available.

		• There is an existing dam on the ARTC fence line which is used to pump water to the property. This is critical infrastructure. Do we really need to impact it? • We are showing an impact to their dam. This dam is the water source for their property. • Noise modelling was undertaken on their property in approximately 2020. • Stakeholder would like to be reassured that their concerns are on file.	
	Specific information relating to revised reference design and property-related queries.	• Stakeholders had a query regarding what the EIS boundary meant. • Stakeholders had a query regarding property hardship - stakeholders requested to be contacted to explain the process. • Stakeholders had a query regarding a likely easement on property.	• ARTC technical subject matter experts discussed the revised reference design with the stakeholder. Further design refinement may occur which will be discussed with the stakeholders. • ARTC to follow up with stakeholder regarding their queries.
	Specific information relating to property-related and general queries.	• South of Dwyer Road over TMR land - proposed road – confirm if pipeline to reservoir. • Concern where crosses creek – erosion • Will they be able to rent their property when construction starts? • ARTC staff member rang to check they were coming to the workshop	• ARTC property team to contact stakeholder re hardship provisions. • ARTC to follow up with stakeholder regarding their queries.

		and said that land will be taken from their property. They would like ARTC to please confirm this.	
	Specific information relating to noise and property-related queries.	• Land at the front of their property is required by Inland Rail. • Stakeholder had noise and property-related queries.	• ARTC subject matter expert discussed the noise and vibration assessment changes and potential mitigation activities. • ARTC property subject matter expert discussed the land compensation process. Property-related fact sheets were also available for more information regarding processes.
	Specific information relating to noise queries.	• Stakeholder was concerns about the alignment being close to the house. • Stakeholder thought that mitigation wouldn't improve noise levels inside the house.	• ARTC subject matter expert discussed the noise and vibration assessment changes and potential mitigation activities.
	Specific information relating to general queries.	• Duplication of the line is much needed. • Stakeholder provided feedback regarding a recent communications activity which contained some inaccurate information.	• ARTC stakeholder engagement staff talked to the stakeholder about his queries and noted his feedback about the recent communications activity. The material will be updated for future use.
	Specific information relating to revised reference design, hydrology and flooding and property-related information.	• Stakeholder's front paddock floods. • There is an increase in impacts to the stakeholders' property due to the revised reference design. • The stakeholder is interested in more information about the early acquisition process. The stakeholder requested the AERTC Property team to contact them.	• ARTC technical subject matter experts discussed the revised reference design with the stakeholder. • ARTC subject matter expert (TG) discussed the hydrology and flooding assessment changes. • ARTC has contacted stakeholder regarding a meeting about the early acquisition process.

	Specific information relating to hydrology and ground water, noise. property and general enquiries.	• Stakeholder is interested in the Washpool Road design. • Stakeholder has an issue with extended process – Southern Freight Rail Corridor to now. • Stakeholder has concerns about the groundwater supply/water supply – may remove access rights. • Stakeholder is concerned about land acquisition – has increased since the initial EIS. • Stakeholder has concerns around the transparency process especially around groundwater and noise. • Stakeholder noted that ARTC need to provide more context around the work we are doing.	• ARTC technical subject matter expert discussed the revised reference design with the stakeholder and that during this phase the design may be revised. • ARTC technical subject matter expert discussed why ground water and surface water monitoring is undertaken as part of baseline ground water monitoring assessments. • ARTC technical subject matter expert discussed the land acquisition process and provided a project status update.
	Specific information relating to revised reference design, haulage routes, general information.	• Off Wild Pig Creek Road, stakeholder is concerned about traffic diversion and haulage routes. It is a “paper road” (approx. 500 Woolloman Road) and is impossible for haulage routes. • Stakeholder asked if spoil can be moved by rail instead of road. • Woolloman Road is not fit for 4 wheel drives now.	• ARTC technical subject matter experts discussed the revised reference design with the stakeholder and answered the stakeholder’s queries.
	Specific information relating to	• Stakeholder regarding Washpool Road queries.	• ARTC subject matter expert discussed the noise and vibration assessment changes and potential mitigation activities.

	noise, hydrology and flooding queries.	• What are the options required in wet weather. • Stakeholder is worried about unregistered bores – has groundwater issues. • Stakeholder noted that the process is an issue and we should be doing work now. Stakeholder is worried that if we don't, issues will never be actioned. • Stakeholder was sceptical of the noise modelling. • Stakeholder wants to have a receptor (logger) at the house.	• ARTC hydrology and flooding subject matter expert to discuss the unregistered bores issues with the stakeholder. • Option for ARTC groundwater team to meet with stakeholder when groundwater modelling is completed with stakeholder's agreement. • ARTC to follow up with stakeholder regarding their queries.
	Specific information relating to revised reference design	• Stakeholder newly impacted due to the changes to the road design – first contact was the letter they received. • Stakeholder was interested in the Washpool Road design. • Stakeholder would like bitumen on Washpool Road • Stakeholder has concerns about flooding, especially the new road – rail and impact for access. • Noted flooding and land slippage in the Washpool area. • Noise concerns • No visual amenity concerns • Stakeholder wanted to know about acquisition and project timing.	• ARTC technical subject matter expert discussed the revised reference design with the stakeholder and answered the stakeholder's queries. • ARTC to confirm if Washpool Road is to be bitumen or not when we upgrade it. • ARTC to contact stakeholder and arrange a future meeting pending their agreement.

		• Stakeholder queries about the design of the underpass and what vehicles could use the underpass.	
	Specific information relating to revised reference design.	• Stakeholder was interested in the Middle Road design • Interested in the Ebenezer area	• ARTC technical subject matter expert discussed the revised reference design with the stakeholder and answered the stakeholder's queries.
	Specific information relating to revised reference design and hydrology and flooding.	• Stakeholder has concerns relating to groundwater impacts from cuts/tunnel and impacts to their business. • Water pipeline • The Middle Road level crossing removal was a key topic the stakeholder was striving for. • Clearance especially Powerlink line – allow for all types of things. • Stakeholder noted that there was no legend for the new roads on the big map. • Stakeholder wished to see updates to potential flood impacts in her property. • Stakeholder wished to know what was happening with community submissions. • Stakeholder wished to know impacts on groundwater as well as surface water. • Stakeholder wished to know about if one on one consultations would	• ARTC technical subject matter expert discussed the revised reference design with the stakeholder, including showing them the Middle Road visualisation and discussing the new road north of the rail here. • ARTC to check clearance heights for roads and the Powerlink line and advise stakeholder. • ARTC subject matter expert showed the improvements made to the model to show greater flood inundation extents. • ARTC subject matter expert also described the process behind the updated EIS works, including the proposed FIood Impact Objectives. • ARTC subject matter expert also communicated to stakeholder the process behind developing mitigation measures for houses within flood extents. • ARTC subject matter expert explained that detailed community consultations would be undertaken in the new year to ensure that community concerns are addressed. Further consultation will be organised and discussed on a case by case basis as required. • ARTC subject matter expert communicated to stakeholder that latest results from groundwater analysis would be available via public consultation in the new year.

		be undertaken to relay outcomes of the flooding and groundwater analysis.	• ARTC subject matter expert indicated that ARTC have received and viewed all submissions and had taken concerns on board with the modelling works. • ARTC subject matter expert described how ARTC will continue to work with other disciplines and other during other stages (construction), to ensure the Flood Impact Objectives are being continued.
	Specific information relating to EIS submission, hydrology and flooding queries.	• Stakeholder wants to go through their EIS submission to the Coordinator-General with the project team. • Stakeholder requested a briefing on the outcomes of the groundwater modelling.	• ARTC subject matter expert explained that the issues raised will be dealt with by subject matter experts in different forums eg Level Crossings (completed), Flooding assessments (completed), Groundwater (2023). • ARTC will provide the stakeholder with a briefing on the outcomes of the groundwater modelling when available.
	Specific information relating to revised reference design, traffic and environmental queries.	• Stakeholder asked about level crossing at Washpool being no longer warranted. • Stakeholder has quolls and rock wallabies on property. • Stakeholder noted issues with Washpool Road flooding (inverts, flow over road) • Stakeholder noted issues with Ipswich Boonah Road near Washpool Road intersection – vehicle use • Bitumen on the road • Offsets	• ARTC technical subject matter expert discussed the revised reference design with the stakeholder and answered the stakeholder's queries. • ARTC to follow up with stakeholder regarding their queries. • Final design to be agreed with the road authority (eg bitumen) • TMR are looking at some of the roads/intersections as issues not directly related to the Inland Rail design.
	Specific information relating to	• Stakeholder wished to know about potential flooding impacts on his property.	• ARTC subject matter expert discussed the hydrology and flooding assessment in relation to the stakeholder's property. • ARTC subject matter expert informed the stakeholder of what works ARTC have done as a part of the Environmental Impact

	hydrology and flooding queries.		Statement, and the additional works as part of the upgraded study.
	Specific information relating to hydrology and flooding queries.	• Stakeholder wanted to clarify what the proposed works were near the property extents. • Stakeholder wished to gain a better understanding about how ARTC models rainfall events, their regularity and intensity, the proposed works as a whole (timelines and timeframes) and further planned connections. • Stakeholder informed subject matter expert of several localised areas near the property that fill up with water when it rains.	• ARTC subject matter expert discussed the hydrology and flooding assessment in relation to the stakeholder's property.
	Specific information relating to hydrology and flooding queries.	• Stakeholder wanted to know about how the floodwaters may impact certain key infrastructure within the area. • Stakeholder described soil scouring in the area.	• ARTC subject matter expert discussed the hydrology and flooding assessment, in particular the velocity Flood Impact Objectives and geomorphological assessment for high-Powerlinrisk areas.
	Specific information relating to hydrology and flooding queries.	• Stakeholder expressed concern that the rail embankments may cause floodwaters to impinge on her property. • Stakeholder wanted to know what more consultation and advice can be given to the community to better assuage fears.	• ARTC subject matter expert explained the process of the updated draft EIS, and how the expert panel had requested upgrades to the modelling. • ARTC subject matter expert discussed application of FIood Impact Objectives and mitigation of impacts. • Further consultation will be available with stakeholders in the new year when the modelling results are finalised.

	Specific information relating to hydrology and flooding queries.	• Stakeholder is concerned that the railway crossing Purga Creek will cause backwater flooding. • Stakeholder advised that the culvert at corner Mt Flinders Road and Ipswich Boonah Road acts as a throttle. • Stakeholder advised that water backs up behind and overtops, flowing west and north around his property. • Stakeholder wanted to know if the runoff from entire catchment is modelled. • The stakeholder was satisfied that runoff from the entire catchment, specifically his local flooding, was included in the models.	• ARTC subject matter expert informed stakeholder of the Flood Impact Objectives and ARTC's work to minimise disturbance. • ARTC subject matter expert explained the behaviour observed is evident in the flood model results.

REVISED REFERENCE DESIGN WORKSHOP, INCLUDING RESULTS FROM UPDATED FLOODING ASSESSMENTS AND NOISE AND VIBRATION STUDIES

29 November, 2022, Rosewood

Number of attendees	Key issues	Stakeholder concerns	Outcomes, ARTC commitments and actions
23	Hydrology and flooding.	• Stakeholders have concerns about Warrill Creek flooding and backing up from the bridge.	• ARTC to follow up with hydrology and flooding subject matter expert on flood height data.
	Specific information relating to revised reference design and hydrology and flooding.	• Stakeholder has lived at the property for many years. • Stakeholder is very concerned about flooding impacts at her property in the Mutdapilly area. • Stakeholder thinks that the embankments will cause floods to back up. • Stakeholder is concerned there will be a increase in the water depth. • Stakeholder described the concern she regarding the Bridge at Warrill Creek bridge and how its construction may impact her property.	• ARTC subject matter expert discussed the hydrology and flooding modelling process as well as the International Flood Panel process. • ARTC subject matter experts were able to reassure stakeholder that the bridge was suitably designed and that ARTC will be undertaking rigorous modelling based on FIOs recommended by expert panel to ensure minimal impacts to her property. • ARTC subject matter expert explained the Flood impact objectives in relation to the property. • Historical data has been included in the requirements model – 700m span bridge explained -on Warrill Creek. • ARTC subject matter expert explained where the embankments are.
		• Stakeholder near Rosewood and hears the coal trains but not the QR trains. • How often do the trains go through and all through the night?	• Stakeholder spoke to the noise subject matter expert and they explained the noise modelling process and assessment criteria. • The freight line is planned to run 24 hours. • Feedback regarding the workshop information in the flyer has been passed back to ARTC's communications team for future note.

		• If something stops the trains, will it be busier the next day to catch up? • Noted that the flyer said 4 – 7pm and that it was not clear that it was a drop in style session but the stakeholder thought it was a 3 hour lecture. • Just general interest in Inland Rail, no real concerns.	• ARTC team will follow up with stakeholder regarding his direct queries regarding the future C2K train information.
	Specific information relating to revised reference design and traffic impacts.	• Road usage in the area, are they going to be heavily impacted by construction traffic? • Connectivity concerns regarding schools and property around Waters Road. • Did the ALCAM count take into consideration traffic impact from both projects? (H2C and C2K)? • Traffic impacts on Rosewood – Laidley Road Crossing and Lane Road.	• ARTC technical subject matter expert discussed the revised reference design with the stakeholder. • ARTC spoke to stakeholder about connectivity being maintained and engagement with schools and Department of Education is taking place to ensure impacts are mitigated. • Subject matter expert to explain how the traffic count took place and send description to stakeholder.
	Specific information relating to revised reference design, hydrology and flooding and general queries.	• Would the construction of Mt Forbes Bridge result in changing the road level in front of their house? • Stakeholders have visibility concerns of traffic coming from Mt Forbes Road Bridge as they exit their driveway. • Stakeholders have current issues with drainage (they use pumps to pump water from their veranda) –	• ARTC advised that there is no major change in the road level anticipated as a result of the new design. • The stakeholders' driveway will be reinstated to the current condition by Inland Rail if impacted by the construction work. • The new design should meet the local authority road design standards which should take into consideration clearance issues. • Regarding drainage issues, further examination will be required, and a follow up response will be provided. • Follow up with the relevant department to ensure the required maintenance is completed for the adjacent property.

		would the proposed works adjacent to their property aggravate the issue? • Maintenance responsibility on adjacent property which is owned by ARTC. The grass is high and requires immediate action.	
	Specific information relating to revised reference design and hydrology and flooding and property-related queries.	• Stakeholder requested current water movement information • Stakeholder is concerned that none of the proposed culverts are feeding the dam • Stakeholder concerns about the inconsistent messages they have been receiving from different people about the project. • Stakeholder concerns that they only spoke to 'PR' people who were not able to provide them with accurate information. • Stakeholder is concerned about the 9m embankment. • Stakeholder requires information regarding the construction duration. • Landholder is concerned about maintaining flow to the dam.	• ARTC technical subject matter expert discussed the revised reference design with the stakeholder and answered the stakeholder's queries. • ARTC subject matter expert discussed the hydrology and flooding assessment changes. ARTC subject matter expert will look to see how these results compare to our flood modelling to discern if the flooding is more regional or local. • ARTC team member discussed the stakeholder's communications concerns. • ARTC environmental subject matter expert responded to the stakeholder's queries about the embankment and confirmed that details regarding the construction duration will be confirmed in due course.
	Specific information relating to revised reference design, noise,	• Stakeholder has been dealing with the project since 2007. • Stakeholder has noise concerns. • Stakeholder primarily wanted to know if their property was going	• ARTC noise subject matter expert advised stakeholder that the residence was predicted to comply with the TMR criteria based on the latest noise modelling and therefore, from a noise perspective, there would be no requirement to resume the property. Discussed the noise and vibration modelling process and criteria with the stakeholder.

	hydrology and flooding and property-related queries.	to be resumed because of noise from Inland Rail. • Stakeholder was also concerned about the elevated nature of track through the property. • Stakeholder has flooding concerns. • Noise monitoring done previously. • How long will be property be disturbed for? • Stakeholder noted that the property flooded. • Stakeholder has not provided land access to ARTC. • Stakeholder has a dam at the property. • Confirming design impact at the property.	• ARTC technical subject matter expert discussed the revised reference design with the stakeholder and answered the stakeholder's queries. • ARTC property subject matter expert discussed the land access process and would contact the stakeholder talk further to organise land access – proposed access for sampling at the property. • ARTC subject matter expert discussed the hydrology and flooding assessment changes – explained the revised flood model. Stakeholder had talked to the subject matter expert previously about flooding and hydrology at the property. Stakeholder showed photos to the subject matter expert of the March flooding event.
	Specific information relating to hydrology and flooding queries.	• Stakeholder wants to know what the scale of flooding will be like in the floodplain near their property. • Expressed concerns regarding proposed works, and that design was not up to standard (believes that there is only going to be a single span bridge at Warrill Creek).	• ARTC subject matter expert provided an explanation of the modelling processes that we have currently been undertaking. • ARTC subject matter expert discussed the current Flood Impact Objective guidelines and what constitutes unacceptable impacts etc. • ARTC subject matter expert was able to assure stakeholder that the Warrill Bridge was bigger than anticipated and fit for purpose - 700m long bridge with 30m spans
	Specific information relating to hydrology and flooding and	• Regions of inundation around the western part of their property. • Stakeholder wished to know what hydraulic risks were on their property extents.	• ARTC subject matter expert provided an explanation of the processes that have currently been undertaken as part of the updated EIS works. • ARTC subject matter expert explained the Flood Impact Objectives as prescribed by the Expert Panel.

	general queries.	• Stakeholder wished to clarify that no worsening of existing flood conditions could occur near their property. • Stakeholder wanted to know about risks with construction works, including water quality and environmental/wildlife issues.	• ARTC subject matter expert provided further explanations about the elimination, mitigation and consultation pyramid approach to impacts. • ARTC subject matter expert explained that from a hydraulic modelling point of view, new fencing would be taken into around during detailed design. • ARTC subject matter expert emphasised that additional consultations will be undertaken once results had been updated and the updated EIS report was released.
	Specific information relating to hydrology and flooding queries.	• Stakeholder wanted to know more about impacts around Kuss Road Bridge. • Stakeholder expressed concern about affluxes because of the scale of the proposed works.	• ARTC subject matter expert discussed the hydrology and flooding assessment changes in relation to their property. • ARTC subject matter expert was able to advise that the design elements of the bridge and the embankments were developed in a way to limit flooding as much as possible, and where required, mitigation measures adopted to ensure minimal impacts in line with the FIood impact Objectives. • ARTC subject matter expert advised stakeholder to await publishing of the updated EIS and seek to make submissions on any questions or queries they may have. • ARTC subject matter expert advised that additional community consultations will be upcoming in the new year.
	No issue noted	• Attendance by contact at the Department of SDILGP regarding ways they may be able to be more involved with Inland Rail.	• ARTC to email contact to exchange contact details. • ARTC to speak to the Social Performance team about further consultation with this Department.

