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Detection Dogs for Conservation

Koala Safe Neighbourhood:

Koala monitoring and community engagement

(2021-2022)

Prepared for Redland City Council

By the University of the Sunshine Coast, Detection Dogs for Conservation

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Detection Dogs for Conservation

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Introduction

We are currently living in a geological epoch named the 'Anthropocene' (Crutzen, 2006, Crutzen, 2016), which is characterised by extensive modification of the environment by humans (Andrade et al., 2021). Anthropogenic changes of the landscape encompass habitat loss, fragmentation and degradation. Since European settlement, Australia is estimated to have lost 38% of its forests through land-clearing (Bradshaw, 2012). Over the past 50 years, the greatest rates of deforestation have been in south-east Queensland and northern New South Wales (Bradshaw, 2012, McAlpine et al., 2009), with less than 40% of remnant vegetation remaining in the south-east Queensland bioregion (Wilson et al., 2002). This affects all biodiversity, but some species are considered especially vulnerable to rapid changes: specialist species.

Such a species is the koala (*Phascolarctos cinereus*), one of the world's most recognised and widely adored animals (Tisdell, 2014). This iconic arboreal marsupial, endemic to eastern Australia and the official faunal emblem of Queensland, is now classified as endangered in Queensland, New South Wales and the Australian Capital Territory (McAlpine et al., 2015, Department of Agriculture Water and the Environment, 2022). Despite koalas being highly specialised, folivorous marsupials reliant on eucalyptus species, they have not yet gone extinct in the highly modified landscapes of Australia eastern coast. With climate change affecting the koala population in their western distribution (Lunney et al., 2014, Ellis et al., 2010, Seabrook et al., 2011, Adams-Hosking et al., 2011, Lunney et al., 2012, Santika et al., 2014), the importance of the highly modified coastal fringe for koala survival, as a species, has been heightened. However, koalas in these coastal habitats are impacted by numerous threats, including vehicle strikes (Dique et al., 2003b), dog attacks (Lunney et al., 2007, Lunney et al., 2004, Holderness-Roddam, 2011, Gentle et al., 2019, Beyer et al., 2018), disease (Craig et al., 2014) and stress (Davies et al., 2013, Marik and Levitov, 2010, Narayan et al., 2013, Narayan and Williams, 2016). In the past 20 years, despite many koala conservation strategies and management plans, the decline in the koala population in QLD has not abated. To help us address these threats, a radical change in management paradigm is required.

Citizen science is an increasingly popular and maturing scientific and engagement tool that involves collaboration between professionally trained scientists and amateur community

volunteers, often with a focus on data collection, community education and genuine involvement in species management (Cohn, 2008, Skarlatidou et al., 2019, Silvertown, 2009, Tulloch et al., 2013, Miller-Rushing et al., 2012, Dickinson et al., 2012, Kullenberg and Kasperowski, 2016). Citizen science and community engagement are an important part of the solution to ensuring koala survival in the Anthropocene.

Aims and objectives

This project is designed to be a pilot study into how to deliver effective wildlife conservation in a highly anthropogenic context. The vision, led by Redland City Council (RCC), and supported by partnerships with the University of the Sunshine Coast Detection Dogs for Conservation, and Griffith University, is detailed in RCC's Koala Conservation Action Plan (2016-2021) and draft Koala Conservation Action Plan (2022 – 2027). Recently, CSIRO, as part of the National Koala Monitoring Program, has joined the partnership in a bid to develop and test better methods for koala monitoring.

The RCC strategy outlines how research is central to understanding and protecting koalas in a complex landscape, and how citizen science can be the driver to sustainable koala populations. The strategy includes:

- Recruitment and monitoring of ambassador koalas, to raise awareness of the koala's plight, and understand the specific life traits and ecology of koalas in highly modified landscapes
- Monitoring of koala population trends in sentinel sites
- Development of a citizen science project to support koala conservation in highly modified landscapes

Part 1 - Koala Population Monitoring through Ambassador Koalas in Koala Safe Neighbourhoods

Redland City Council's Koala Safe Neighbourhoods (KSN) program is a key component of Council's comprehensive planning under the Redlands Koala Conservation Strategy 2016-2021 and Koala Action Plan 2016-2021 to conserve koalas in the city. The KSN program aims to engage the broader community in koala conservation actions by fostering a sense of custodianship and protection of local neighbourhood koalas. This action is facilitated by community education campaigns to highlight the health and movements of a few key 'ambassador' koalas, while at the same time gathering important movement, health and genetic data and trialling innovate monitoring device solutions. The KSN program underpins the four main objectives of the Strategy and Plan through:

- Robust research and monitoring of ambassador koalas (Decisions based on science – research and monitoring)
- Identification of movement paths and the utilisation of habitat to inform habitat protection and enhancement (Protect and improve koala habitat - securing, linking and replanting koala habitat)
- Understanding population dynamics of ambassador koalas to actively mitigate current and emerging threats through active management of ambassador koalas and passive management through the dissemination of research findings (Reduce koala deaths – preventing koala mortality from vehicles and dogs)
- Developing cost effective monitoring technologies that can engage the community as citizen scientists, and community engagement through workshops, council events and social media (Community making a difference – increasing community connection).

The program is in its fourth year, with ambassador koalas caught in the four KSNs of Ormiston, Thornlands, Birkdale and Mount Cotton. This report provides an update on the progress of Redland City Council's (RCC) Koala Safe Neighbourhoods (KSN) program to 31 May 2022.

Methods

Koala Search and Capture

Koalas were recruited to the program during periods of targeted search and capture. Koala detections resulted from on-ground surveys, detection dog searches or thermal drone surveys. A minority of koalas were not captured from the wild but opportunistically recruited via wildlife hospitals. When koalas were detected and assessed as safe for the koala capture team to attempt a capture, koalas were captured using two main techniques:

- Flag and/or climb method – a qualified koala catcher/s used a telescopic pole with a 'halo' attachment on the end, which was waved above the koala's head to encourage the animal to descend the tree. The primary flagger was sometimes required to ascend a ladder or climb into the tree using ropes and a harness to reach the koala. Due to safety concerns, more koalas were found than were caught. Koalas in large trees or those at risk of falling from trees overhanging roads, cement footpaths, water bodies, houses with dogs, or near power lines, for example, were typically not attempted.
- Koala trap method – corflute was used to enclose the tree housing the koala, and a treadle-operated cage trap was placed within the wall of the structure to trap the koala once it descended the tree looking for an avenue of escape.