Appendices

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MEETING MINUTES

Meeting	Engagement Session: Inland Rail Calvert to Kagaru Draft Koala Management Plan - Existing Koala population, habitat and threatening processes
Date	18 August 2022
Time	6pm
Location	Rosewood Uniting Church Hall
Facilitator	Michelle Norton

Attendees

Community representatives

- Anne Page & Carla Parker- Logan & Albert Conservation Association Inc.
- Holly Hosie- Southern Queensland NRM (CM- Southern Queensland Landscapes)
- Edward (Ted) Fensom- Wildlife Queensland (Logan Branch) and Brisbane Regional Environment Council
- Ian Beale- Wildlife Queensland (Scenic Rim Branch)
- Rodney Adam- Environmental Planning Coordinator- Logan City Council
- Phil Smith- Natural Environment & Land Manager- Ipswich City Council
- Lara Solyma- Biodiversity Officer (Environmental Planning)- Biodiversity and Climate Change- Scenic Rim City Council
- Dalene Adam- Hiddenvale Wildlife Centre
- Jim and Maureen Barrow- local Peak Crossing landowners
- Dr Ben Allen- University of Queensland (USQ)
- Associate Professor Pete Murray- University of Queensland (USQ)
- Keith McCosh, The Boonah Field Naturalists
- Robyn Keenan- Scenic Rim & Ipswich Community Consultative Committee member
- Rosemaree Thomasson- Scenic Rim & Ipswich Community Consultative Committee member and member of Rosewood District Protection Association
- Geoff Lundie- Jenkins- DES & the Queensland Koala Advisory Council

Observer Roles

- Richard Hancock- Project Manager, Scenic Rim Regional Council & Ipswich City Council
- Jarrod Hunter- Project Engineer, Scenic Rim Regional Council & Ipswich City Council

ARTC

- Dr Vanessa Gorecki, Program Environment Senior Advisor- Ecology
- Mr Michael Price, Senior Environment Advisor, G2H
- Fleur McPherson, EIS Delivery Specialist, G2K

  Karen Hillery, Stakeholder Engagement, C2K

ERM

- Michelle Norton, Facilitator
- Dr David Dique, Partner and Principal Ecologist

No	Topics Covered During Engagement Session
1	**Introductions and C2K context** ■ Introduction to attendees ■ Purpose of workshop ■ Summary of Calvert to Kagaru alignment and study area relating to koalas ■ Legislation updates and EIS feedback.
2	**Meeting background and purpose** ERM is working with ARTC Inland Rail to prepare a draft Koala Management Plan as part of the revised EIS. The KMP is to: ■ identify important/locally significant koala populations that are likely to be impacted by the project ■ identify existing threatening processes on these populations. ■ assessment of project impacts at site-specific level of detail ■ project design considerations and management actions that will be undertaken to avoid, and mitigate project impacts on koalas including details of objectives and performance criteria that must be met to ensure these measures are effective in preventing adverse effects on koala populations in the project area ■ a monitoring program that will be undertaken to ensure mitigation measures are effective in mitigating impacts on koalas including details of monitoring methods and timing ■ adaptive management measures and threshold triggers that will be undertaken where monitoring demonstrates that mitigation measures are not effective. ■ to ensure koala safety and movement are maximised through design and layout; and to manage risks to koalas on-site during the construction and operational phases. Focus of this session - access local knowledge and technical experts on the koala populations affected by the C2K alignment and to understand existing koala population distribution and existing threatening processes.
3	**Koala observations and populations** ■ Koala ecology relevant to coastal populations and peri-urban communities ■ Type and extent of records held by community groups, including any existing studies and surveys that support understanding the distribution of important populations ■ Evidence of habitat use ■ Landscape structure and koala movement opportunities
4	**Existing threatening processes** ■ Summary of known key threatening processes impacting on koalas ■ Records and observations from wildlife carers on koala injury, disease and mortality

No	Topics Covered During Engagement Session
5	**Close and next steps** Information from this workshop will be used in the preparation of the KMP to provide local knowledge and context to management measures. Closed: 8.00pm

No	Action Items and Recommendations
1	**ACTIONS** ■ Follow up required with Lara Solyma- Biodiversity Officer (Environmental Planning)- Biodiversity and Climate Change- Scenic Rim City Council **(please see Appendix D for outcome)** ■ Contact the Ipswich Koala Protection Society (IKPS)- Rebecca Larkin ikps@outlook.com.au for further information on local koala population
2	**ADDITIONAL COMMENTARY** Workshop participants provided information in a 'rural context' and were able to locate areas of interest on maps. Images, maps and emails were shared citing concerns regarding koala populations in areas where it was considered that previous mapping was not adequate. **Koala Ecology- Habitat & Populations** ■ Bill Ellis & Branch Study at Mount Byron (edge of D'aguilar Range) to Sommerset RC – Habitat discovered 25 years ago on road reserve – 3000 hectares of koala habitat nearby not mapped – road reserve to Creek 2 adjoining paddocks Koalas tracked and trees mapped ■ Observations in Scenic Rim- Brown Mountain – Dale Anderson doing similar study ■ SEQ River Valleys likely to show same result as Ellis and Branch Study and Brown Mountain Study ■ Logan – Mixture of remnant and HUR tracts including South of the line – Strategic alignment with state corridors and Logan corridors near Wooloomin Creek? ■ Koala records outside mapped koala habitat along Inland Rail Corridor (maps and records available) ■ Information in observational records illustrating movement patterns and home ranges for koalas within Inland Rail Corridor ■ "Rural" koalas- use individual paddock trees ■ Ebenezer and Mount Forbes- best habitat (Ipswich Koala Protection Association) ■ Creeks- Corridors- Big Blue gums ■ Concept of home range

No	Action Items and Recommendations
	■ More porous ■ Moves depending on season ■ Large areas!!! Time range ■ Blue Gums and other perhaps “non-preferred” gums ■ Study at Peak Crossing- University of QLD **Existing Threats** ■ Ipswich Koala Protection Society (IKPS) admission data for sick, injured and orphaned koalas. IKPS contact Rebecca Larkin ■ IKPS data also includes health observations including cause of admission and disease status ■ Linear infrastructure causing fragmentation and disrupting movements and dispersal in koala populations ■ Assumptions made because they are rarely seen in some areas ■ Phenomenon of rural koala ecology that was previously unknown – Maps don't capture because trees are too far apart ■ Potential to cut corridors/koala movement across creek! ■ Lack of habitat/ habitat destruction ■ Lack of connectivity ■ Vehicle strike ■ Disease **Other Feedback or Suggestions** ■ Logan City- have provided all koala information to ARTC ■ Make use of scat and scent detection dogs ■ Like to see koala proof fences like at Munruben - Peak Crossing- Kagaru – Ebenezer ■ Logan- biodiversity corridor mapping - areas that they are trying to keep development out of. ■ Fencing needs to be considered with the ability to connect ■ Hotspots or records – Records are sparce – Logan have previously provided details to ARTC
3	**RECOMMENDATIONS** ■ Maps and areas highlighted may provide further information for field studies ■ Relevant information and data to support

Attachments:

Appendix A *Process and Participant Knowledge Sharing Template*

Appendix B *Visual Presentation of Participant Feedback*

Appendix C *Feedback for ARTC*

Appendix D *Information Received After Follow-Up*

APPENDIX A - PROCESS AND PARTICIPANT KNOWLEDGE SHARING TEMPLATE

Participant Knowledge Sharing Objectives:

- **Consult** – Engaging to understand current level of knowledge and awareness of koalas and threatening processes associated with the B2G Project.
- **Involve** – providing ways for community groups and key stakeholders to share information re koala presence, important habitat, existing populations, and potential threats.

At the Koala Community Forum participants were asked:

- *What you know about koalas: known observations, current populations and important habitat areas, and potential threats and how has the local koala population changed over time?*

The facilitator explained the process to invitees including the response template provided.

Invitees were invited to prepare responses to the questions in the template and/ supporting information where relevant.

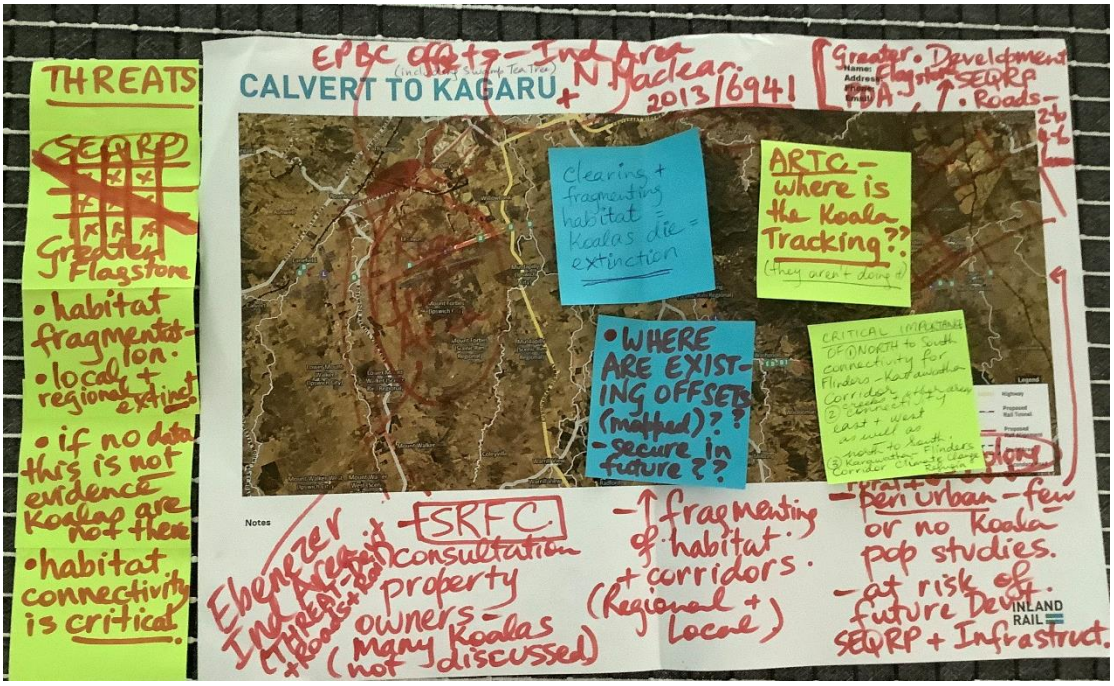
- *'Any supporting information (maps, photographs, footage, digital data sets) which can be shared is greatly appreciated.*

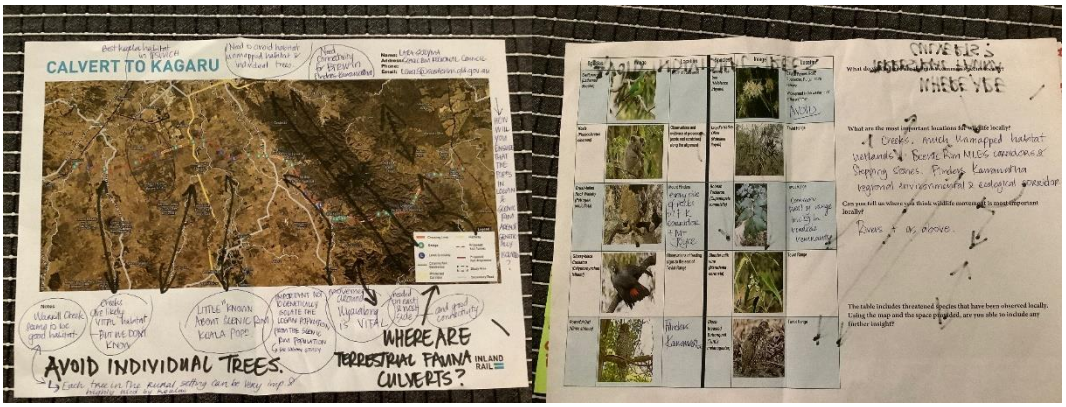
Participants could record summary information in the table below (hard copies provided to participants on entry to the workshop) and attach supporting information (maps, photographs, footage, digital data sets etc).

Participant Knowledge Sharing Template

What do you know?	Summary Response
Do you keep koala records for your local area, and do you know where they occur in the landscape?	
Do you know what the current population of koalas is in your local areas, and do you have an estimates of population size?	
Can you identify important habitat areas for koalas in the local area?	
What evidence or information can you share to support your knowledge of koala populations?	
Has the koala population changed over time in your local area and what evidence to you have to support your view?	
Do you know if there are any threats to koalas or the future of koala populations in your local area?	

APPENDIX B - VISUAL PRESENTATION OF PARTICIPANT FEEDBACK





Side 1 Side 2

APPENDIX C - FEEDBACK FOR ARTC

A document named the “Parking Lot” was created for participants to note any area where they might like further feedback or would simply like ARTC to consider.

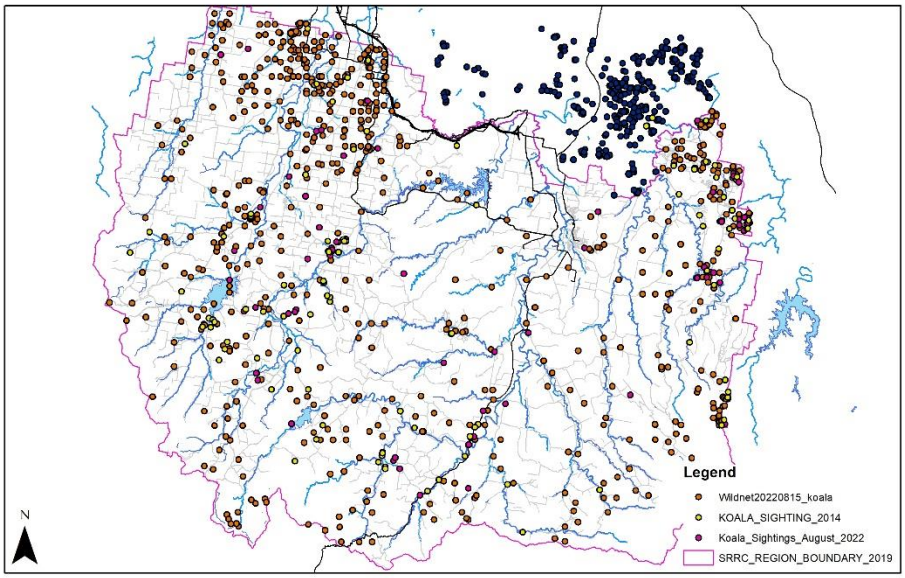
Parking Lot

- Wild Pig Creek & Wollamin Creek & WFOK (might be WFCK/ WFGK) Corridor
- Quoll Observation Recount W. Pig Creek Road
- Sacred Sites. N. Point W. Pig Creek Road- Rocktool South of line
- Grasslands in this area noted as 70% Native Grasslands DR D.P.R Sands XXXX?
- Rainforest on N. bank (left bank) Wooloomin Creek
- Wild Pig Creek Road bt 600 square meters David Garteen
- Fences
- TMR only fenced Munruben 8km because Koala Scat Dogs used
- Fauna overpasses & underpasses work at Karawatha- Kuraby BCC
- Lack of habitat/habitat destruction
- Lack of connectivity
- Vehicle strike
- Disease
- Flooding

APPENDIX D - INFORMATION RECEIVED AFTER FOLLOW UP

Attachment 1 & 2 to be sent directly to ARTC

Koala records in Scenic Rim Regional Council and nearby



Above: Koala Sitings- Attachment 3 from FW: Scenic Rim Follow up: Re C2K Workshop Thursday 18 August

Peak Crossing Koala Research Project

2018-2019

Final Report 2019

Prepared by the Koala Ecology Group

The University of Queensland

This report should be cited as:

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Acknowledgements

This project was a collaboration between the Koala Ecology Group from the University of Queensland and the Queensland Trust For Nature. The project was also jointly supported and funded by the New Hope Group, Scenic Rim Regional Council and Ipswich City Council, for which we were very grateful . We also wish to thank those private landowners who permitted access to their properties for the purposes of the study, and to the RSPCA and Ipswich Koala Protection Society for collaborating on the monitoring of male koala 'Hitch'. Additional thanks are also given to the staff at the Australia Zoo Wildlife hospital for the successful treatment of the female koala 'Sheree'.

Table of Contents

Overview

This report presents the findings of a short field study on koalas in the Peak Crossing district of South East Queensland (SEQ). The study was aimed at improving our understanding of the health, ecology and movement of koalas in this area, which is predominantly an agricultural landscape. Surveys were conducted by a team of four experienced koala researchers from the University of Queensland, and three ecologists from Queensland Trust For Nature (QTFN). The aim of the surveys was to locate 4-6 koalas to include in the collar monitoring program. Koalas were given a thorough health assessment by a wildlife veterinarian (A. Gillett) and were fitted with GPS tracking collars so their movements could be examined in detail.

The main research findings are summarized below:

- Koalas were located during surveys along creek lines (Sandy and Purga Creek) and in loosely connected habitat patches at Peak Crossing.
- The study highlighted that there is a high level of chlamydial infection within the koala population at Peak Crossing (est. 60 – 80% koalas are infected with the bacteria). Four of the six wild-caught koalas examined during the study were infected with *Chlamydia pecorum* and additional sick-looking animals were observed. Chlamydial infection in koalas often leads to disease and death, if untreated; it is widely regarded as a major contributor to population declines in SEQ. The high prevalence of infection in the examined koalas suggests that *Chlamydia* is a significant issue for the conservation of koalas in the Peak Crossing district.
- GPS collar data were used to examine movement patterns/pathways and estimate short-term home ranges. Koalas were found to rely heavily on riparian vegetation along Sandy and Purga Creeks, where the favoured food tree, Queeensland blue gum (*Eucalyptus tereticornis*), is reasonably common. They were also found within habitat patches away from creek lines, but which had some forested connection to them. The data suggest that the thinly-vegetated creek

lines serve two functions: 1. Provision of habitat for koalas to live within, and 2. Provision of forested linkages for koalas to move through and access larger habitat patches.