Health examination

All veterinary procedures were conducted by or under the direct supervision of an experienced wildlife veterinarian with the assistance of an experienced wildlife veterinary nurse. After induction of general anaesthesia, all captured koalas received a full veterinary physical and clinical examination and the findings were recorded.

The following standardised veterinary procedures and diagnostic tests were performed:

- General physical exam, including weight, body condition score, tooth wear (approximating koala age)
- Ear punch for DNA analyses (and fitting of ear tag when needed),

- Blood collection and processing for packed cell volume and total protein (PCV/TP) estimation and cytology,
- Cystocentesis for urinalysis (Combur test, USG and urine sediment cytology),
- Ultrasound of kidneys, reproductive tract and bladder,
- Urine sediment.

While under general anaesthesia, koalas were microchipped and fitted with a GPS/VHF collar. Koalas were then transferred to a transport cage for recovery. Sub-adults were microchipped, but being smaller in size, a GPS collar was only fitted at the discretion of veterinary personnel. A recapture date was assigned to each koala based on size/age and circumstances. Most adult koalas were rescheduled for a six-monthly health check, whereas growing sub-adult koalas were rescheduled for a collar sizing check between 45 days to 3 months. Veterinary examinations were rescheduled earlier than six months if possible underlying health issues were detected and required a follow-up health check.

If, in the judgement of the veterinary team, a koala was found to have an illness that was unlikely to respond to treatment, the koala was euthanised before recovery from anaesthesia by intravenous injection of concentrated pentobarbitone sodium (Lethabarb). If, in the judgement of the veterinary team, a koala's illness or injury warranted veterinary treatment or care, the koala was transferred to the Australia Zoo Wildlife Hospital. Unless veterinary treatment was required, captured koalas were released at the point of capture within 24 hours of their veterinary assessment.

Collars used in this study are specifically designed for koalas and feature a customised safety weak link, designed to break if the koala becomes entangled or caught on a branch. Indeed, no collar-related incidents have been recorded to date.

Monitoring Technologies

All healthy captured adult koalas were fitted with monitoring devices prior to release. Technologies fitted to koalas during their veterinary examination prior to release included:

- Microchip, inserted subcutaneously into the inter-scapular area to enable identification of individual koalas at any facility with a microchip scanner (e.g. wildlife hospital),

- Bluetooth ear tag,
- Collar assembly incorporating a customised safety weak link (designed to break if a koala became entangled), a GPS and a VHF unit. The GPS tracker units were programmed for 3 to 6 attempted location fixes per day. The VHF beacon was incorporated for periodic radio-tracking (welfare checks) and to enable locating of dropped collars.

Radio-tracking and welfare checks

Radio-tracking occurred at minimum once or twice per month for each koala for welfare checks of all collared koalas. This was to ensure that there were enough opportunities to clearly observe the animal at least once per month, according to animal ethics permit conditions. Welfare-related checks occurred as frequently as every second day, particularly during the translocation of koalas to the Redlands and the intensive monitoring of koalas needing urgent capture for illness or collar checks. Koalas were observed with binoculars to try to ascertain: 1) external signs of chlamydial infection, often referred to as pink eye (for ocular infection/conjunctivitis) and wet or dirty bottom (for urinary tract infection), 2) presence of a joey for females, and 3) to ensure the fit and placement of the collar. Other data such as location, time, position in the tree, tree species (when known) and koala's behaviour were also recorded.

Results

The recruitment and monitoring of koalas for this program commenced in April 2019 and has resulted in the capture from the wild, or recruitment from a wildlife hospital post treatment, of koalas from Ormiston, Birkdale, Thornlands and Mount Cotton KSN, or Minjerribah to date (Table 1).

Recruitment

- A total of 63 koalas have been recruited to the KSN program to the end of May 2022.

- The majority (71%, n=45) of koalas were captured from the wild through searches in the four KSN by the DDC team, detection dogs and thermal imaging drones. Eighteen koalas (29%) were recruited from wildlife hospitals after successful treatment and rehabilitation for illness, injury, or were orphaned and hand raised.

Health and mortality

- A total of 28 of the 45 (61%) koalas caught from the wild during this program were assessed as healthy at their initial veterinary examination.
    - Seventeen koalas (37%) caught from the wild were sick (n=14) or orphaned (n=3) and were admitted to AZWH for treatment. Of these, nine were euthanased at their initial veterinary examination, or while in care after a poor prognosis or response to treatment.
    - Chlamydial disease was the primary reason for all illness – female koalas were more likely to succumb to disease, with 78% of female koalas admitted to the hospital euthanased as a result of reproductive disease in combination with other factors. This contrasts with male koalas with chlamydial disease who had a 71% survival rate when admitted to the hospital.
    - Eight of the 17 sick koalas caught from the wild (47%) were successfully treated at a wildlife hospital and fitted with monitoring devices before release to the wild.
    - Some of these animals were admitted to a wildlife hospital on multiple occasions (see Note below).
- Koalas are being vaccinated with a USC-developed one-shot chlamydia vaccine to trial the effectiveness and longevity of its protection against chlamydial disease (see Table 1). Koalas will continue to be vaccinated at the time of their scheduled health exams or on discharge from the AZWH.
- The program has recorded 20 deaths since commencing in 2019. In the year to 31 May 2022, six koalas have died – Silkie and Oscar (Ormiston KSN), Patti (Birkdale), Grace (Thornlands) and Takka (Victoria Point). Adverse and prolonged wet weather periods

in the first half of 2022 have likely contributed to the deaths of Oscar (septicaemia; Ormiston) and Grace (Thornlands).

Technology

- Of the 54 koalas released to the wild with monitoring devices throughout the program, 12 koalas (22%) are currently actively monitored with satellite tracking and/or VHF telemetry devices or Bluetooth Low Energy (BLE) tags in the four KSN.
    - Koalas Bark, Bruce, Frodo, Kimo and Twiggy are the ambassadors of Ormiston; Axle and Uka are the ambassadors of Birkdale; Benson and Blake represent Thornlands; and Larissa, Miles and Thelma are monitored in the Mount Cotton KSN.
    - Thirty-six ambassador koalas have been fitted with BLE ear tags to date – 13 koalas currently wearing a new style of ear tag and 23 koalas, presumed alive and in the wild, are wearing past designs. To note, Ted's Bluetooth ear tag was recently detected in the wild at 603 days post deployment.
    - Three koalas are currently fitted with BLE tags outside the KSN boundaries.
    - BLE ear tags provide an average range of up to 70 m where there is direct line of sight between the koala's ear tag and the mobile phone. Limitation or reduced range of the BLE ear tags depends on the position of the koala, the amount of sun, obstacles (natural or human-derived) that can obstruct the signal between the transmitter (ear tag) and receiver (mobile phone).
- The BLE CSIRO/DDC koala monitoring app is currently in development, with in-field testing due to commence in September 2022. Human Ethics approval for the App is now secured. When completed, the app will allow citizen scientists to better monitor their local ambassador koalas and feed data back to DDC and Redland City Council about the health, welfare and locations of individual animals (see also Part 3).

Note - multiple hospital admissions for treatment of injury or illness

Bark, a previous ambassador koala from Ormiston KSN, was reported to the Redlands Afterhours Wildlife Ambulance (RAWA) as having a stained, wet rump – the tell-tale signs of chlamydial disease. He was recaptured and admitted to AZWH for the treatment of cystitis on 5/12/2021. Bark was re-collared on discharge from the hospital and recruited back into the KSN program.

Benson from Thornlands has been admitted to AZWH twice for vehicle related injuries. He was rescued by the RAWA volunteers on Shore St East and spent five weeks undergoing treatment for peritonitis from suspected vehicle or dog-related trauma. He was recruited to the KSN program at the completion of his treatment and released into more suitable habitat in Thornlands to the south of his rescue location. Benson proceeded to move north to establish a home range around the suburban streets of south-eastern Cleveland. He dropped his tracking collar earlier this year, but was reported to RAWA on 17/12/21 and rescued, suffering a broken foot and fractures to his right leg from a vehicle hit. He was successfully rehabilitated at AZWH and released back into the KSN program as an ambassador koala.

Axle, a Birkdale KSN ambassador, has been admitted three times to AZWH. He first spent two weeks in care with diarrhoea and dehydration (14/10/21) after being rescued by RAWA for suspected cystitis as he was observed with a dirty rump. He was again admitted to AZWH on 22/5/21 for conjunctivitis but was also diagnosed with cystitis. At his most recent veterinary exam on 25/4/22, he was assessed as having sub-clinical cystitis and was admitted to the AZWH for a short course of antibiotic treatment. He was re-collared on discharge from AZWH and remains in the program.

Bruce (Ormiston) was previously admitted to AZWH for chlamydial disease (conjunctivitis) after being hit by a vehicle in October 2017 (released December 2017). He has shown no signs of illness or injury until he was noted with mild conjunctivitis in the right eye during routine monitoring on the 13/11/21 and was captured and admitted to AZWH for treatment. He was fitted with tracking devices on discharge after treatment.

Miles, a Mount Cotton ambassador koala, was captured for a routine health examination on 10/12/21 and was noted as lethargic and skinny with low body condition. He was transferred to AZWH for care and treatment of possible trauma to lumbar spine and abdomen. After

treatment, Miles was re-collared and released at his point of capture in Mount Cotton. Miles was originally admitted to hospital as an approximately 600g, 6 month old, orphaned koala, raised in care and released into the KSN program on 13/5/21.

Blake, from Thornlands KSN, was previously treated at AZWH for conjunctivitis after being rescued by RAWA volunteers on 18/3/20. Approximately two months after release, Blake was recruited to the KSN program where he has been monitored since 11/9/20. During a routine tracking event, he was noted to have a semi-closed and crusty eye and was captured and admitted to the AZWH for treatment of mild conjunctivitis. He was re-collared on release and remains an ambassador koala for the Thornlands KSN.

Table 1 Summary of koalas caught for the KSN Program, including health and current status

Name	Sex	KSN	Date of first vet check ~	Age first capture ~	Wt (kg)	Diagnosis at initial vet exam	Initial action on capture of koala by DDC or rescue group#	No. vet checks ^	Current status, as of 30 May 2022	Status Date
Ambassador koalas										
Brian	M	Ormiston	17/04/19	2.2	7.05	Healthy	Released with tracking devices#	2	Presumed alive, not monitored – dropped collar	N/A
Kimo[V]	F	Ormiston	17/04/19	5	6.8	Healthy	Released with tracking devices#	5	Currently monitored	30/05/2022
Lucky	M	Ormiston	17/04/19	6.5	6.68	Healthy	Released with tracking devices	1	Found dead – disease, chronic ill-thrift	5/05/2019
Banjo	M	Ormiston	24/04/19	4	7.51	Healthy	Released with tracking devices#	2	Presumed alive, not monitored – dropped collar, VHF ear tag flat	N/A
Gumnut	F	Ormiston	24/04/19	1.9	4.11	Healthy	Released with tracking devices#	1	Presumed alive, not monitored – dropped collar	N/A+
Lulu	F	Ormiston	24/04/19	2.5	5.06	Healthy	Released with tracking devices	1	Dead – train-related trauma. Joey also dead	7/07/2021
Bruce	M	Ormiston	1/05/2019	3.33	8.3	Healthy	Released with tracking devices#	4	Currently monitored – VHF ear tag	30/05/2022
Cuddles	F	Ormiston	1/05/19	1.4	3.98	Healthy	Released with tracking devices#	1	Presumed alive, not monitored – dropped collar	N/A+
Monty	M	Ormiston	1/05/19	4	9.19	Healthy	Released with tracking devices#	1	Presumed alive, not monitored – dropped collar	N/A
Billie	F	Ormiston	1/05/19	TBC	TBC	Diseased	Admitted to AZWH, euthanased	1	Dead – chlamydial disease	2/05/2019
Saxon	M	Ormiston	1/05/19	3.5	5.6	Diseased	Admitted to AZWH for treatment	1	Dead. Euthanased while in care – oxalate nephrosis from antibiotic treatment for cystitis	6/06/2019
Ted	M	Ormiston	1/05/19	4	7.3	Healthy	Released with tracking devices#	2	Presumed alive, not monitored – dropped collar	N/A