- The GPS collar data also recorded koalas crossing roads and pasture/cropping fields; during these events they are very vulnerable to vehicle strike and dog predation.
- The movement pathways/behaviours of examined koalas are likely a result of the significant fragmentation of habitat in this agricultural landscape. Koalas appear to occur at relatively low densities in the district, making the population more vulnerable to deaths from known threats (cars, dogs) and stochastic weather events (e.g. heat waves).
- This study has revealed that there is still a reasonable koala population at Peak Crossing, with individuals living along riparian habitat strips and within loosely connected habitat fragments. Specifically, we advocate for enhanced protection of this population through 1. Habitat protection and restoration, and 2. Management of sick/injured koalas, especially those affected by chlamydial infection.
- Various management recommendations are provided, aimed at improving the health of the population and enhancing the conservation of koalas and their habitat in the Peak Crossing district. In particular, habitat restoration works are suggested for Purga Creek and Sandy Creek; a focus could be placed on bare stretches of Purga Creek in the vicinity of the Peak Crossing State School, to try and link up larger areas of habitat and provide koalas with safe passage options in the future. In addition, we recommend that efforts to treat sick koalas are continued in the Peak Crossing district, as chlamydial infection is likely to be a significant issue for the future conservation of the koala population. Treatment of sick koalas usually relies on members of the public noticing the animal and reporting it to rescue groups such as the Ipswich Koala Protection Society. Efforts to improve community awareness around this issue are therefore important.

Introduction

In south-east Queensland, an extensive body of ecological research has been conducted on wild koala populations in the heavily developed local government areas of Brisbane, Redlands and the Gold Coast (Dique *et al*. 2004, Rhodes 2015). This research has provided valuable information on the distribution, abundance, health and ecology of koalas in these densely populated regions, as well as information on the key threats facing the species. Much has also been learned about the behavioural ecology of koalas in these areas, such as their habitat and dietary preferences, reproductive output (Gifford *et al.* 2002), home range sizes and dispersal distances (Dique *et al.* 2003b). These data have been used to underpin conservation and management strategies for the species, which is now listed as threatened in Queensland under federal environmental legislation.

Unfortunately, very little such research has been conducted on free-ranging koala populations in non-coastal regions of south-east Queensland, including Peak Crossing and surrounds. This region spans the local government areas of Scenic Rim Regional Council and Ipswich City Council. Much of the original native vegetation in the Peak Crossing region was cleared many decades ago for agricultural development. Undoubtedly, this would have had a very negative impact upon populations of koalas and other native wildlife. However, koalas are known to have persisted along thin riparian corridors and in relatively isolated habitat patches in the region, but no detailed scientific research has been conducted to assess the health status and ecology of the surviving koala population. This research is required to inform effective management of the species, and to identify opportunities to enhance habitat connectivity and reduce population threats.

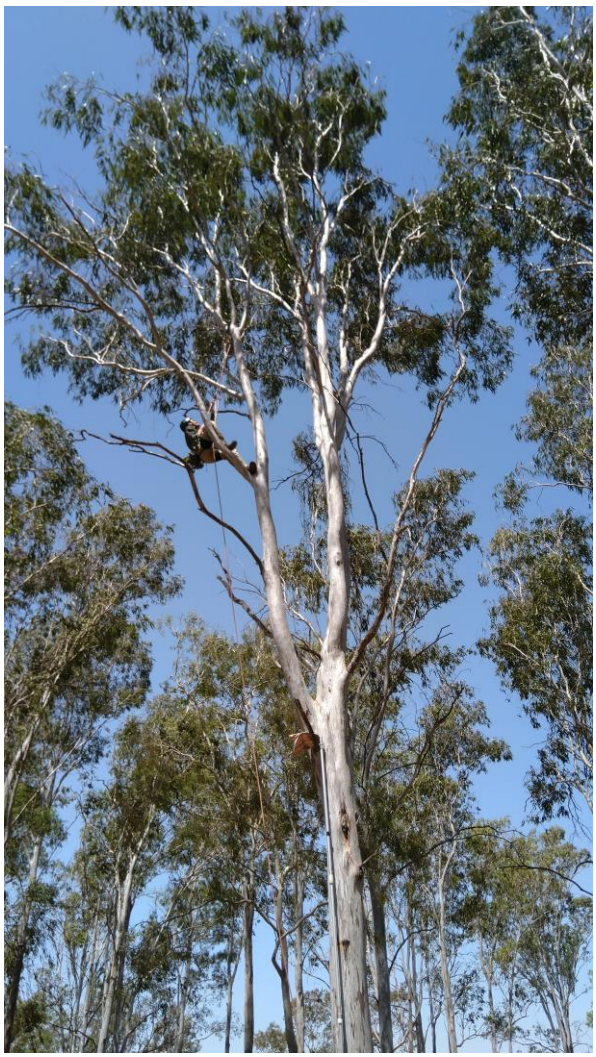
The aim of this research project was to fill some of the gaps in our scientific knowledge of koalas in the Peak Crossing region of south-east Queensland. Specifically, the research examined the health, ecology and movement of koalas along Sandy Creek and Purga Creek near the township of Peak Crossing, which link to the Flinders-Goolman Reserve. A further aim was to use the collected data to identify areas in this landscape where koalas where

at risk of car and dog interactions, and to identify areas where habitat restoration would be of greatest benefit to the local koala population. Lastly, the project also aimed to engage students at the Peak Crossing State School and the broader community, with the intention of educating people about koalas that utilise the area and the specific threats to the local population.

Methods

Capture of study animals

Koala catching fieldtrips were conducted at the study site in March, June and November 2018. Koalas were captured using a modification to the method of Ellis *et al*. (1995) and Ellis *et al.* (2015), where one team member ascended the tree containing the koala (see photograph below), whilst the other members waited quietly on the ground at the base of the tree. A plastic bag (~ 40 cm x 20 cm, volume 8 l) fitted to the end of a telescopic aluminium pole was waved above the koala's head, which usually resulted in the koala descending to escape the disturbance. Once on the ground, the koala was restrained by hand and immediately placed in a cloth bag (40 cm x 80 cm, volume 20 l). The bag was briefly hung in a cool area to allow the koala to settle while the in-field examination and collaring space was set-up.



Sampling and measurements

Koalas were anesthetised by a specialist wildlife veterinarian (Dr A. Gillett) to facilitate a detailed health examination and sample collections. During the examination the animal's age, body mass, head size, tooth wear, body condition and gender were recorded. A small tissue biopsy was collected from the ear (3mm dia) and a uniquely-numbered, coloured ear tag was inserted through this hole to aid future identification. Koala body condition index was based on Ellis and Carrick (1992), whereby the amount of muscle tissue around the scapula was used as an indication of condition (scale 1 – 10, with 4 or below considered very poor).

Each koala was physically and visually examined for clinical signs of disease. Clinical signs of ocular infection can include reddening and/or swelling of the conjunctiva, serous or purulent discharge and partial or complete closing of the eyelids. Severe cases can result in staining or loss of fur around the eye. Corneal opacity (blue or white haze of the cornea) may also be present. Clinical signs of urogenital infection may include brown/yellow staining of the fur on the rump of the animal. The rump may be wet due to incontinence and in severe cases scalding and ulceration of the rump may occur.

In addition to assessment of overt signs of disease, ultrasonography was used to examine the reproductive tract, bladder and kidneys for internal signs of disease. Ultrasound examination may reveal thickening of the bladder wall (common in koalas with cystitis), kidney disease, and the presence of ovarian bursal cysts in the female reproductive tract (which can make them infertile).

Swab samples were collected from each eye and the urogenital sinus/cloaca (females) or penile urethra (males), for chlamydial disease testing. Sterile cotton-tipped swabs (Copan; Interpath Services, Melbourne) were vigorously rubbed around the inside of the koalas' eyelids (conjunctiva) and by inserting a swab inside the urogenital sinus or inside the penile urethra, to collect elementary bodies or dislodge organisms (Weigler et al. 1988, Vogelnest et al. 2008). Quantitative Polymerase Chain Reaction was performed in the laboratory to detect and quantify chlamydial infection in the koalas. This

approach provided an accurate indication of the prevalence of chlamydial infection (Jackson et al. 1999, Devereaux et al. 2003).

Koala examinations were conducted in the field using a mobile vet lab, so that koalas could be released at the capture location as soon as possible. Koalas were usually released 40 – 60 minutes after capture.

Collars

Koalas were fitted with collar-mounted VHF transmitters and Global Positioning System (GPS) loggers. The total weight of the collars was 80-100g. The VHF transmitter allowed the koalas to be tracked to determine their locations, whilst the GPS units logged the location of the koalas. All but one of the collars were programmed to record their location every 10 minutes between 23:00 and 24:00 hrs each day; the other collar was programmed on a much higher fix schedule and recorded the location every 30 minutes between 18:00 and 06:00 hrs each day;

All collars were fitted with a 'weak link' as a safety measure, designed to break if the collar became wedged on a snag or branch of a tree. When the link breaks the koala is freed of the collar, therefore preventing it becoming trapped or injured. The rubber in the weak link also deteriorates over time so if the VHF portion of the collar malfunctioned and we were unable to relocate the koala, the collar would fall off once the weak link is weakened and severed (usually ~6mths).

Data analyses

We filtered the collar GPS data to utilise one daily GPS fix for each koala, retaining that with the greatest accuracy. The exception to this was the single high fix collar, for which all high accuracy fixes were retained so that movement patterns could be examined in finer detail (mean accuracy of retained fixes was 10-15m).

The collar datasets were used to map the location of koalas each day, providing a map of the movement of each individual. We also calculated the home range of some of the koalas using the 100% minimum convex polygon method to estimate a short-term home range, which represents the area used

by the koala during the period it was wearing the GPS collar. This home range does not represent the entirety of the area utilised by the koala over its lifetime or the area needed for that koala to persist. It is only a representation of the space used by the koala for the short period whilst wearing the collar. Longer tracking periods would be required to provide a more complete understanding of the space requirements of koalas at the study site.

We also used the GPS collar data to estimate the nightly distance moved, by calculating the direct path (Euclidean distance) between GPS points on consecutive nights. This provided a minimum distance moved, as it is highly likely that the koalas moved in a non-linear fashion between the recorded points. To examine tree preferences, we recorded the tree species koalas were observed in at first capture and on subsequent tracking occasions.

Results and Discussion

Details of examined koalas

Seven koalas (4F, 3M) were examined as part of the Peak Crossing koala study (Figure 1, Table 1). Six of the koalas were captured in the field at Peak Crossing and surrounds (Figure 2). In addition, one koala (male 12334 “Hitch”) had previously been admitted to the RSPCA after he was hit by a car and rescued through the Ipswich Koala Protection Society (IKPS). This koala was collared just prior to being released back to the wild, once he had finished treatment. Two additional koalas were sighted during fieldtrips but were not captured.

Figure 1. Koalas were given a thorough veterinary examination in the field. This photograph shows Dr Amber Gillett (veterinarian) performing an ultrasound examination, while the koala is anaesthetised. Drs Ben Barth and Bill Ellis (at right) prepare to collar the koala.

Table 1. List of koalas examined as part of the Peak Crossing koala research project (2018).

UQ Number	Name	Sex	Age class	Weight (kg)	Body condition	Left ear tags	Right ear tags	Estimated age (yrs)	Field notes
12326	**Greg**	Male	Adult	6.12	4	Light blue B9	Maroon A17	4-6	Poor condition (skinny). No sign of disease. Hind right tibia previously broken.
12327	**Lynette**	Female	Adult	5.15	7	Maroon A15	Yellow C3	7-10	Good condition, pouch empty. No signs of disease.
12328	**Sheree**	Female	Adult	4.78	5	Yellow C7	Yellow C6	5-7	Poor condition. Left eyeball previously lost. Right eye majorly inflamed. Rump damp and stained. Treated at AZWH then released nr. Peak Crossing school.
12329	**Carrie**	Female	Adult	4.32	8	Light blue B8	Light blue B6	2-3	Good condition, unfurred pouch young (est. 2.5mths old). No signs of disease.
12334	**Hitch**	Male	Adult	6.4	7	Yellow C2	nil	4-6	Admitted to RSPCA through IKPS after being hit by car near Amberley. Collared when healed, released at Purga Nature Reserve.
12335	**Shiraz**	Female	Adult	5.48	7	UQ197	Blue B1	7-10	Good muscle mass but rump heavily stained and damp. Ultrasound exam revealed internal disease (reproductive cysts and kidney failure). Euthanised.
12336	**Bailey**	Male	Adult	8.14	7	Blue B2	UQ119	5-7	Good muscle mass but rump had minor staining.

Notes:

- Body condition was measured by feeling the muscle mass on the scapula ridge; scale 1 to 10, with 10 being the best condition
- Age was estimated from tooth wear, based on Gordon et al. 1991

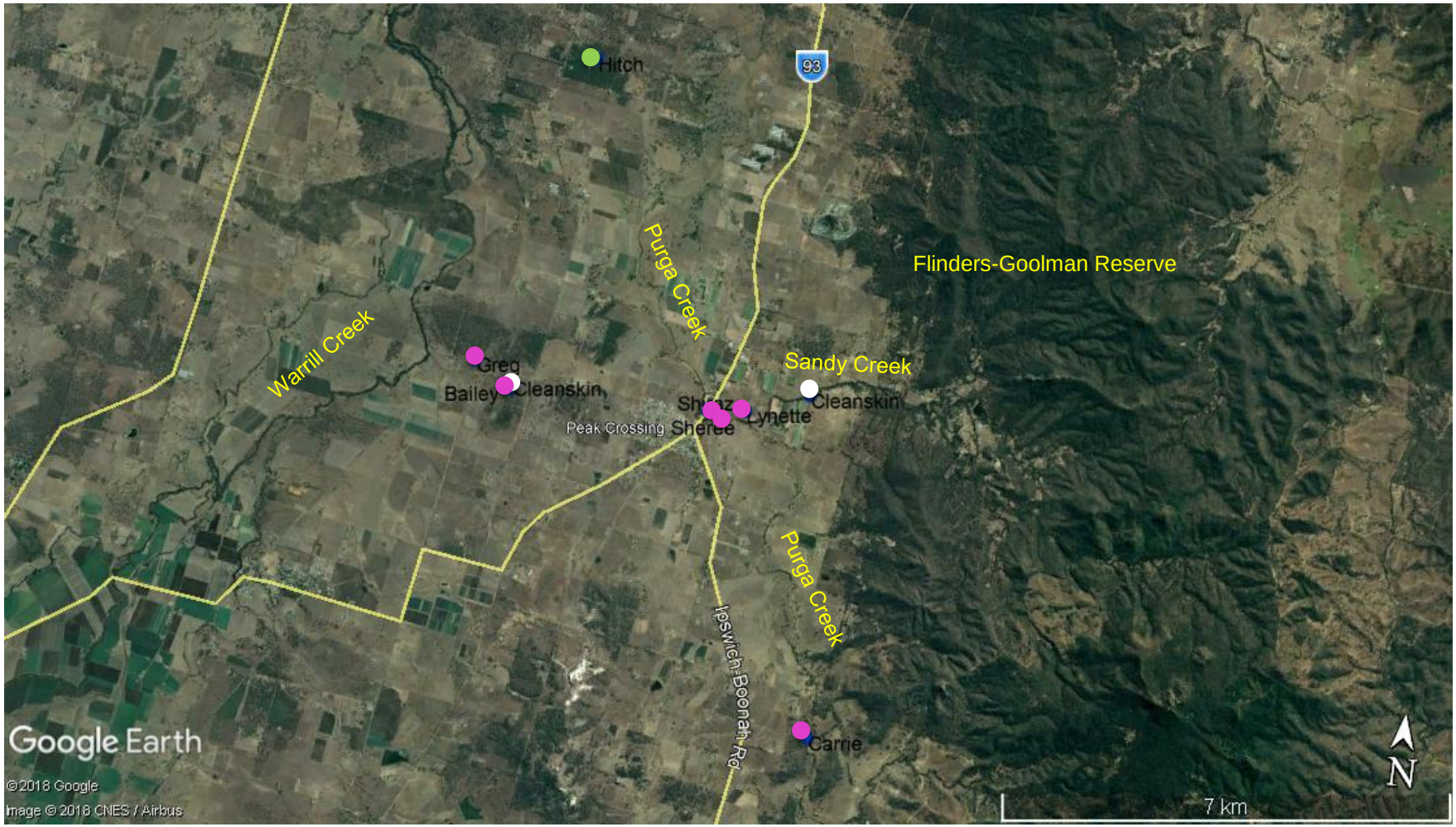


Figure 2. The location of koalas at their initial capture (pink dots) and the location of two untagged koalas ('cleanskins') that were not captured (white dots). The location shown for Hitch (the koala rehabilitated after being hit by a car) is where he was released with a collar after treatment (green dot).

Male 12326 “Greg”

This male koala was first captured on 12th March 2018 on private property (Sticky Gully Nature Refuge) along Peak Crossing - Churchbank Weir Road, opposite Webers Road *(-27.776713, 152.694380)*. He was captured from a Queensland blue gum (*Eucalyptus tereticornis*). At capture, the visual signs were good with both eyes and rump clear (see photographs below). However, his body condition was 4/10, which is considered poor. The veterinarian inspection revealed a previously broken tibia on his right hind leg. The bone had clearly healed and the koala climbed well during capture and release. Based on tooth wear, Greg was estimated to be young, at 2-4 years.

In June 2018, Greg’s collar was found on the ground at the base of a tree. The rubber weak link in the collar had ripped, suggesting the koala had become snagged and then tore free of the collar which would have fallen to the ground. The GPS data revealed he had moved 1.15 km over 15 nights (Table 2), remaining within the habitat fragment on Sticky Gully Nature Refuge (Figure 3). This fragment is largely isolated by cleared agricultural land but does connect to the west with riparian vegetation lining Warrill Creek

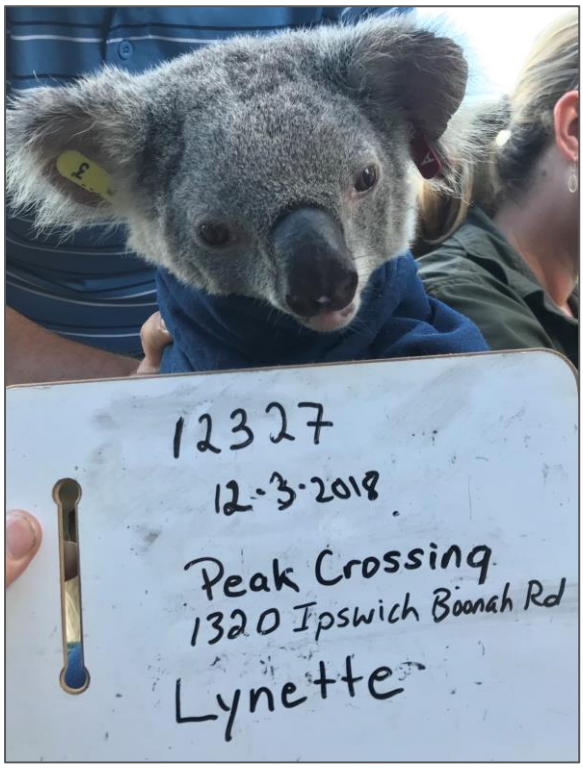
(east branch), near Churchbank Weir. Greg's home range estimate for this short period of time was estimated at 7.9ha (see Table 2 and yellow polygon in Figure 3).

Figure 3. Movement and home range estimation for Greg. The dots are the nightly locations recorded on the GPS collar, with the blue line connecting consecutive nights; the pink dot is the 1st GPS point. The transparent yellow polygon is the minimum convex polygon which represents the home range estimation.

Female 12327 “Lynette”

This female koala was captured in a large blue gum (*Eucalyptus tereticornis*) from private property opposite the Peak Crossing State School on the 12th of March *(-27.779238, 152.737771)*. The farming property was located immediately north of the junction of Sandy and Purga Creeks and contained several large blue gums around the homestead and farm shed; Lynette was found within one of these large isolated trees, approximately 140m from riparian vegetation along the creek lines.

At capture, all visual signs were of good health; both eyes and rump were clear (see photographs below), and her body score was 7/10, indicating that she was in good condition (Table 1). Her tooth wear indicated she was 7-10 years old.



On our recapture trip in June 2018, Lynette’s collar was found on the ground under a blue gum, with the weak link in the collar ripped. The collar was located approximately 350 m from her point of capture. Unfortunately, the

logged data suggested the collar fell off Lynette reasonably soon after capture, so the movement dataset was quite limited. The map of her movement shows she crossed open fields/cropping areas during the time she was collared (Figure 4). The data also recorded her in the riparian vegetation at the intersection of Sandy Creek and Purga Creek. Lynette's home range over the 10 nights she was wearing the collar gives us an estimated home range of 1.7 ha (Figure 4) and she had travelled at least 0.46 km over these 10 consecutive nights (see Table 2 and orange polygon in Figure 4).

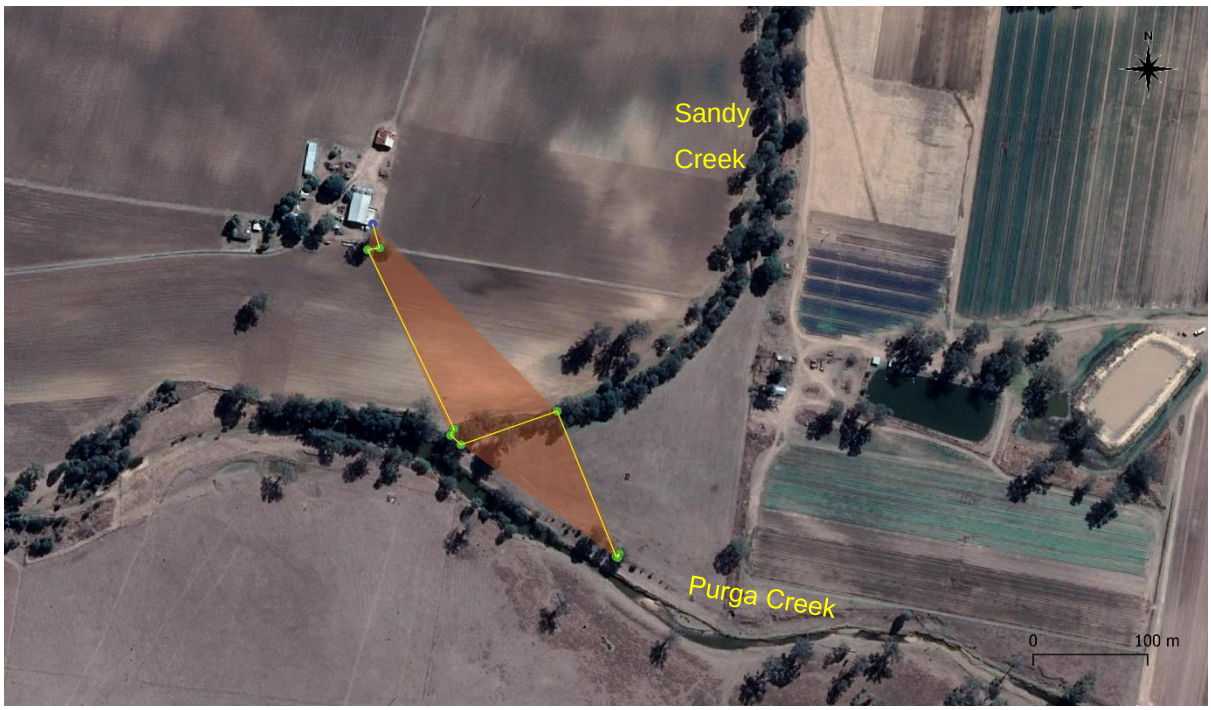
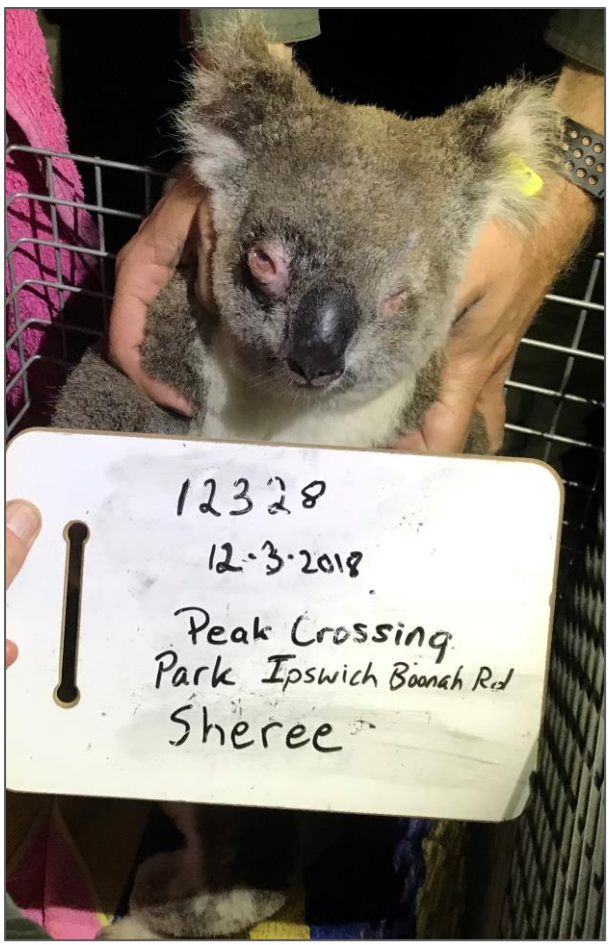


Figure 4. Movement and home range estimation for Lynette. The dots are the nightly location recorded on her GPS collar, with the yellow line connecting consecutive nights, the blue dot is the 1st GPS point. The light orange polygon is the minimum convex polygon, representing the home range estimation.

Female 12328 “Sheree”

This female koala was captured on 12th March 2018 in Peak Mountain View Park, opposite the Peak Crossing State School (-27.77988, 152.73182). She was captured from a large blue gum (*E. teretecornis*). It was immediately apparent that Sheree had major health issues. Her right eye had significant inflammation and her left eye was missing, with the socket also inflamed (see photographs below). Her rump had minor staining and was damp, indicating she was likely infected with *Chlamydia*. She had a body score of 5/10 and was estimated to be 5-7 years old. Sheree was transported in a wildlife cage to Australia Zoo Wildlife Hospital for further assessment and treatment.



After two months of antibiotic treatment, Sheree's right eye was no longer inflamed or infected with *Chlamydia*. Although she had previously lost her left eye, we were confident that her reduced vision would not pose a major impediment to her survival in the wild. We (the Koala Ecology Group) have previously monitored other koalas with one eye and found that they coped fine in the wild. Although their visual perception would undoubtedly be reduced, these koalas maintained weight and body condition. As such, the decision was made to return Sheree back to where she was originally captured.

Sheree was returned to Peak Mountain View Park on 11th May 2018, by Felicity Shapland from QTFN. Felicity liaised with staff at the Peak Crossing State School so that Sheree's release was observed by a class of students. The students learned about Sheree's situation (being sick and located close to a busy road) was used to educate the students about the challenges that koalas face and how the local community can help protect them.

Prior to release, Sheree was fitted with a slightly different collar that recorded her location far more frequently (every 30 minutes from 6pm to 6am). Her collar only remained on for eight days but still logged a detailed movement dataset. It revealed that Sheree remained in Peak Mountain View Park for several days, before moving from across Ipswich-Boonah Road into the grounds of Peak Crossing State School. She was also sighted by the students on at least one occasion, who were able to identify her from the collar and ear tags. Her collar was retrieved from the school grounds, having torn free at the weak link. While wearing the collar Sheree moved 1.12 km and had an estimated home range of 1.75 ha (see Table 2 and aqua polygon in Figure 5).

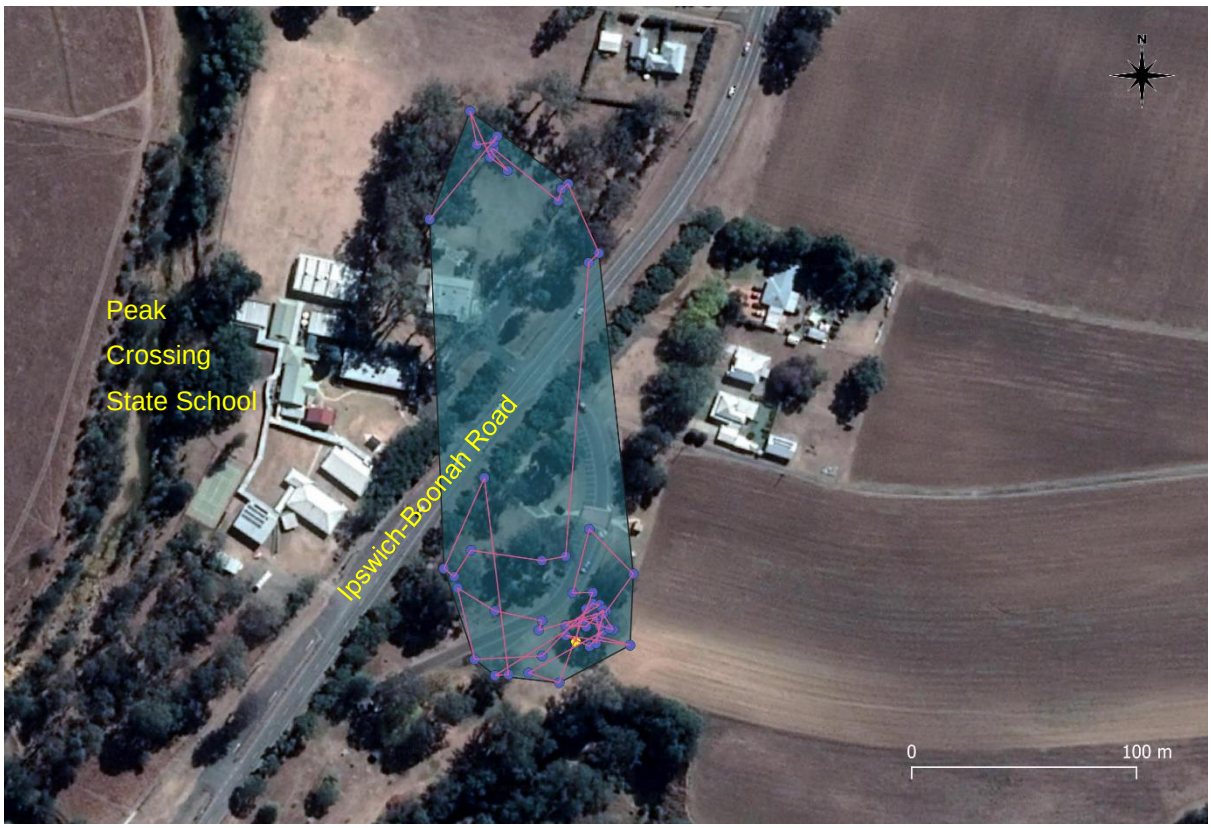


Figure 5. Movement and home range estimation for Sheree. The dots are locations recorded on her GPS collar, with the pink line connecting consecutive locations. The yellow dot is the 1st GPS point, at her release location after treatment. The transparent blue polygon is the minimum convex polygon which represents the home range estimation. Note: Sheree's collar dataset was filtered to retain all high accuracy locations.

Female 12329 "Carrie"

This female koala was captured on 13th March 2018 on private property off Ipswich-Boonah Road (-27.82349, 152.75386), from a spotted gum (*Corymbia citriodora*). Carrie was located within a small patch of trees dominated by spotted gums, on a gentle slope that ran down to riparian vegetation along Purga Creek. She was found to be in good condition with a body score of 8/10. Her eyes were clear and the rump showed no signs of disease (see photographs below). The veterinary examination did not reveal any significant health issues. Further, Carrie was found to be carrying a small, unfurred pouch young that was estimated at 2.5 months of age.

In June, Carrie's collar was found on the ground with the weak link torn. It had remained attached for approximately 13 days. During that time, she did not move far, totalling just 615 m with an average of 51m per night (Table 2). Her collar was found only 100 m from her point of capture. She had an estimated home range of 1.95 ha over the 13 days the collar was attached (Table 2 and purple polygon in Figure 6). The location of her fallen collar revealed she had spent time in the riparian vegetation on Purga creek, which was dominated by

blue gums, but the data show that for most of the time she remained on the slope above the creek, where spotted gums are the dominant tree species (Figure 6).

Figure 6. Movement and home range estimation for Carrie. The dots are the nightly locations recorded on her GPS collar, with the yellow line connecting consecutive nights; the red dot is the 1st GPS point. The transparent purple polygon is the minimum convex polygon which represents the home range estimation.

Male 12334 "Hitch"

Prior to the commencement of the Peak Crossing koala study, this male koala was hit by a car on the Cunningham Highway near Amberley and then rescued through the Ipswich Koala Protection Society (IKPS). Hitch was admitted to the RSPCA for treatment of a broken hind leg on the 10th September 2017. At the time he was an otherwise healthy male, weighing 6.4kg. After an extended period of time in care, he was considered to be suitably recovered to be returned to the wild. The timing and location of his release coincided with our study and provided the opportunity to collaborate with IKPS and monitor Hitch after his release. He was released in the Purga Nature Reserve on the 11th of June 2018 with a GPS collar.

Hitch was recaptured on the 23rd November 2018 to remove his collar. He was in excellent condition; he weighed 7.6kg and his body score was 9/10 (he was 7/10 at release in June 2018). He had bulging muscles over his scapula ridge/shoulder blade (see photograph above). His rump was clean and dry, and his eyes were clear. Despite Hitch's previous car-strike injury he climbed well at recapture. His behaviour and physical condition showed he had made an excellent recovery following this accident.

Hitch's tracking data revealed he travelled 3.2 km over the 28-day period that the collar logged his movements; his home range during that period was estimated at 20.7ha (see Table 2 and blue polygon in Figure 7). His recapture location was on private property 1.1 km from the point of release in Purga Nature Reserve (Figure 7). The collar was not recording GPS locations at the time of recapture (battery was depleted). His movements revealed he had crossed Middle Road at least once following his return to the wild. Although the vegetation in the area of Hitch's capture location was fragmented, it did connect to the Purga Nature Reserve and Purga Creek (to the east) and the riparian vegetation along Warrill Creek (to the west).

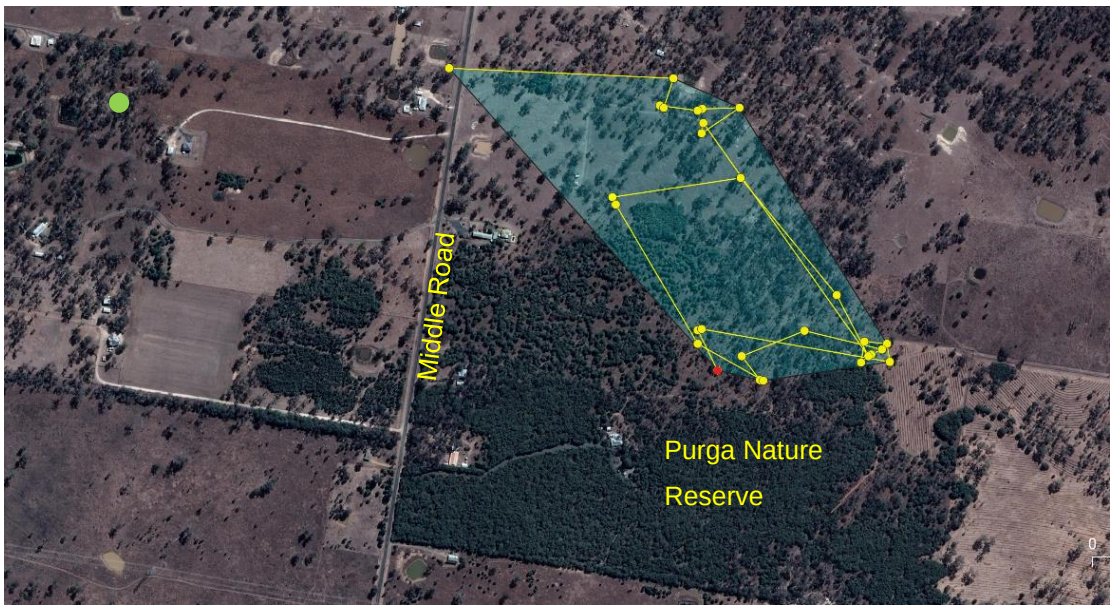


Figure 7. Movement and home range estimation for Hitch. The dots are locations recorded on his GPS collar, with the yellow line connecting consecutive locations; the red dot is the first GPS point, near his post-treatment release location in Purga Nature Reserve. The transparent blue polygon is the minimum convex polygon which represents the home range estimation. The green point to the left of the map is the final capture location (the collar was not recording at this time).