Name	Sex	KSN	Date of first vet check ~	Age first capture ~	Wt (kg)	Diagnosis at initial vet exam	Initial action on capture of koala by DDC or rescue group#	No. vet checks ^	Current status, as of 30 May 2022	Status Date
Rubin	M	Ormiston	2/07/19	2	5.72	Diseased	Admitted to AZWH for treatment	1	Released with tracking devices. Presumed alive, not monitored – dropped collar	N/A
Chips	M	Ormiston	21/08/19	2.5	8.22	Healthy	Released with tracking devices#	1	Presumed alive, not monitored – dropped collar	N/A
Leaf	F	Ormiston	21/08/19	1.8	4.99	Healthy	Released with tracking devices#	1	Presumed alive, not monitored – dropped collar	N/A+
Poppy	F	Ormiston	21/08/19	4	5.46	Healthy	Released with tracking devices	1	Dead. Found dead in field from unknown cause	7/1/2020
Bilbo	M	Ormiston	18/09/19	5	8.66	Healthy	Released with tracking devices#	1	Presumed alive, passive monitoring – dropped collar	N/A+
Ember	F	Ormiston	18/09/19	3	6.56	Diseased	Admitted to AZWH for treatment#	1	Released with tracking devices. Presumed alive, passive monitoring – dropped collar. Sighted at Cowley St.	N/A+
Wonky	M	Ormiston	18/09/19	6.5	7.84	Healthy	Released with tracking devices	2	Dead. Not monitored – dropped collar. Recaptured, euthanased – trauma (vehicle?)	13/04/2021
Pebbles	F	Ormiston	25/09/19	6.5	6.7	Diseased	Admitted to AZWH for treatment	1	Dead. Euthanased while in care– disease, lymphedema, joey River fostered	30/09/2021
River	F	Ormiston	25/09/19	0.8	1.01	Orphaned	Admitted to AZWH for foster care#	1	Released with (BLE) tracking device. Presumed alive, not monitored	N/A
Silkie	F	Ormiston	25/09/19	5.5	6.01	Healthy	Released with tracking devices	3	Dead. Admitted to AZWH 9/12/21. Euthanased – severe chlamydial reproductive disease	10/12/2021
Bluey	M	Ormiston	30/10/19	2.5	7	Healthy	Released with tracking devices#	1	Presumed alive, not monitored – dropped collar	N/A
Olive	F	Ormiston	30/10/19	TBC	TBC	Diseased	Admitted to AZWH, euthanased	1	Dead – blind from potential head trauma, reproductive disease	31/10/2021

Name	Sex	KSN	Date of first vet check ~	Age first capture ~	Wt (kg)	Diagnosis at initial vet exam	Initial action on capture of koala by DDC or rescue group#	No. vet checks ^	Current status, as of 30 May 2022	Status Date
Milo	M	Ormiston	30/10/19	3.5	6.65	Healthy	Released with tracking devices#	1	Presumed alive, not monitored – dropped collar	N/A
Tally	F	Ormiston	30/10/19	6	5.97	Healthy	Released with tracking devices	1	Dead. Was passively monitored – dropped collar. Euthanased - chlamydial reproductive disease	7/11/2021
Bark	M	Ormiston	16/06/20	1.5	4.28	Healthy	Released with tracking devices#	2	Currently monitored	30/05/2022
Nibble	F	Ormiston	3/09/20	0.81	1.39	Healthy	Joey of Kimo, no devices fitted	1	Presumed alive, never monitored	N/A
Slinky*	M	Ormiston	7/10/20	1.8	5.06	Orphaned	Admitted to AZWH for foster care	2	Dead. Released with tracking devices. Dropped collar – passively monitored. Euthanased – trauma domestic dog	6/02/2021
Squirrel*	M	Ormiston	15/04/21	1.3	3.5	Orphaned	Admitted to AZWH for foster care	3	Dead. Admitted to AZWH, euthanased – non-chlamydial disease	31/12/2021
Rainbow	F	Birkdale	25/08/20	6	6.23	Healthy	Released with tracking devices#	2	Presumed alive, not monitored – dropped collar	N/A
Uka	F	Birkdale	25/08/20	2.5	6.56	Healthy	Released with tracking devices#	4	Currently monitored	30/05/2022
Liptus*	M	Birkdale	22/01/21	1.05	3.03	Diseased	Admitted to AZWH for treatment#	2	Released with tracking devices after treatment for conjunctivitis. Presumed alive, not monitored – dropped collar	N/A
Banjora	F	Thornlands	2/09/20	4.5	6.16	Diseased	Admitted to AZWH for treatment	1	Dead. Euthanased while in care – chlamydial disease	23/09/2020
Lackey	M	Thornlands	2/09/20	2.5	6.47	Diseased	Admitted to AZWH for treatment#	3	Released with tracking devices. Presumed alive, not monitored – dropped collar	N/A+
Cariad	F	Thornlands	3/09/20	6	6.52	Diseased	Admitted to AZWH, euthanased	1	Dead – chlamydial disease	4/09/2020

Name	Sex	KSN	Date of first vet check ~	Age first capture ~	Wt (kg)	Diagnosis at initial vet exam	Initial action on capture of koala by DDC or rescue group#	No. vet checks ^	Current status, as of 30 May 2022	Status Date
Blake	M	Thornlands	11/09/20	2	6.74	Healthy	Released with tracking devices#	3	Currently monitored	30/05/2022
Daisy	F	Thornlands	14/09/20	3	5.48	Diseased	Admit to EVE clinic, euthanased	1	Dead – leukaemia, joey Sir Derek fostered	15/09/2021
Hazel	F	Thornlands	9/09/2020	1.5	4.12	Orphaned	Admitted to AZWH for foster care#	2	Released with tracking devices. Presumed alive, not monitored - dropped collar	N/A
Sir Derek	M	Thornlands	14/09/20	0.8	3.15	Orphaned	Admitted to AZWH for foster care#	2	Released with tracking devices. Presumed alive, not monitored – dropped collar	N/A
Summer	F	Thornlands	17/09/20	3	6.16	Healthy	Released with tracking devices	1	Dead. Admitted to AZWH 10/12/20. Euthanased, chlamydial disease, reproductive disease.	10/12/2020
Benson*[V]	M	Thornlands	17/12/20	2	5.78	Injured	Admitted to AZWH for treatment#	2	Released with tracking devices. Currently monitored	30/05/2022
Blinky	M	Thornlands	10/05/21	9	6.85	Diseased	Admitted to AZWH for treatment#	2	Released with tracking devices. Dropped collar – passive monitoring	31/12/2021+
Princess	F	Thornlands	13/04/21	11	6.43	Diseased	Admitted to AZWH, euthanased	1	Dead. Euthanased – chlamydial disease	13/04/2021
Bob	M	Mt Cotton	5/02/21	5	7.93	Diseased	Admitted to AZWH for treatment#	1	Released with tracking devices. Presumed alive, not monitored – dropped collar	N/A
Nugget	M	Mt Cotton	13/04/21	TBC	TBC	Diseased	Admitted to AZWH for treatment	1	Dead. Euthanased while in care – chlamydial disease, oxalate nephrosis from antibiotic treatment	15/05/2021
Larissa*[V]	F	Mt Cotton	5/05/21	4	5.03	Healthy	Released with tracking devices	2	Currently monitored	30/05/2022
Olly*	F	Mt Cotton	5/05/21	1.5	3.69	Orphaned	Admitted to RSPCA for foster care#	1	Released with tracking devices. Presumed alive, not monitored – dropped collar	N/A

Name	Sex	KSN	Date of first vet check ~	Age first capture ~	Wt (kg)	Diagnosis at initial vet exam	Initial action on capture of koala by DDC or rescue group#	No. vet checks ^	Current status, as of 30 May 2022	Status Date
Thelma*	F	Mt Cotton	5/05/21	9.25	5.98	Injured	Admitted to RSPCA for treatment#	3	Released with tracking devices. Currently monitored	30/5/2022
Louise*	F	Mt Cotton	13/05/21	1.5	3.78	Orphaned	Admitted to RSPCA for foster care#	1	Released with tracking devices. Presumed alive, not monitored – dropped collar	N/A
Miles*V	M	Mt Cotton	13/05/21	2	4.39	Orphaned	Admitted to RSPCA for foster care#	3	Released with tracking devices. Currently monitored	30/5/2022
Oscar	M	Ormiston	16/06/2021	1.50	4.74	Orphaned	Admitted to AZWH for foster care	4	Dead – Septicaemia. Found dead in field after wet weather	26/01/2022
Lorri*	F	Birkdale	5/07/2021	1.20	3.31	Orphaned	Admitted to RSPCA for treatment#	2	Presumed alive, not monitored – dropped collar	N/A
Patti*	M	Birkdale	5/07/2021	1.70	3.56	Orphaned	Admitted to RSPCA for treatment	2	Dead – Septicaemia	11/08/2021
Takka*	M	Victoria Pt	5/07/2021	1.40	3.38	Orphaned	Admitted to RSPCA for treatment	2	Dead – typhlocolitis, peritonitis, maladaptation	18/07/2021
Axle*	M	Birkdale	9/07/2021	2.7	7.12	Diseased	Released with tracking devices#	5	Released with tracking devices. Currently monitored	30/5/2022
Gummi	M	Ormiston	23/08/2021	1.3	4.29	Healthy	Released with tracking devices	1	Presumed alive, not monitored – dropped collar	N/A
Grace	F	Thornlands	22/10/2021	1.5	3.84	Orphaned	Admitted to AZWH for foster care	4	Dead – Septicaemia? Found dead after significant wet weather event	24/2/2022
Leuca	M	Mount Cotton	29/03/2022	2.5	6.59	Healthy	Released with tracking devices#	1	Presumed alive, not monitored – dropped collar	N/A
Geraldine	F	Thornlands	15/04/2022	2.5	6.51	Healthy	Released with tracking devices#	1	Presumed alive, not monitored – dropped collar	N/A
Angie	F	Birkdale	15/04/2022	1.80	3.83	Healthy	Released with tracking devices#	1	Presumed alive, not monitored – dropped collar	N/A
FrodoV	M	Ormiston	20/04/2022	3.50	7.07	Healthy	Released with tracking devices#	1	Released with tracking devices. Currently monitored	30/5/2022

Name	Sex	KSN	Date of first vet check ~	Age first capture ~	Wt (kg)	Diagnosis at initial vet exam	Initial action on capture of koala by DDC or rescue group#	No. vet checks ^	Current status, as of 30 May 2022	Status Date
Twiggy[V]	F	Ormiston	30/5/2022	2	4.36	Healthy	Released with tracking devices	1	Released with tracking devices. Currently monitored	30/5/2022

*Koalas recruited from wildlife rehabilitation facilities.

[V] Chlamydia vaccine administered.

~Date of first vet check and age is at the time of capture from the wild or collaring after discharge from a wildlife rehabilitation facility.

^Vet checks are typically carried out at the Endeavour Veterinary Ecology clinic, however, koalas with disease are referred directly to the Australia Zoo Wildlife Hospital. During treatment, koalas may have multiple exams – these during-treatment exams are not included in the above totals.

Functioning Bluetooth Low Energy (BLE) ear tag.

Older styles of BLE ear tags that may or may not be functional.

+ Confirmed sighting in the wild while not actively monitored.

Table 2. Summary of other koalas caught by the DDC team, including health and current status

Name	Sex	KSN	Date of first vet check ~	Age first capture ~	Wt (kg)	Diagnosis at initial vet exam	Initial action on capture of koala by DDC or rescue group#	No. vet checks ^	Current status, as of 30 May 2022	Status Date
Released from the Australia Zoo Wildlife Hospital with BLE ear tag										
Aroha*	F	Victoria Pt	10/02/21	1.3	3.2	Healthy	BLE ear tag only#	1	Not monitored, not found	16/06/2021
River	F	Ormiston	25/09/19	0.8	1.01	Orphaned	Admitted to AZWH for foster care#	1	Released with (BLE) tracking device. Presumed alive, not monitored	N/A
Ruby*	F	Cleveland	27/05/21	3	3.88	Healthy	BLE ear tag only#	1	Passively monitored by the community/KAG	29/05/2021+
Cowley Street development										
Lancelot	M	Ormiston	26/08/21	3		Diseased	Admitted to AZWH for treatment	1	Dead. Euthanased – chlamydial disease	Lancelot
Guinevere	F	Ormiston	9/09/21	2.5	6.5	Healthy	Released with tracking devices#	1	Currently monitored	31/12/2021
Sick or injured koalas captured during routine monitoring or catching										
Wasa	F	Birkdale land	15/07/21	3		Diseased	Admitted to AZWH, euthanased	1	Dead - chlamydial disease, reproductive disease	16/07/2021
Shoyu	F	Birkdale land	15/07/21	3		Diseased	Admitted to AZWH for treatment	1	Dead. Euthanased while in care – chlamydial disease, oxalate nephrosis	26/07/2021