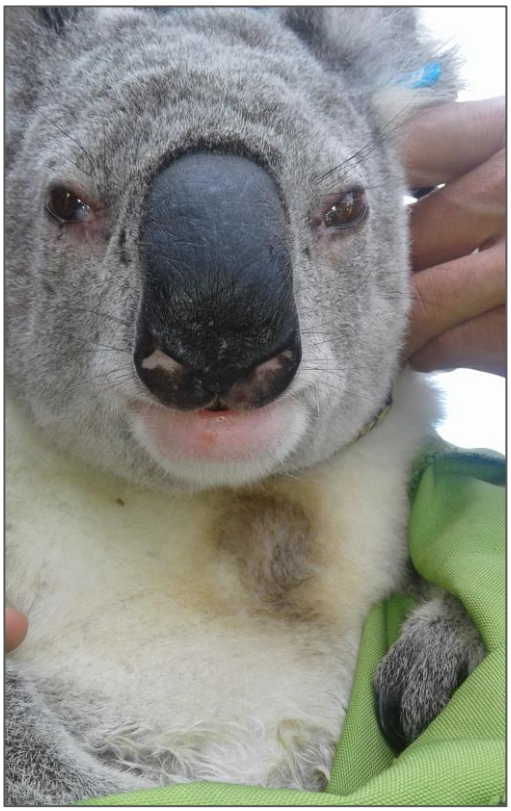
Female 12335 “Shiraz”

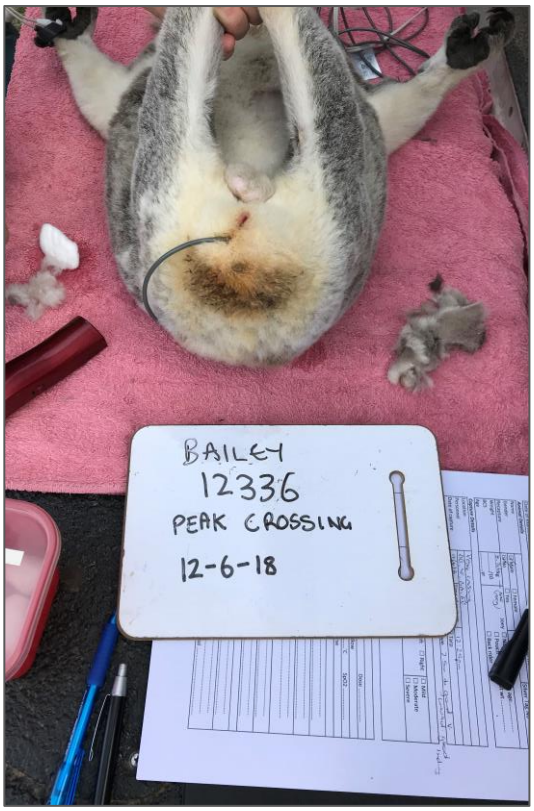
This adult female koala was captured on 12th June 2018 in Peak Mountain View Park, opposite the Peak Crossing State School (-27.77970, 152.73217). She was captured from a yellow box (*E. melliodora*). Unfortunately, Shiraz had a heavily stained, damp rump (see photograph below), which is generally indicative of cystitis (chlamydial infection of the bladder/urogenital tract). During the ultrasound examination (see photograph below) the veterinarian found that Shiraz had cysts in her reproductive tract (specifically, the ovarian bursa). This is not uncommon among female koalas that have urogenital tract chlamydial infections. Sadly, the presence of cysts means that the koala was no longer capable of reproducing. Under current Queensland Government legislation, the veterinarian was required to euthanise Shiraz because infertile koalas are not permitted to be returned to the wild. In addition, the ultrasound exam revealed that Shiraz had severe kidney disease. She was estimated to be between 7-10 years of age.

Although it was extremely disappointing to see Shiraz euthanised, the reality is that she would have continued to suffer and endure a slow, painful death as a result of her diseased condition, had she not been caught. Worse still, she may have transmitted her chlamydial infection to males if they attempted to mate with her.

Male 12336 “Bailey”

This male koala was captured near Peak Crossing-Churchbank Weir Road on private property (-27.7801217, 152.7001451). He was captured from a blue gum (*E. tereticornis*). Bailey had minor staining on his rump, but it was dry, and both eyes were clear. He was otherwise in good condition with a body condition score of 7/10. The decision was made to collar Bailey and to reassess his health upon recapture in 1-2 months.





Unfortunately, we were unable to locate Bailey following his initial capture. Despite repeated visits to the area by Bill Ellis (KEG) and Felicity Shapland (QTFN), the collar VHF transmitter signal was unable to be detected. The collar was checked at release and a signal was recorded by QTFN during a radio-tracking session approximately one week after release. It is possible that the collar malfunctioned after that time, or that it was damaged while on the koala (e.g. during an aggressive koala interaction). Because the collar signal could not be detected it was not possible to obtain the data logged on the GPS. However, the weak link on the collar would have broken down and after a few months, allowing the collar to fall free if it was still on the koala.

Cleanskin koalas

In addition to the collared koalas, two further koalas were observed but not captured; for this reason they are referred to as ‘cleanskins’. One of these was a male koala in a very large blue gum, located in the thin riparian strip along Sandy creek to the east of Peak Crossing, (-27.77595, 152.74761) (Figure 2). His rump appeared to have major staining, indicating he was likely had a chlamydial infection. His eyes were noted to be clear. The second cleanskin was in a paddock to the west of Peak Crossing in a blue gum, near the koala Bailey (-27.77943, 152.70059) (Figure 2). This female koala also appeared to have a stained rump, again possibly indicating a chlamydial infection.

Home ranges and movements of study animals

Movement metrics and short-term ranges were calculated for five koalas (Table 2). Unfortunately, the datasets obtained for each koala were quite limited, and considerably smaller than anticipated. It was expected that for each koala, between 30 – 60 days of movement would be logged on the collars. However, several of the collars tore at the weak links and fell off the koalas not long after attachment. As such, movement datasets mostly ranged between 8 – 15 days. It is very unlikely that the true extent of a koala's home range size and movements would be recorded over this short time period. Despite this, the GPS loggers still provided some interesting insights into the movement of koalas in the Peak Crossing area.

Table 2. Movement metrics for collared koalas. The short-term home range estimates were calculated using the 100% Minimum Convex Polygon (MCP) ^.

Koala	Days with collar	MCP (ha)	Total Distance (km)	Mean overnight distance (m)	Max. overnight distance (m)	Notes
Greg	15	7.93	1.15	82	220	Remained within forested habitat patch; collar found on ground
Lynette	10	1.73	0.46	50	173	Crossed large areas of open cropping land; collar found on ground
Sheree	8	1.75	1.15	59*	160*	Crossed open ground near school and Ipswich-Boonah Road; collar found on ground.
Carrie	13	1.95	0.62	51	153	Crossed some open areas but largely remained in forested patch; collar found on ground
Hitch	28	20.7	3.16	113	505	Crossed Middle Rd and some semi-open areas with scattered trees.

*To ensure a consistent comparison, the data from Sheree's high fix collar schedule were re-analysed to include only one fix per night in the calculation of these metrics.

^Home range values presented here are based on short monitoring periods, so they are likely underestimates of true home ranges. Home range estimates vary greatly depending on the method of calculation and the time frame over which they were collected; for an example see Goldingay and Dobner (2014). Care should be taken when comparing these absolute values to other sources of data.

Perhaps the most notable finding from the movement plots (Figure 3 – 7) was that many of the koalas crossed reasonably large stretches of open ground, and sometimes roads, in the short periods that they were monitored. This finding is supported by our research in other predominantly agricultural landscapes where koalas have regularly been recorded walking >50-100m through pasture/cropping land to access trees. This behavior is undoubtedly a result of the highly fragmented nature of habitat in agricultural landscapes such as at Peak Crossing. In fragmented landscapes koalas are often forced to spend considerably more time on the ground than they are in well-forested areas. This is because required resources (food trees, shelter trees, potential mates) are far more spatially scattered. The movement plot for female koala Lynette (Figure 4) highlights this issue; although relatively few points were logged for Lynette, she was recorded to cross a large area of cropping land (>100m wide) to access the thin strip of riparian vegetation along Sandy Creek (Figure 8). In contrast, Greg's movement plot (Figure 3) revealed he was one of the only koalas that remained entirely within a well-forested area while he was monitored.

Figure 8. View from the tree where Lynette was initially captured, showing the pasture and cropping land (soy) that she was recorded crossing to reach the riparian vegetation along Sandy Creek (visible 140m in the distance).

Aerial imagery of the Peak Crossing district highlights that much of the remaining koala habitat is fragmented by cleared paddocks and agricultural land, roads, housing and other infrastructure. Most koalas living in this predominantly agricultural landscape will likely have to traverse these non-habitat areas, on the ground, as part of their normal ranging movements or during dispersal. At these times koalas are extremely vulnerable to predation by dogs (wild and domestic) and to being hit by vehicles, especially on roads with higher speed limits. The threat posed by dogs and vehicles to koalas are ubiquitous in heavily developed regions (Dique *et al.* 2003a; Dique *et al.* 2003b). In addition, cattle trampling has emerged as a previously unknown threat to koalas in agricultural areas, although the extent of this is yet to be quantified.

Given their vulnerability when on the ground, there would likely be enormous benefit to the local koalas if further habitat restoration work was conducted along bare stretches of Sandy and Purga Creeks. Figure 9 provides an example of a bare stretch of Sandy Creek where koalas would be required to traverse open ground between scattered trees. Restoration works in these areas would benefit a suite of other species and serve to reduce soil erosion.

Figure 9. Ben Barth (UQ KEG) and Felicity Shapland (QTFN) examine a bare stretch of Purga Creek at Peak Crossing.

On average, koalas moved a total of 50-100m per night. However, as this was measured as a straight line (Euclidean) distance between points, it is likely an underestimate. The maximum overnight movement was recorded by Hitch, who moved 505m. In previous studies, koalas have been known to move several kilometres in a single night (e.g. when dispersing). But in SEQ, they tend to move only short distances each night in an established home range. The home range estimates produced in this study were smaller than previously published accounts from SEQ and northern NSW, but this was not surprising given the short monitoring periods. For example, in the Redlands (Qld), koala home ranges were estimated to be between 2.8 – 38.4 ha (de Oliveira *et al.* 2014) and in north-western NSW, koalas were found to have home ranges between 1.1 – 107.2 ha (Kavanagh *et al.* 2007). These estimates were derived using the same method (100% MCP estimator), though both studies were conducted over a far longer time period than the present study. Home range size and koala movement is influenced by multiple biotic and abiotic factors, such as the season (breeding v non-breeding), age, sex and condition of the individual, as well as the availability and spatial configuration of resources (food and shelter trees, potential mates).
It is also evident from aerial images that show property boundaries that a significant portion of remaining koala habitat in the Peak Crossing district is located on private property. This means that effective koala conservation and habitat restoration will best be achieved by working with private landowners, especially along the creek lines. This challenging task is made more possible due to the general goodwill that most people have towards koalas and towards improving their plight.

Tree species utilisation

Although there were relatively few opportunities to observe tree use during the study, koalas were found in blue gums (*Eucalyptus tereticornis*) on seven of nine observations (78%). On the other two occasions, the koalas were found in a spotted gum (*Corymbia citriodora*) and a yellow box (*E. melliodora*). Blue gum is the only one of these three species that is a highly preferred fodder species. It is a commonly utilized koala food tree at a range of sites across Queensland (Melzer *et al.* 2014).

Disease prevalence

Four of the six (67%) wild-caught koalas examined during the study returned positive swabs for *Chlamydia* (Table 3). The highest chlamydial load was detected from Shiraz's urogenital tract swab, which exceeded 3 million copies. This was not surprising given that Shiraz had a heavily stained rump suggestive of a serious chlamydial infection. Similarly, Bailey returned a positive urogenital tract swab, which was also expected given that he had some minor staining on his rump. However, Bailey's chlamydial load was relatively low, at less than 2,000 copies. Neither Shiraz nor Bailey returned positive swabs from their eyes.

Table 3. Laboratory results for the Quantitative Polymerase Chain Reaction testing for *Chlamydia pecorum* for the koalas examined as part of the study.

Koala	Date	Sample location	*Chlamydia pecorum*	Copies/mL
Greg	12/03/2018	Left eye	Negative	
	12/03/2018	Right eye	Negative	
	12/03/2018	Urogenital	Negative	
Lynette	12/03/2018	Left eye	Negative	
	12/03/2018	Right eye	Negative	
	12/03/2018	Urogenital	Positive	30,615
Sheree	12/03/2018	Left eye	Negative	
	12/03/2018	Right eye	Positive	2,359
	12/03/2018	Urogenital	Positive	<100
Carrie	13/03/2018	Left eye	Negative	
	13/03/2018	Right eye	Negative	
	13/03/2018	Urogenital	No result	
Sheree	2/05/2018	Left eye	Negative	
	2/05/2018	Right eye	Negative	0
	2/05/2018	Urogenital	Negative	0
Shiraz	12/06/2018	Left eye	Negative	
	12/06/2018	Right eye	Negative	
	12/06/2018	Urogenital	Positive	3,153,478
Bailey	12/06/2018	Left eye	Negative	
	12/06/2018	Right eye	Negative	
	12/06/2018	Urogenital	Positive	1,769

For each of these koalas (Bailey and Shiraz), the swab test results were in accordance with the visual assessments of their health (i.e. uninfected eyes that appeared clear/non-inflamed, infected rumps that appeared stained). This is not always the case with koalas. For example, Lynette's eyes and rump were clear/non-inflamed and her body score was 7/10; all the physical evidence suggested she was a perfectly healthy koala. However, as seen in Table 3, Lynette returned a strong positive swab sample from her urogenital tract, revealing she has a serious chlamydial infection (>30,000 copies). This highlights the importance of thorough disease testing and veterinarian examinations. Lynette's infection may have been the reason that she was not carrying a pouch young.

In most instances, infections such as Lynette's tend to lead to disease (chlamydiosis) and eventually death, unless they are treated in captivity. Unfortunately, treatment is not a quick process and usually requires the koala to be in care for at least four weeks, receiving daily antibiotic injections. But as shown with Sheree, treatment can be highly successful and may add many reproductive years to a koala's life. Sheree returned positive swabs from both her right eye and urogenital tract, but these sites were negative when re-tested after antibiotic treatment (Table 3).

Only Carrie and Greg tested completely negative for *Chlamydia.* Although the study sample size is small (six wild koalas) it does suggest that chlamydial infection and associated disease is a major issue for the conservation of koalas in the Peak Crossing region. The infection statistic becomes considerably worse (up from 67% to 80%) if it is assumed that the two uncaught cleanskins were both infected with *Chlamydia* (they each had stained rumps).

Chlamydial infection is considered one of the major threats to koala populations in Queensland (Rhodes *et al.* 2011). Chlamydiosis is generally a disease infecting the eyes, urinary tract and reproductive tract, which is spread through close contact between koalas. If left untreated, it can cause conjunctivitis, blindness, thickening of the bladder wall (resulting in a painful leaking bladder), cyst formation in the reproductive tract, sterility and, in severe cases, contributes to the death of an individual (Polkinghorne *et al.*

2013). While disease is present in most populations of koalas in Queensland, the prevalence varies markedly between populations (Grogan 2017, Grogan et al. 2018). The level of infection in the Peak Crossing population would be considered high when compared to other SEQ populations.

A systematic approach to assessing and treating chlamydial infection and disease has been suggested as the best approach to conserving affected populations, rather than the haphazard or opportunistic approach that is currently widely implemented (Wilson *et al.* 2014). However, a strategic approach would come at significant expense as it would be time-consuming and labour-intensive.

Conclusions and Management Recommendations

This project provides a preliminary examination of the health status and movement of koalas in the Peak Crossing district. The two main findings from this research are summarised here.

Firstly, the study results suggest that habitat fragmentation is likely a significant issue for koalas in the area. Despite the short monitoring periods, several of the koalas were recorded crossing open paddocks, cropping land and roads. At these times they are highly vulnerable to vehicle strike and dog attack. It is possible that further land clearing on private properties may exacerbate the fragmentation of remaining koala habitat. As in other areas of South East Queensland, the protection of koala habitat in rich agricultural landscapes is an immense challenge, especially where that habitat occurs on private land. Effective protection is best achieved through local government Councils, as they regulate most local development and planning matters. Similarly, where possible, the local Councils should seek to undertake and/or promote koala habitat restoration, especially along Sandy and Purga Creek lines. The riparian vegetation along Sandy Creek appears to be more dense and continuous than along Purga Creek. This is fortunate as Sandy Creek links directly to the Flinders-Goolman Reserve east of Peak Crossing. This large forested reserve likely serves as an important source of dispersing koalas that can move along, and live within, the Sandy Creek corridor. In comparison, many stretches of Purga Creek are sparsely vegetated in the Peak Crossing area (e.g. north-west and east of the state school). There appear to be many opportunities to plant koala food trees (ideally *E. tereticornis*) and shady shelter trees (e.g. river oak *Casuarina cunninghamiana*) in bare stretches of the creek (Figure 10), provided that the landowners are willing to support/allow this action. This restoration could be achieved by third parties or by incentivizing the landowners to undertake the work themselves, and by pointing out the many other benefits e.g. bank stabilization/reduced erosion.

Regardless of how it is achieved, habitat restoration should be targeted at linking up larger areas of habitat wherever possible. Riparian vegetation along creek lines is often very narrow, but even single tree rows can be frequently

utilized by koalas. These riparian strips serve as habitat in their own right (where koalas can live and establish home ranges) but also as linkages to other habitat areas for dispersing koalas. Even isolated, scattered food and shelter trees (a.k.a. paddock trees) are of value to koalas, but the more connected the trees are, the less time koalas will need to spend on the ground where they are vulnerable.

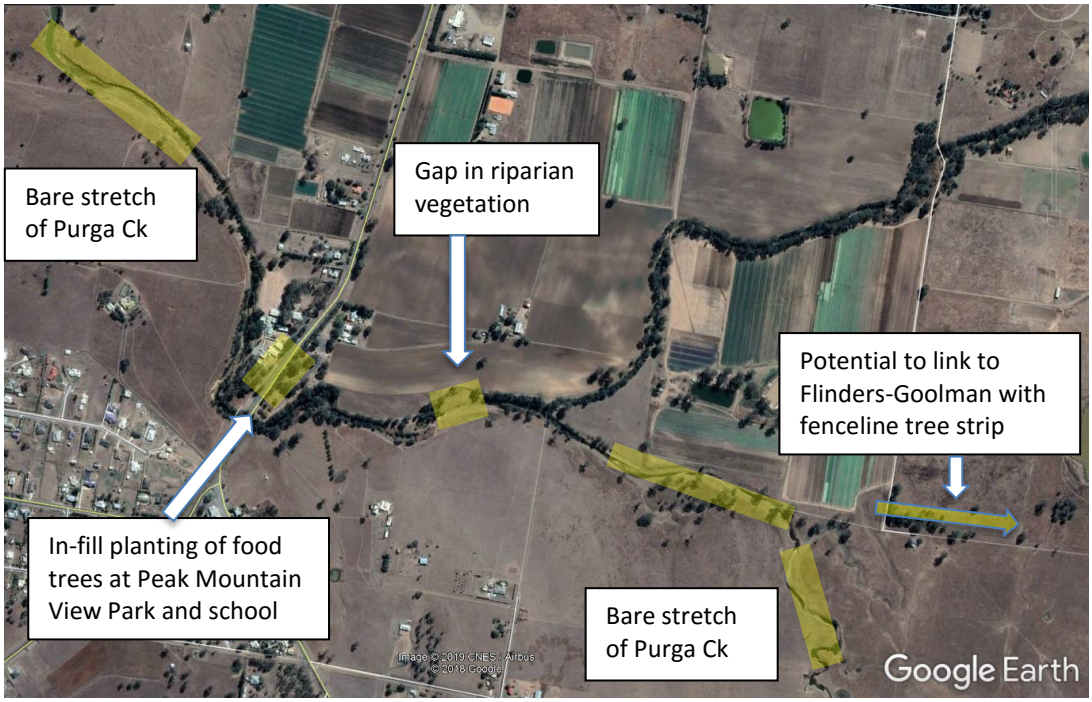


Figure 10. Suggested areas to target for koala habitat restoration in the vicinity of Peak Crossing, using mixed species plantings (food and shelter trees).