Name	Sex	KSN	Date of first vet check ~	Age first capture ~	Wt (kg)	Diagnosis at initial vet exam	Initial action on capture of koala by DDC or rescue group#	No. vet checks ^	Current status, as of 30 May 2022	Status Date
De-Ville	F	Ormiston	9/09/21	4		Diseased	Admitted to AZWH for treatment	1	Treated and released, not monitored tags fitted	14/11/2021
Quinn	F	Birkdale land	9/09/21	8		Diseased	Admitted to AZWH, euthanased	1	Dead - chlamydial disease, reproductive disease	10/09/2021
Tibereus	M	Cleveland	10/11/21	6		Vehicle hit	Admitted to AZWH for treatment	2	Dead. Euthanased – vehicle trauma, head injury causing seizures	11/11/2021
Lucifer	M	Mt Cotton	15/08/21			Disease	Admitted to AZWH for treatment	1	Dead. Euthanased – chlamydial disease, causing blindness	27/09/2021
Silica	F	Mt Cotton (Sandy Creek C.A.)	10/6/2022			Disease	Admitted to AZWH for treatment	1	Dead - chlamydial disease, reproductive disease	10/6/2022
Caydyn	M	Cleveland	19/6/2022	3	6.55	Disease	Admitted to AZWH for treatment	1	In care being treated	30/5/2022

*Koalas recruited from wildlife rehabilitation facilities.

[V] Chlamydia vaccine administered.

~Date of first vet check and age is at the time of capture from the wild or collaring after discharge from a wildlife rehabilitation facility.

^Vet checks are typically carried out at the Endeavour Veterinary Ecology clinic, however, koalas with disease are referred directly to the Australia Zoo Wildlife Hospital. During treatment, koalas may have multiple exams – these during-treatment exams are not included in the above totals.

Functioning Bluetooth Low Energy (BLE) ear tag.

Older styles of BLE ear tags that may or may not be functional.

+ Confirmed sighting in the wild while not actively monitored.

Monitoring

The monitoring team was present 103 individual days on the ground in the Redlands between June 2021 – May 2022 (119 team*day), whether to catch or release ambassador koalas, attend sick koalas, or perform health checks.

Radiotracking

Individual tracking events for the last year (since June 2021) are illustrated in

Figure 1. Figures 2 to 4 detail individual koalas in each KSN.

Figure 1. Individual tracking events from June 2021 to May 2022. Health checks were performed on radio-tracked koalas.