The second major finding from the study is that there appears to be a high level of chlamydial infection in the population, based on the results from our study sample. *Chlamydia* is a bacterial pathogen known to cause various diseases in affected koalas, and which often leads to infertility and eventually death. Infected koalas can live with *Chlamydia* for many years, which facilitates the spread of this sexually-transmitted bacteria. For this reason, it is very difficult to eliminate *Chlamydia* from an entire population. The most effective approach is to conduct systematic surveys to identify and treat infected koalas, however, this is a time-consuming and costly approach. Alternatively, koalas can be identified and treated opportunistically, as

generally already occurs throughout much of SEQ through wildlife rescue and care networks (e.g. residents reporting sick koalas). Although less effective at reducing the impact of *Chlamydia* on the entire population, there is still merit in opportunistically treating infected individuals. This approach will still reduce overall prevalence of *Chlamydia* and increase the likelihood of mature females producing healthy young. We strongly recommend that such efforts to treat sick koalas are continued in the Peak Crossing district, as chlamydial infection is likely to be a significant issue for the future conservation of koalas.

Treatment of sick koalas usually relies on members of the public noticing the animal and reporting it to rescue groups, such as the Ipswich Koala Protection Society. Efforts to improve community awareness around this issue are therefore important. Ideally, support should be provided to wildlife rescue and care networks that undertake this important work, often at considerable expense to the individuals that volunteer their time in these roles.

This study has revealed that there is still a reasonable koala population at Peak Crossing, with individuals living along riparian habitat strips and within loosely connected habitat fragments away from creek lines. Specifically, we advocate for enhanced protection of this population through 1. Habitat protection and restoration, and 2. Management of sick/injured koalas, especially those affected by chlamydial infection. Ideally, the protection and restoration of koala populations and koala habitat within the Peak Crossing district should be guided by an overarching management plan, which places this koala population within the context of the broader populations surviving within the relevant local government areas.

The challenges to koala conservation that this short research project has identified are problems faced by koala populations throughout SEQ and more broadly across Queensland and New South Wales (Department of Environment & Climate Change NSW 2008; Goldingay and Dobner 2014). Below are some general recommendations arising from the research project and experiences elsewhere, to assist koala conservation in the region.

General koala conservation management recommendations:

1) Design and implement a plan to manage and treat infectious disease (incl. *Chlamydia*) within the Peak Crossing koala population;
2) Protect existing koala habitat in the district and broader landscape, targeting areas of highest value (e.g. well-connected areas, extensive habitat patches, riparian corridors);
3) Implement a revegetation plan to increase the amount of koala habitat in the landscape and improve habitat connectivity, where possible;
4) Engage with local landowners to increase their awareness of koalas and ways that they can contribute to koala conservation (incl. responsible dog ownership, planting of koala food trees);
5) Implement measures to mitigate koala fatalities on roads (e.g. exclusion fencing, reduced speed zones, improved lighting, signage, traffic-calming road designs).

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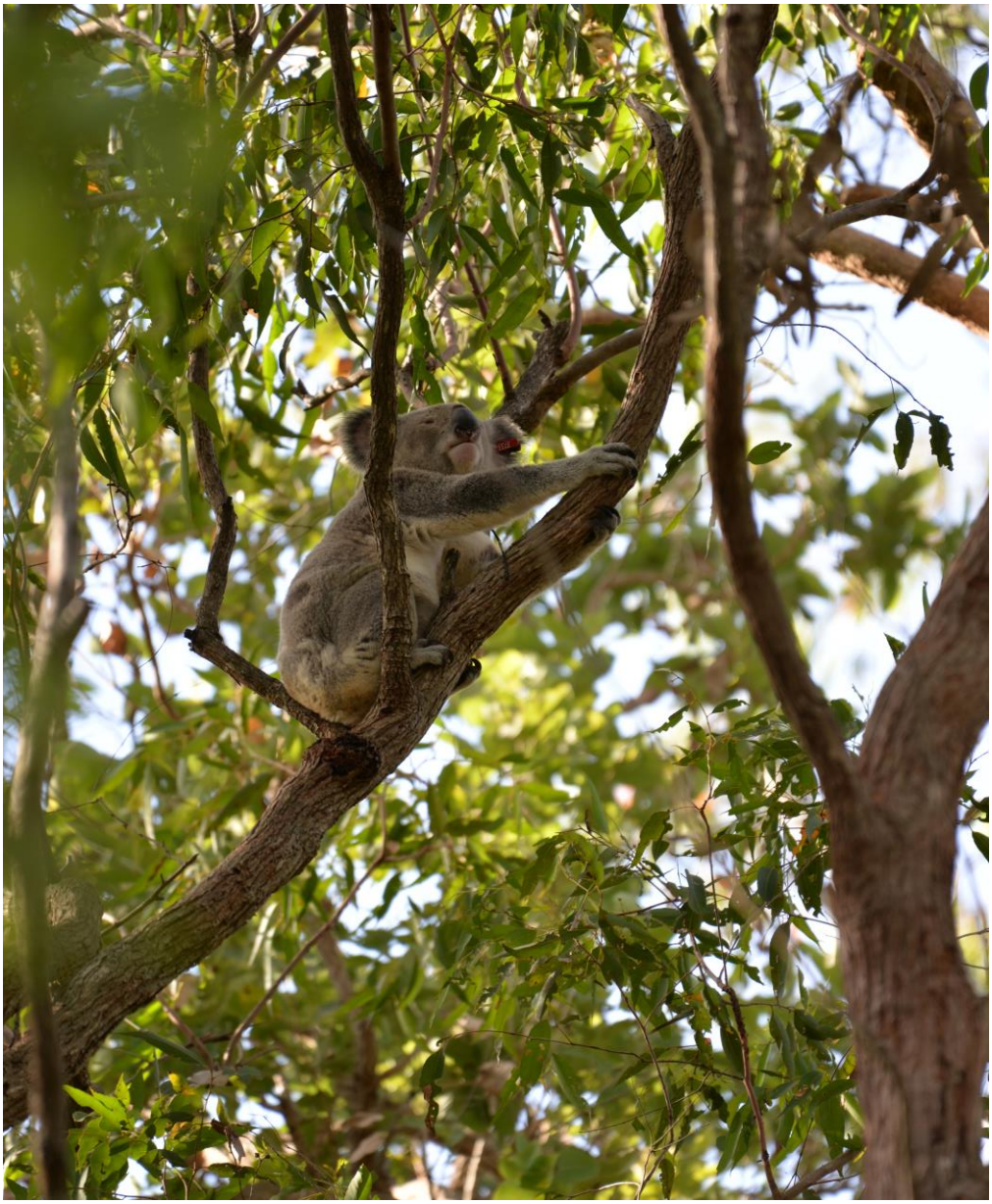

Photo courtesy of Angela Bell

SURVEY REPORT
ARATULA KOALA STUDY

Prepared by

OWAD Environment

for

Scenic Rim Regional Council

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Report Title: Survey report − Aratula Koala study

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Project Summary: This report presents the survey results of a study into Koala presence/absence at Aratula, Scenic Rim Regional Council Local Government Area, using certified Koala scat detection dogs and non-invasive sampling of Koala genetic material sourced from Koala scats.

Document preparation and distribution history

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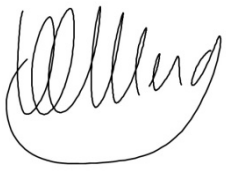

Olivia Woosnam
Director
Date: 12/11/2017

SURVEY REPORT − ARATULA KOALA STUDY

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1.0 BACKGROUND

1.1 Purpose of this report

OWAD Environment was engaged by Scenic Rim Regional Council (SRRC) to assess a selection of properties in Aratula, Queensland, for presence/absence of Koala *Phascolarctos cinereus*.

Potentially viable genetic material was selectively sampled and sent to WildDNA, the specialist laboratory at Federation University Australia. Viable samples will be analysed to determine the number of unique individuals sampled, their gender, and determine presence/absence of *Chlamydia* and Koala retrovirus KoRV-A in those individuals.

This report presents the methods used for the field assessment, the survey effort achieved, the collection and handling procedures of genetic material, and the locations where samples transferred to WildDNA were collected.

It is understood that SRRC is currently discussing with State government authorities the possibility of implementing strategies to reduce or minimise wildlife roadkill in Aratula. This report may be used to inform these discussions.

1.2 Subject properties

Eleven properties were searched, identified as the following lot and plan descriptions: 2RP180596, 13RP885715, 1RP227283, 3RP227283, 7RP885728, 4SP209812, 901SP209813, 42RP229855, 43RP229855, 1RP864040 and 445CC3420 (Aratula State School).

These properties amount to a surface area of 163ha in total. All these properties are located within approximately 2.5km from Aratula's town centre, and within 1km from the Cunningham Highway. See **Figure 1** for the physical location of the subject properties.

Additionally, three road reserves were searched: adjoining Lot 1 on RP227283, adjoining Lot 1 on RP864040 and near Aratula State School (Lot 445 on CC3420).

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Subject properties (and lot and plan descriptions)

Cunningham Highway

FIGURE 1
SUBJECT PROPERTIES

Aratula Koala study

OWAD ENVIRONMENT

2.0 SURVEY METHODOLOGY

2.1 Site selection

The subject properties were selected by SRRC based on areas of interest for this project (i.e. vicinity to Cunningham Highway), and on land access. Indeed many of the subject properties are privately owned, hence permission from the owners was a prerequisite for this study.

2.1 Sampling design

The study team applied convenience sampling in order to assess the maximum amount of ground within the 2 days allocated for field assessment. Convenience sampling is a non-probability sampling technique where areas are sampled because of their convenient accessibility to the researchers. In this instance this entailed the study team accessing each property by car or by foot, and sampling each property in areas easily accessible.

2.2 Field assessment

Koala presence/absence was inferred by presence/absence of their characteristic scats. Indeed Koala scats can persist in the landscape for up to 12 months or more, providing a much more reliable indicator of Koala distribution than the location of live individuals. Moreover, one aim of this study was to collect potentially viable fresh Koala scats for analysis purposes.

In order to (1) assess a maximum amount of surface area within the two days allocated for field work, (2) find Koala scats as quickly as possible and (3) maximise the chances of finding fresh Koala scats potentially viable for analysis, the field survey was conducted with the assistance of professional detection dogs.

The field assessment was conducted by Olivia Woosnam (Senior Koala Ecologist, Certified Environmental Practitioner (CEnvP) and principal dog handler), Alex Dudkowski (Field Ecologist, CEnvP and second dog handler) and professional detection dogs Taz and Missy. The dogs and their handlers are certified by the Conservation Division of the Australian Canine Detection Certification Council (CDCC).

Olivia and Alex were accompanied by SRRC Natural Resources Officer Keith McCosh at all times for the duration of the field assessment.

This field assessment was conducted under OWAD Environment's Animal Ethics Permit for Scientific Purposes (permit № CA 2015/01/840 for “Scat surveys using detection dog”).

2.2.1 Detection dog searches

One dog was handled at a time. The detection dog was led on leash to the area to assess. The dog was then taken off lead and when prompted by the handler, scanned the ground layer for Koala scats, as well as above the ground for target scent that may be above ground level (e.g. scats fallen on rocks, stuck in branches or in bark along tree trunks).

The dog searched non-discriminatorily: it was not directed to any specific trees or tree species. The handler only gave the dog the general direction of the search. During searches, the dog was redirected/recalled/or stopped using an Acme dog whistle if required for safety reasons (e.g. near roadsides, approaching barbed wire fencing, etc), or to prevent the dog from entering properties where access was not permitted for this study. The handler kept the dog within immediate sight at all times.

The study team used two handheld GPS units (model Garmin Alpha 100 and Garmin GPSMap 78) to record the coordinates of all Koala scats sampled. The detection dogs' search tracks were recorded with a Garmin T5 dog tracking collar, which records the tracks of the dog at a rate of one waypoint every 2.5 seconds.

2.2.2 Opportunistic searches

When the detection dog was not actively searching (e.g. walking back to the vehicle with the dog on leash), the study team still paid attention to leaf litter and/or tree canopies in case scats or live Koalas were spotted. Additionally, in a few instances in this study the use of detection dogs was not warranted (e.g. few scattered trees with mown grass and little to no no undergrowth) in which case humans proceeded to searching without the dogs.

2.2.3 Quality Assurance

Field quality assurance procedures

Field quality assurance (QA) procedures are undertaken to ensure that the data collected in the field is representative of the true site conditions and is therefore valid for interpretation. QA procedures include the use of properly trained and certified (CEnvP) staff, CDCC certified conservation detection dogs and handlers, the use of appropriate scat based survey methodologies and the implementation of daily field quality control (QC) searches.

Field QC searches are conducted each day on all OWAD Environment Koala field assessments. Either the detection dog finds naturally deposited Koala scats within the first few minutes each day (typically within circa 15-20mn), in which case there is no need to deposit scats for Quality Control. Or, if no naturally deposited scats are found within the first few minutes, then a third party (the client or the Field Assistant) randomly deposits scats, ensuring the handler does not know when or where scats have been placed. When QC scats are deposited, the Field Assistant starts a chronometer (without the handler knowing) and records the time it takes for the dog/handler team to find the scats. Once the chronometer starts, the team has a maximum of 5 minutes to find Koala scats.

A QC search enables the assessment of the dog/handler team's ability to find the target scent in the specific conditions of the survey. This enables to ensure that there are no exceptional circumstances that may be disabling the dog's ability to find its target scent e.g. a scent that may be obscuring the scent of the target odour; or hindering the handler's ability to appropriately handle and communicate with the dog.

Crucially, the handler is never informed in advance where QC scats are deposited. Not disclosing this information ensures there is no bias in how the handler handles the dog on those searches. It is only after the dog/handler team has completed a QC search that the Field Assistant discloses that this was a QC search.

Field quality control search interpretation

For each QC search, there is one of three outcomes possible:

- The dog/handler team finds the deposited QC scat within 5 minutes. The location of that deposited scat is recorded as 'QC'. The QC search is marked as successful and work resumes; or
- The dog/handler team finds a naturally deposited Koala scat within 5 minutes. The location of that scat is recorded and included in the field results. The QC search is marked as successful and work resumes; or
- The dog/handler team fails to find the deposited scat or naturally deposited scats within 5 minutes[1]. The QC search would be marked as unsuccessful. In the event where a QC search were to fail, the team would stop work immediately, analyse the situation and try to identify the reason for failure. Upon identification of the potential cause, a second QC search would be immediately conducted to confirm the reason for initial failure. If the cause is successfully identified and remediated, work may resume. Should the second QC search also fail, the study team would reassess the site conditions / environmental conditions / the detection dog / sampling design / survey methodology / the handler's protocols etc. If the potential cause/s for failure cannot be quickly identified and remediated, the study team would liaise with the client. No further survey work would be conducted until the reason/s for failure are identified and remediated.

The accuracy of our detection dogs is closely monitored throughout the year. The results of each field QC search are recorded in the relevant dogs' logbook, and are available for each project upon request by the client.

2.2.4 Selection of scats for laboratory testing

Koalas typically produce 100 to 150 scats in each 24 hour period (Ellis *et al* 1998). Depending on factors such as local weather events, ecosystems, microbacterial activity, insect predation, geography, moisture, exposure to elements, Koala scats in South East Queensland can maintain some structural integrity for up to 12 months or more.

In this study however, one aim was to sample scats that may viable for laboratory testing. This meant finding and collecting fresh Koala scats that fitted the following criteria:

- Deposited up to 2-3 weeks prior to field assessment;
- Not damaged by rain/moisture/dew;
- Not damaged by fire;
- Not damaged by mould;
- Not predated on by insects;
- Surface not cracked due to prolonged sun exposure;
- Not covered in dust/dirt/debris; and
- Not significantly damaged by any other factor.

[1] This instance has never occurred to date.

Each time fresh scats were found, a careful visual inspection was performed to assess whether these scats may be in sufficient condition to be potentially viable for analysis. Only scats that were considered to have a chance of containing sufficient genetic material were collected.

Following the initial visual inspection in the field, the study team then performed a second inspection in the office. This entailed placing the scats under a spotlight, taking close up photography of the scats and then inspecting those photographs on a computer screen.

Identifying fresh scats

Fresh scats are typically dark brown to black on the outside, have a shiny surface, bright green or yellow inside, and solid to the touch. Older scats typically have a dull surface, have less color contrast between the surface and the inside, and crumble under compression. See **Plate 1** as an example.

Plate 1: Fresh koala scats (left) and old Koala scats (right)

Where bush fires occur, Koala scats can burn. This does not prevent the detection dogs from finding these scats, however burnt scats are not viable for analysis as the genetic material has been damaged. Burnt scats are typically dull and very dark/black, and unusually solid. Depending on how long the scats were subjected to fire, they can be either entirely carbonised throughout, or only the surface may have carbonised such as the example provided in **Plate 2** below. When searching in areas that have recently burned, the study team only collects scats that have not been damaged by the fire (either deposited post-fire, or scats not directly exposed to the fire).