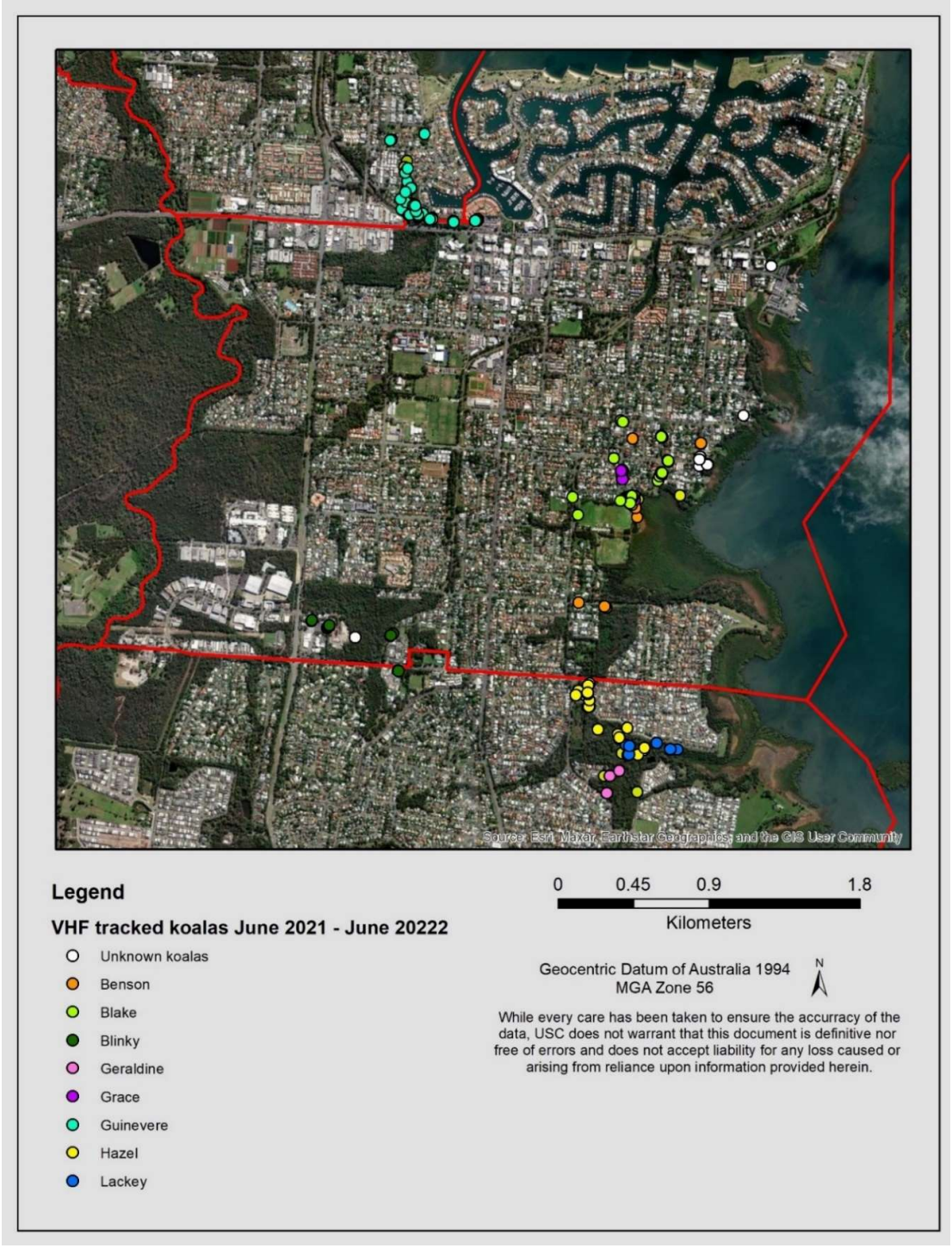

Figure 2. Locations of individual koalas identified by radio-tracking

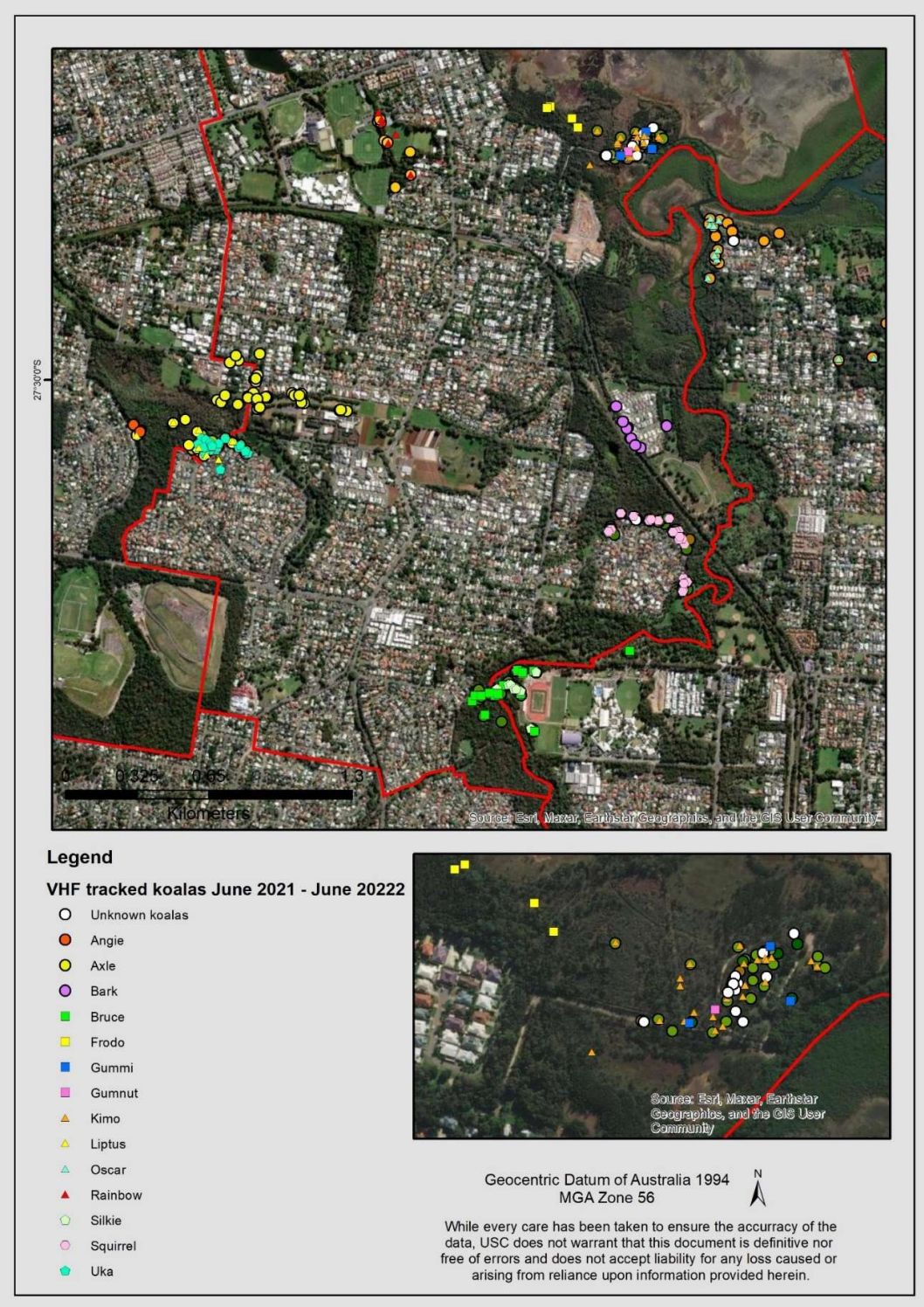

Figure 3. Ormiston

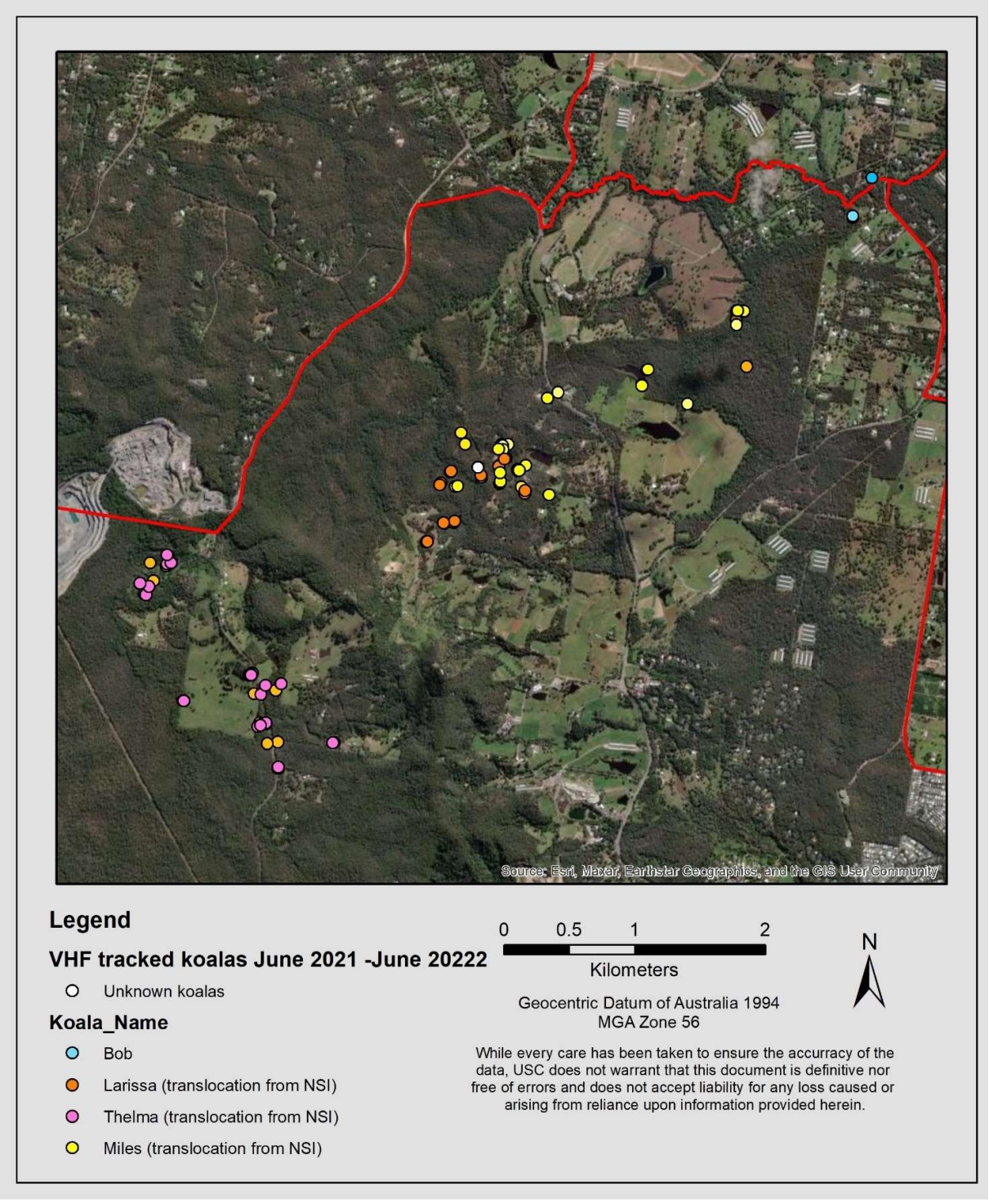

Figure 4. Mount Cotton

GPS collar data

The GPS collar data for the June 2021 – 2022 period from GPS loggers and trackers are presented in maps in Appendix 1.

Bluetooth ear tag

The new Bluetooth ear tag (version 5) was deployed 12/03/2022 (Figure 5). The version V5 has been deployed on seven koalas to date (Benson 19/04/2022, Bruce 4/06/2022, Frodo 20/04/2022, Gumnut 9/07/2022, Jazza 6/07/2022, Kimo 28/03/2022 and Thelma 17/03/2022). It has been successfully detected in the field 84% (N= 56) of the time, at an average of 27 m (5 - 60 m). The longest deployment currently is 163 days (Kimo).

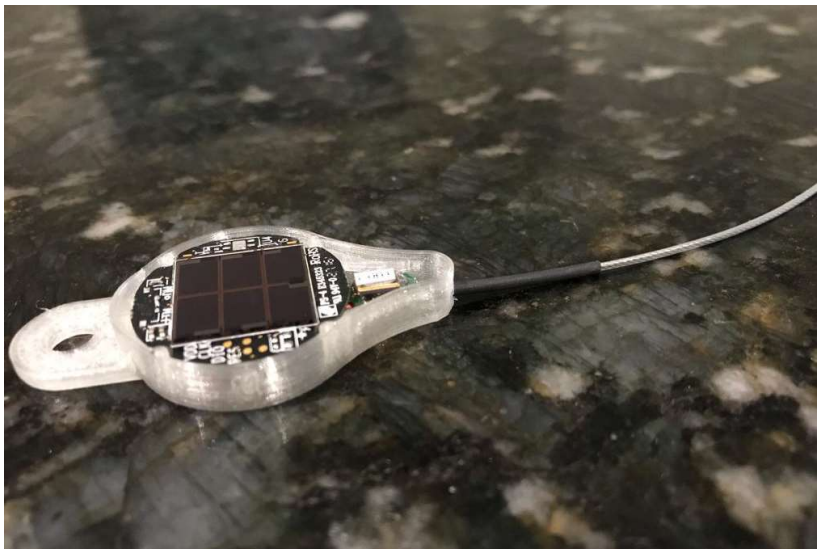

Figure 5 Version 5 (V5) solar Bluetooth tag is mounted in 3D print with some of the reinforced antenna protected in the casing so that in the occurrence of a breakage there is still some length of internal antenna and therefore some range

Since the start of the program, there has been 539 detection attempts across the five different versions of Bluetooth ear tags (Table 3, Figure 6, see also Appendix 2), which were deployed on 48 koalas