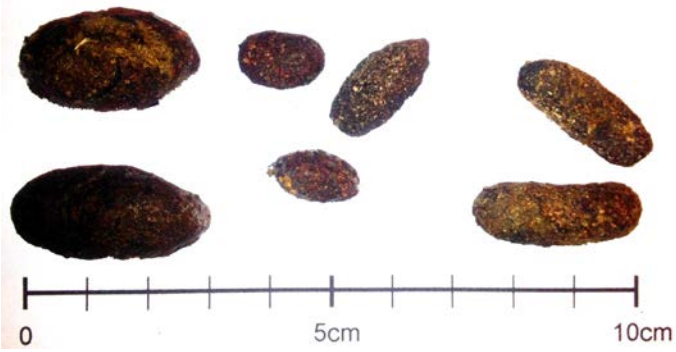
Plate 2: Burnt Koala scats

Identifying scats from potentially distinct individuals

Typically, one individual produces scats that are relatively calibrated in both shape and size. There can be significant variation in the shape and/or size of scats produced by different individuals: they can be oblong or round in shape, and can range in size from <10mm to >40mm. **Plate 3** is a typical example of the variations in scat size and shape that can be found between individuals. These variations were used in this project to estimate whether a

particular individual may have previously been sampled from a nearby location. In instances where at one location there were fresh scats potentially originating from more than one individual, these variations also assisted the study team in estimating how many distinct individuals these may originate from, in order to sample each individual in distinct scat collection kits.

Plate 3: Variations in Koala scat size and shape



2.2.5 Scat collection and handling protocol

When potentially viable Koala scats were found, their physical condition was assessed in the field. If deemed potentially viable for analysis, a sample was collected and placed in a purpose-built Koala scat collection kit (see **Plate 4**). The scats were collected from the environment using toothpicks, ensuring no direct contact with humans or the detection dogs, and minimal friction on the forest floor so as not to damage or compromise the genetic material on the surface of the scats.

The toothpicks were then securely plucked onto a piece of foam, and the foam placed and secured into a purpose-built collection kit. Where possible/available, several scats were collected and placed in each kit. The reason for collecting more than one scat per individual at each location, where possible, is that >1 scat provides several chances at extracting a sufficient quantity of sufficient quality genetic material[2] to enable laboratory testing.

The pre-affixed label of each collection kit was then completed, which included the following information:

- A unique sample code;
- Location;
- Date collected;
- Name of entity collecting the sample (OWAD Environment); and
- Coordinates (UTM zone 56 format).

[2] DNA quantity is determined by measuring the concentration (ng/µl) of DNA recovered from an individual scat. Quality of the DNA is then determined by amplifying a control site using PCR (polymerase chain reaction). Results of the quantity and quality tests together, provide a Quality Control score 'pass', 'low quality pass' or 'fail'. All samples that pass QC can be used to provide genotypic data. High quality genetic material ('pass') typically returns full analysis results. 'Low quality pass' genetic material may return partial or full results. Very low quality genetic material ('fail') is not viable for analysis.

Each kit was then placed in a paper bag. Where are one location the study team found fresh scats potentially originating from multiple Koala individuals, these were placed into distinct collection kits.

Plate 4: Koala scat collection kit

While the survey team is in the field, the work vehicle can reach high temperatures, which can rapidly deteriorate genetic material. Therefore the kits were placed in a double insulated cool container with ice packs and desiccant sachets to control both the temperature and humidity, in order to prevent deterioration of the genetic material. This storage method also prevents dissipation of the detection dogs' target scent in the vehicle.

At the end of each fieldwork day the collected kits were removed from the field container, transferred into a cardboard box with desiccant sachets and stored at ambient temperature in a cool room away from direct sunlight.

Four days after completion of the field survey, a second inspection of the scats collected was performed in the office. Upon selecting the best samples, these were then carefully packed and secured in a cardboard parcel with desiccant sachets, and posted to the WildDNA laboratory via overnight postage.

2.3 Data entry

At completion of the field assessment, the detection dogs' survey tracks and all relevant coordinates were transferred to ArcGIS format, and field notes were entered electronically. Photographs of samples sent to the laboratory were taken and saved electronically.

3.0 SURVEY RESULTS

3.1 Search effort

The field assessment was conducted over two days, on 31 October and 1 November 2017.

A total of 18.6km were searched for Koala scats, being 16km searched by the detection dogs and 2.6km searched by humans (without detection dogs).

The search tracks of both detection dogs and humans are shown on **Figure 2**.

3.2 Field Quality Control

All Quality Control searches were successful. QC scats did not have to be deposited by a third party during this project, since on both days naturally deposited scats were found by the detection dogs within minutes (being in 8mn32s on the first day and in 5mn27s on the second day). No unusual or exceptional circumstances were observed that may have impeded the dog's detection abilities to perceive and locate their target scent.

3.3 Koala scats found

Koala scats were found at a very significant number of locations, on all 11 properties searched as well as in all three road reserves inspected. A total of 58 Koala scat location coordinates were recorded (see **Appendix 1**). However in six instances the study team stopped recording each individual location due to the sheer number of trees Koala scats were present under in these areas. These six 'saturated areas' are highlighted in yellow on **Figure 2**. Indeed the purpose of this study was not to conduct a fine-scale individual tree survey, but a local landscape scale assessment.

Appendix 1 includes the coordinates of Koala scat locations recorded, as well as field notes for each of those locations. Of note, at many locations an abundance of scats was found of various ages, shape and size classes, indicating these areas are repeatedly used by more than one individual Koala.

Two Koalas were observed during the field assessment, at the locations identified as SCE02-03-04 and SCE14-15 on **Figure 2**. See **Appendix 1** for photos of these two individuals. Upon visual inspection, they did not appear to display any obvious clinical signs of disease (e.g. 'wet bottom', sore eyes). Their gender could not be determined with any certainty as the observers could not get a visual on the chest of these individuals. Scats from both these individuals were sent for laboratory testing, so provided these are viable the laboratory result will be able to identify their gender.

3.3 Genetic material collected

A total of 18 potentially viable samples were collected from the field. During the first day of field assessment however, it became apparent that the study area had experienced a storm the day prior, as evidenced by the moisture contained in the scats and on visible signs of recent rainfall on the ground. Conscious that this event may have compromised the viability

the genetic material, the study team purposely collected from the field more samples than budgeted for in this study.

Following the field assessment, the 18 samples collected were placed in a cardboard box with desiccant sachets and left to dry for a few days in order to extract a maximum amount of moisture from these samples. On Sunday 5 November 2017, all samples were retrieved from their respective kits for close reexamination under a spotlight.

3.4 Genetic material submitted for testing and analysis

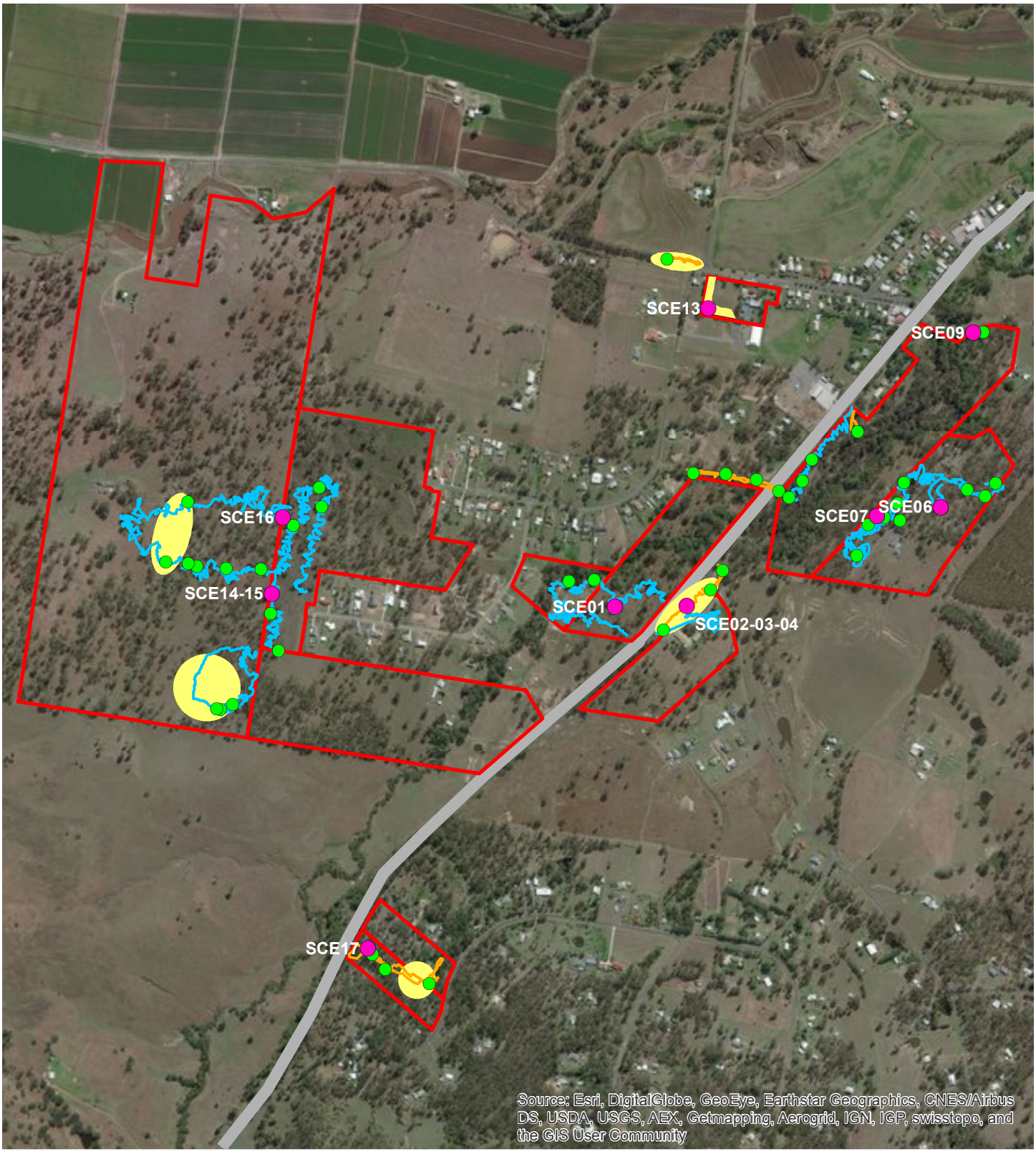
After closely re-inspecting the 18 samples collected from the field, the study team selected the 12 samples that were the least weather-affected and hence were deemed to have the best chance of being viable for analysis. These 12 samples were posted to the laboratory on Monday 6 November 2017 via overnight postage. All 12 samples arrived safely, with no scats falling from their toothpicks during Australia Post handling.

The laboratory surface-washed the 12 samples on Tuesday 7 November 2017. These surface washes will first undergo DNA quantity and quality testing. The samples that are identified as containing viable genetic material will proceed to testing for gender identification, DNA profiling and *Chlamydia*/KoRV detection.

The samples sent to the laboratory are identified with the following 12 unique sample codes: SCE01, SCE02, SCE03, SCE04, SCE06, SCE07, SCE09, SCE13, SCE14, SCE15, SCE16 and SCE17. Their locations are shown on **Figure 2**. See **Appendix 1** for photos of these samples.

Samples codes SCE05, SCE08, SCE10, SCE11, SCE12 and SCE18 which all contained fresh scats or fresh pap, were deemed too weather affected upon second inspection at the office. Being most likely not viable for analysis, these were not sent to the laboratory.

It must be noted here that due to the storm that occurred immediately prior to the field assessment, the condition of the majority of the samples sent to the laboratory was affected (see **Appendix 1** for further details). As a result, the viability of the genetic material of some of these samples may have been compromised. In some instances however, even low quality genetic material can be still tested and can return either partial or even full results.



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- Subject properties
- Cunningham Highway
- Detection dog search tracks - total 16km
- Human search tracks (without detection dog) - total 2.6km
- Koala scat samples sent to laboratory (and sample code)
- Other Koala scats found
- Areas saturated with Koala scats

FIGURE 2
SURVEY EFFORT AND FINDINGS

Aratula Koala study

OWAD ENVIRONMENT

4.0 INTERPRETATION OF FIELD SURVEY RESULTS

The findings from the field assessment indicate that there are a number of Koalas established in the area. At many locations there was evidence of regular and ongoing visitation by one or more individuals. There was also evidence of breeding, as evidenced by the presence of pap at several locations.

Koalas presence was found on every property assessed in this study, including the three road reserves assessed, and with sometimes very large amounts of Koala scats e.g. in the order of hundreds if not thousands of scats in patches.

There were signs of frequent and ongoing Koala visitation extremely close to the Cunningham Highway, as evidenced by scats as well as a live individual spotted on 31 October 2017 roosting in a tree just meters from the highway.

Note, the tree species included in **Appendix 1** should not be interpreted as an indicator of tree preference or dietary preferences in any way. Indeed the majority of areas sampled in this study have been historically cleared for grazing, and many of the ironbark species have been or still are selectively logged for use as fencing posts. This results in many of the areas assessed currently largely dominated by *C. citriodora* and *E. tereticornis*, and as a results these two species were significantly oversampled in this study compared to ironbark and other tree species. Moreover, previous research studies have demonstrated that there isn't necessarily a strong correlation between preferred roosting tree species (typically where most scats are found) and diet (Cristescu *et al* 2011).

If some of the samples sent for testing are viable, once available the laboratory report will identify how many distinct individuals these samples originate from, as well as their gender and whether they are infected with *Chlamydia* and/or KoRV. If the DNA is of sufficient quality, it will also include whether any of the individuals identified are related (parent-offspring pairs, first degree relation e.g. full siblings, second degree relation e.g. half siblings). This will provide a first insight into the health and structure of Aratula's Koalas.

With regard to the *Chlamydia* test, it is important to highlight the following:

- *C. pecorum* characteristically infects the urogenital and/or the gastrointestinal tracts and is therefore typically detectable in scats;
- A positive *C. pecorum* result does not necessarily mean that the Koala displays clinical symptoms (e.g. latent infection, as opposed to infectious particles rapidly shedding);
- The other common species of the bacterium, *C. pneumonia*, is generally located/found in the eyes and upper respiratory tract and is therefore only detectable in scats if the bacterium has spread to the urogenital and/or gastrointestinal tract;
- A positive *C. pneumonia* result typically does mean that the Koala displays clinical symptoms as the bacterium has spread from the upper respiratory tract to the urogenital and/or gastrointestinal tract; and
- A negative *Chlamydia* result does not mean that the Koala in not infected with *Chlamydia*, as either (1) the level of *C. pecorum* infection may be below the threshold for laboratory detection, or (2) *C. pneumonia* may not have spread to the urogenital and/or gastrointestinal tracts.

5.0 CONCLUSION AND RECOMMENDATIONS

The findings and observations of the field assessment reveal that a number of Koalas are present and active in all properties and road reserves assessed in this study. There was evidence of regular and ongoing Koala visitation in many of the areas assessed.

12 samples of genetic material collected during the field assessment were submitted to the WildDNA laboratory. Once viable genetic material is tested, the laboratory report will identify how many distinct individuals these samples originate from, as well as their gender and whether *Chlamydia* and/or KoRV were detected in those individuals. This will provide an initial insight into Aratula's Koala population genetics and health status. Depending on how many samples are viable, and on the subsequent laboratory results for these, it may also provide an initial insight as to whether the Cunningham Highway may currently represent a barrier to gene flow.

It is understood that Koalas struck by traffic are frequently reported in Aratula. Given the amount of evidence found during this field assessment and the current lack of fencing or safe crossing structures, it is not surprising that Koalas would regularly cross the path of oncoming traffic.

It is recommended to investigate a range of possible measures to minimise wildlife roadkill in Aratula. This could include measures such as Koala-proof fencing, designated safe crossing structures, flashing signs to make motorists aware of the presence of Koalas, reducing the speed limit over short sections of the highway, road pavement treatment, and a local communication campaign to make local residents aware that Koalas are present in Aratula.

Once control measures have been implemented, further non-invasive genetic sampling and analysis can be used to evaluate the success of those measures (for instance where the same individuals are sampled either side of a designated crossing structure, this provides evidence that these individuals are utilising the structure and that gene flow is therefore maintained/or restored).

Non-invasive genetic sampling and analysis is also a valid method to determine population size in a given area. Sampling a given area multiple times constitutes a DNA based mark-recapture sampling program from which population estimates can be estimated. Once a robust estimate has been obtained, this can be used as a basis for an ongoing population monitoring program. For instance, if/when a population size is observed to reduce over time, this can prompt investigations as to what threats are at play that are impacting the population, and how to control or minimise those threats. Alternatively, if the population is observed to increase over time this is an indicator that management measures implemented are successful and the population is recovering. Additionally, when individuals are reported dead or injured a sample of their genetic material can be obtained to determine whether these individuals were already identified in the monitoring program (through their unique genetic profile), or if not whether and how they are related to individuals already identified.

Further, even though domestic dog attacks are rarely reported in the area it is understood that such instances would likely not be reported if they did occur. This is indeed not uncommon in rural areas, however the current lack of such reports in Aratula means that the actual rate of dog attacks in Aratula is currently unknown. However, in some regions of

Australia dog attacks are known to constitute more than half of Koala fatalities. It is therefore recommended to combine efforts aimed at minimising roadkill with efforts to − in the first instance − identify whether dog attacks are a significant threat to the survival of Aratula's Koalas. Of note, during the field assessment the study team observed two roaming domestic dogs that crossed the highway and entered a property known to harbour Koalas. Strategies should be devised to promote responsible dog ownership and to encourage local residents to report dog attacks on Koalas. If dog attacks are identified as problematic, SRRC could then consider implementing a program similar to that implemented in Port Macquarie-Hastings Council specifically to reduce dog attacks on Koalas. Such programs involve basic obedience training and foster responsible dog ownership through the adequate management and control of domestic dogs in Koala habitat.

6.0 STUDY LIMITATIONS

6.1 Field survey limitations

As with any faecal pellet survey, the two major limitations of this study are pellet detectability and inferring absence.

6.1.1 Koala scat detectability

The use of purpose-trained, CDCC certified professional detection dogs greatly minimises the risk of not detecting scats when they are in fact present. Professional detection dogs and their handlers are extensively trained by a professional scent detection dog specialist; the dogs are then continuously trained and developed by their designated handlers; and the handlers and the dogs are then formally assessed to obtain CDCC certification once fully operational. In 2015 OWAD Environment conducted trials designed to test the detection abilities of a certified Koala scat detection dog/handler team in varying groundcover complexities. The team was found to have a 100% detection rate across all groundcover complexities. That is, in every single instance the dog/handler team was able to detect at least one Koala scat within 5 minutes when scats were known to be present within 100 metres or more. Vegetation structure and groundcover complexity did not affect the professional detection dog team's detection rates whatsoever[3].

Even though professional detection dogs are capable of detecting the scent of Koala scats long after they have decomposed, OWAD Environment takes the approach to always retrieve at least one scat. As a result, scats must have sufficient physical integrity to be recovered. The rate at which pellets decay can vary significantly between areas due to factors such as varying ground layer structure, composition, moisture, sunlight, local weather events, invertebrate and microbacterial activity (Rhodes *et al.* 2011, Witt and Pahl 1995).

The two professional detection dogs used in this study are purposely trained to ignore residue scent and do not indicate on scats that are so old that they have lost their physical integrity. In the occasional instances where they are correct in indicating on a certain scent threshold but exceptional circumstances have resulted in the scats having already decayed beyond recognition/or having been displaced from their original location (e.g. due to surface water flow), they are made to search further until at least one scat with sufficient integrity is recovered.

[3] These field trials were conducted in 2015 in partnership with Logan City Council and the University of Queensland. On average the detection dog/handler team found scats in 357% more instances than humans alone searching for Koala scats at the same sites. When analysing results across easy, medium and hard groundcover complexities, the dog/handler team found scats:

- in 84% more instances than humans in easy groundcover complexities (e.g. very open forest with very little to no ground vegetation or leaf litter, or mown parkland setting);
- in 1,100% more instances in medium groundcover complexities (e.g. patchy grass cover, some leaf/bark litter/branch debris, small sparse shrubs); and
- in infinitely more instances in hard groundcover complexities (e.g. thick tall grass, dense shrubs, thick leaf/bark litter/ branch debris). The dog/handler team found scats at 9 of 15 such sites; humans did not find any scats at any of those 15 sites.

6.1.2 Inferring absence

While for the purpose of this study recovering a single Koala scat is an absolute finding, failure to detect Koala scats in an area is not necessarily conclusive. That is, absence of evidence is not necessarily evidence of absence. While the risk of 'false negative' was minimised as far as possible, failure to detect Koala scats may suggest either of the following:

- Koalas are not present in the area (i.e. true absence);
- Koalas occur in the area, however scats were not detected because:
    1) no scats were deposited in the areas assessed (i.e. Koalas passing through an area without defecating);
    2) there were scats in the vicinity, however these were outside of the lands the subject of this study;
    3) scats were deposited in the past at the sites sampled, but were too decomposed for the dog to indicate (whether residue odour perceivable by the dog but trained to not indicate on, or scats deposited so long ago that even residue odour has disappeared);
    4) the dog indicated on a scat, but exceptional circumstances resulted in the scat being too decayed to be physically collected; or
    5) scats were deposited at the sites sampled, but were dispersed or obscured by exceptional physical disturbance and the dog could not locate the scats themselves as the scent was dispersed (e.g. significant surface water flow following significant rainfall).

Finally, it must be noted that as with any scat-based survey, the absence of scats at time survey does not negate the possibility of the target animal visiting the area and depositing scats in the future.

In this study, the risks of false negative were minimised by:

- The geographical spread of field searches across each subject property, conducting several searches on the larger properties;
- Using certified professional detection dogs, who are significantly quicker and more efficient at detecting and locating scats over large areas than humans alones; and
- An good search effort applied across the study area, with a total of 16 kilometres actively searched by the detection dogs and an additional 2.6km searched by humans.

During the course of this study, each indication by a detection dog resulted in the successful retrieval and identification of at least one Koala scat. There were no instances in this study where the study team identified or suspected a risk of potential false negative. Evidence of Koala presence was found in all areas investigated as part of this study, including the 11 properties and the three road reserves.

6.1.3 Data interpretation

This study provides an indication on Koala presence/absence only in the areas surveyed as part of this study. No extrapolation should be made to the greater landscape or as to the tree species under which Koala scats were found, as the ratio of tree species investigated in this study was heavily biased toward *C. citriodora* and *E. tereticornis* which are both heavily

overrepresented in this study compared to other tree species that may be present in the greater landscape.

6.2 Scat analysis limitations

6.2.1 Scat condition

The key limitation of current methods for extracting genetic material from Koala scats, is that the scats need to be relatively fresh (less than approximately 2-3 weeks old), undamaged and in good physical condition.

The methods used to isolate genetic material from Koala scats target cells on the surface of the scats. This means that a number of factors (local weather events, site conditions, mechanical action e.g. friction/abrasion, insect predation, microbacterial activity etc.) can damage the surface of scats and therefore compromise the viability of the genetic material.

6.2.2 Personnel collecting scats

There are a number of prerequisites in order for the personnel collecting scats to successfully provide the laboratory with viable koala genetic material for analysis purposes:

- *The ability to identify and differentiate Koala scats from other animal scats* −
  The OWAD Environment personnel is extremely experienced in identifying Koala scats, and their professional detection canines do not indicate on any similar looking scats that don't originate from Koala.
- *The appropriate timing for scat collection* −
  The local storm that occurred on 30 October 2017 in Aratula may have compromised the viability of the genetic material sourced from scats. Unfortunately OWAD Environment and SRRC staff managing this project were provided with erroneous information as to local weather conditions immediately prior to the field assessment, and this may affect the number of samples that will be viable for laboratory analysis.
- *The appropriate collection, storage and postage of scats* −
  OWAD Environment personnel followed the scat collection and storage procedures detailed in **Section 2.2.5**. Scat collection, storage and packing of the kits for postage was done with great care to minimise damage to genetic material from the time of collection in the field to reception by the WildDNA laboratory. There was no damage to the scats during collection, storage or transit of the samples.
- *The adequate ability of personnel to estimate the age and condition of Koala scats* −
  Assessing whether a sample may or may not be viable for analysis is paramount. OWAD Environment is highly experienced in estimating the age and condition of Koala scats, and prior to conducting this study had significant prior experience in collecting Koala scats for analysis purposes. In this study, OWAD Environment is conscious that a number of samples submitted to the laboratory were damaged by the recent rain event, despite these samples being fresh to very fresh. In an attempt to maximise the chances of obtaining laboratory results, OWAD Environment initially collected more samples than required and then proceeded to a second inspection and selection of samples for submission to the laboratory.
- *The ability to distinguish scats from putative distinct individuals* −
  Personnel collecting scats must be sufficiently experienced to determine whether various fresh scats in one location may originate from distinct individuals, as scats from distinct individuals should be placed in distinct collection kits. In two instances

in this study, OWAD Environment submitted more than one sample from the same location (SCE02-03-04 and SCE14-15) as these were considered to originate from putative distinct individuals.

6.3 Limitations of data interpretation

The interpretations provided in this report are only valid indications for the areas sampled as part of this study. The results included in this report are to be read and interpreted in conjunction with the laboratory report once available.

Once the laboratory report is available, the restricted sample size and sampling area will influence the outcomes. For instance, a greater proportion of related individuals may be detected than actually represented in the population. No advanced population analyses (e.g. gene flow, genetic diversity, identification distinct populations or subpopulations) will be able to be performed as such analyses require a larger sample base and larger sampling areas.

7.0 REFERENCES

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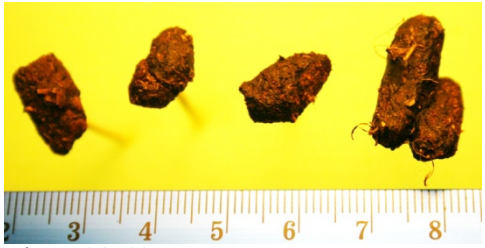
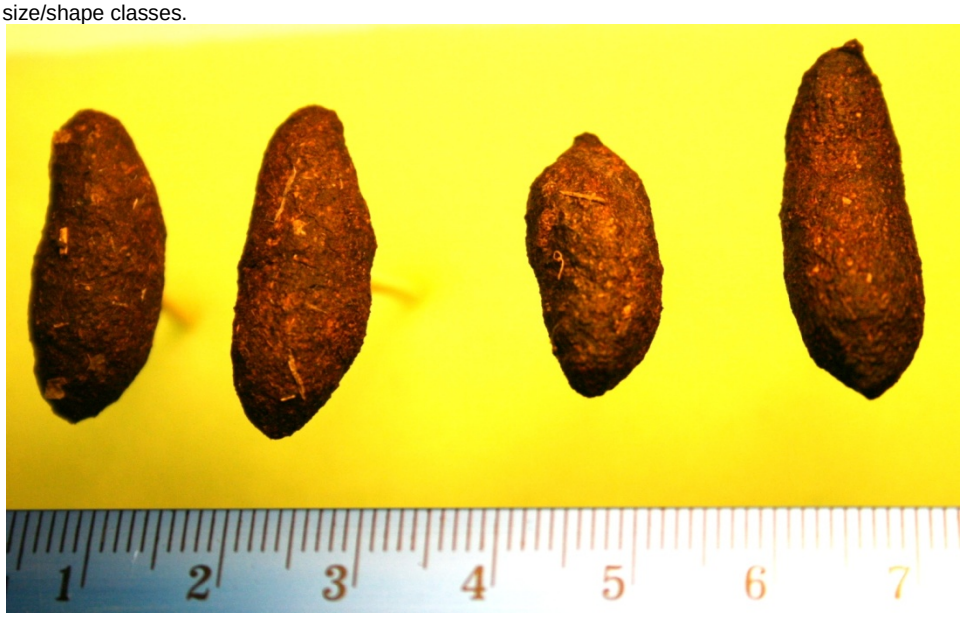
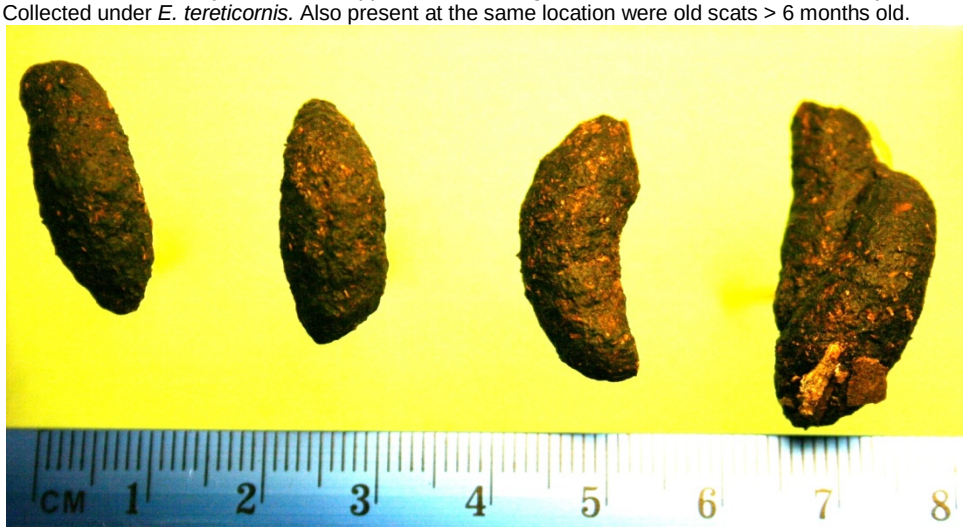
APPENDIX 1
FIELD NOTES AND PHOTOS

Point number	Coordinates (UTM zone 56)		Comments
	Easting	Northing	
SCE01	454824	6904010	Fresh scats but dull/affected by weather. Potentially still viable though, sent to the laboratory. Collected under overlapping *C. citriodora, Acacia spp.* and *E. tereticornis.* 
01	454770	6904080	Pap and scat scats < 2 months old under *E. tereticornis*.
02	454705	6904075	A few scats > 2 months old under *E. tereticornis.*
03	454949	6903951	Abundance of scats of a variety of shape/size and age classes under *E. tereticornis (/E. seeana?).*
SCE02	455009	6904013	SC02: Very fresh but dull scats/affected by weather. Potentially still viable though, sent to the laboratory. Collected under *E. tereticornis*. Scats look similar to individual sampled at SCE01? SCE03: Very fresh scats collected underneath live Koala still present at time of scat collection. Sent to the laboratory. Collected under the same *E. tereticornis*. SCE04: Fresh scats but dull/affected by weather. Potentially still viable though, sent to the laboratory. Collected under the neighbouring *E. tereticornis*. Also present at that location was an abundance of older scats from a variety of shape/size and age classes.
SCE03	455009	6904013	
SCE04	455009	6904013	 Above: SCE02  Above: SCE03  Above: SCE04  Above: live Koala observed
04	455070	6904054	Scats from a several distinct shape/size and age classes under *C. citriodora* and *E. tereticornis.*
05	455101	6904105	A few large scats approx. 4-6 weeks old under *C. citriodora.*
06	455731	6904315	Abundance of scats of a variety of shape/size and age classes under *C. citriodora.*
07	455778	6904298	Abundance of scats of a variety of shape/size and age classes under *E. tereticornis.*
SCE05	455804	6904331	Scats collected for potential analysis, however upon closer inspection scats are too weather affected. Not sent to the laboratory as genetic material likely unviable. Collected under *C. citriodora.*

Point number	Coordinates (UTM zone 56)		Comments
	Easting	Northing	
SCE06	455663	6904270	Fresh scats but dull/affected by weather. Potentially still viable though, sent to the laboratory. Collected under *C. citriodora.* Also present at that location were older scats > 2 months old of 2 distinct size/shape classes. 
08	455568	6904332	A few scats approx. 2 months old under *E. crebra.*
09	455552	6904279	Single scat found > 3 months old under *C. citriodora.*
10	455518	6904243	Abundance of scats of a variety of shape/size and age classes under *C. citriodora.*
SCE07	455499	6904246	Notable amount of pap present. Sample collected, affected by weather but appear in still relatively good condition. Sent to the laboratory. Collected under *C. citriodora.* 
11	455499	6904243	Scats of a variety of shape/size and age classes under *C. citriodora.*
12	455476	6904223	Scats and pap < 2 months old under overlapping *C. citriodora* and *E. tereticornis.*

Point number	Coordinates (UTM zone 56)		Comments
	Easting	Northing	
13	455448	6904143	Scats of a variety of shape/size and age classes under *C. citriodora.*
SCE08	455558	6904235	Scats collected for potential analysis, however upon closer inspection scats are too weather affected. Not sent to the laboratory as genetic material likely unviable. Collected under *C. citriodora.* Also present at that location were a variety of scats and pap from varying size/shape and age classes.
14	455771	6904719	A few scats > 4 months old under *C. citriodora.*
SCE09	455745	6904718	SCE09: Pap? Affected by weather but appear in still relatively good condition. Sent to the laboratory. Collected under *E. tereticornis.*
SCE10	455745	6904718	SCE10, 11 and 12: Scats collected for potential analysis, however upon closer inspection scats are too weather affected. Not sent to the laboratory as genetic material likely unviable. Collected under the same *E. tereticornis.*
SCE11	455745	6904718	
SCE12	455745	6904718	Also present at that location were older scats > 3 months old.  Above: SCE09
SCE13	455062	6904777	Scats in relatively good condition collected from Aratula State School during the school visit. Scats weather affected but appear in still relatively good condition. Sent to the laboratory. Collected under European Pine. 
15	453936	6903989	Abundance of scats of a variety of shape/size and age classes under two *E. tereticornis.*
SCE14	453938	6904041	Very fresh pap, live Koala still present at time of collection. Sent to the laboratory. Collected under *E. tereticornis.*  

Point number	Coordinates (UTM zone 56)		Comments
	Easting	Northing	
SCE15	453938	6904041	At same location as SCE14, slightly older looking scats that may originate from a distinct individual. Scats affected by weather but may still be viable. Sent to laboratory. Collected under *E. tereticornis.* 
16	453993	6904215	Abundance of old scats > 6 months under *C. citriodora.*
17	454060	6904313	Abundance of old scats > 6 months under *C. citriodora.*
18	454066	6904264	Pap and scat scats < 2 months old under *E. crebra.*
19	453957	6903895	Abundance of scats of a variety of shape/size and age classes under overlapping *C. citriodora* and *E. tereticornis.*
20	453838	6903756	Abundance of scats of a variety of shape/size and age classes under *E. crebra.*
21	453807	6903743	Abundance of scats of a variety of shape/size and age classes under *E. tereticornis.*
22	453798	6903745	Scats of a variety of shape/size and age classes under *E. crebra.*
23	453911	6904104	Pap and scats of a variety of shape/size and age classes under *E. crebra.*
24	453821	6904105	A few old scats > 6 months old under overlapping *E. crebra* and *E. tereticornis.*
25	453745	6904111	Approx 4-6 week old scats under *C. citriodora.*
26	453722	6904116	A few scats of same shape/size class but two distinct age classes (< 2 months and > 3 months old) under *E. tereticornis.*
27	453664	6904120	Abundance of old scats > 6 months old under *C. citriodora.*
28	453720	6904275	Abundance of scats of a variety of shape/size and age classes under three neighbouring trees (two *C. Citriodora* and one *E. tereticornis*).
SCE16	453966	6904236	Fresh scats affected by weather but appear to still be in good condition. Sent to the laboratory. Collected under overlapping *E. crebra* and *C. citriodora.* 
29	454348	6903040	Scats < 1 month old from two distinct size classes under *E. melanophloia* and *C. citriodora.* Property owners sighted the individuals these scats belong to on 15 & 16 October, being a mother and its joey that was starting to become independent from its mother.
30	454235	6903077	A few old scats > 6 months old under *E. crebra.*

Point number	Coordinates (UTM zone 56)		Comments
	Easting	Northing	
31	454202	6903117	Abundance of scats of a variety of shape/size and age classes under *E. tereticornis.*
SCE17	454190	6903131	Fresh scats affected by weather but appear to still be in good condition. Sent to the laboratory. Collected under *E. tereticornis.* Also present at the same location were old scats > 6 months old. 
SCE18	454190	6903131	Fresh pap collected from same location, however upon closer inspection the pap appears too damaged by weather. Not sent to the laboratory as genetic material likely unviable. Collected under the same *E. tereticornis* as SCE17.
32	455024	6904353	Abundance of scats of a variety of shape/size and age classes under overlapping *E. tereticornis* and *Acacia spp.*
33	455108	6904352	Scats of a variety of shape/size and age classes under *E. tereticornis.*
34	455187	6904338	Abundance of scats of a variety of shape/size and age classes under *E. tereticornis.*
35	455246	6904310	Abundance of scats of a variety of shape/size and age classes under overlapping *C. citriodora* and *E. melanophloia.*
36	455331	6904389	Single scat found approx 2-3 months old under *E. crebra.*
37	455306	6904336	Pap and scats < 2 months old under *E. tereticornis.*
38	455272	6904292	Abundance of scats of a variety of shape/size and age classes under *E. tereticornis.*
39	455449	6904462	Abundance of scats > 3 months old from a variety of shape/size classes under *E. tereticornis.*
40	454955	6904903	Abundance of scats of a variety of shape/size and age classes under a row of roadside trees including *E. crebra* and *E. melanophloia.*