(some of the kolas received multiple versions). Version 1 lacked range, and we first worked on increasing range with the addition of an external antenna, which can be seen in version 2 and 3 (Figure 7). However, durability of this external antenna proved difficult in field condition, which triggered us to trial an internal antenna (Version 4). Version 4 did increase durability, however had even lower detection distance than version 1. We are now trialling Version 5 which is attempting to have sufficient range without compromising durability. Altogether, ten ear tags have been trialled and successful for more than 200 days in the field, with the maximum durability at 601 days in the field.

Table 3 Number of koalas on which each solar Bluetooth ear tag (BLE) version was deployed, and the number of detection attempts for each version.

Bluetooth ear tag Version	Number of koalas on which a tag was deployed	Number of detection attempts	Percent success
1	11	139	**63%**
2	6	64	**81%**
3	4	87	**67%**
4	20	186	**34%**
5	7	56	**84%**
Total	**48**	**539**	

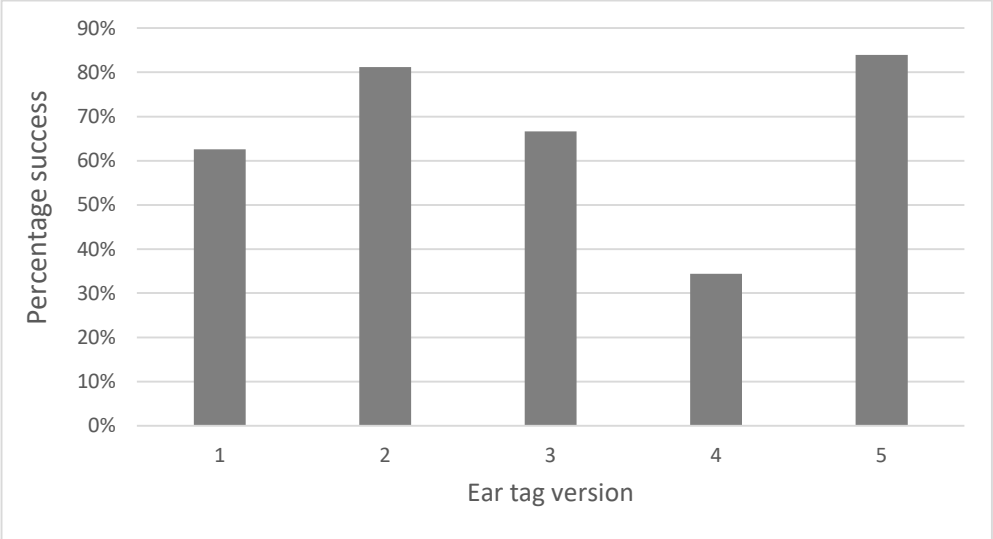

Figure 6 Percentage of success for each ear tag version

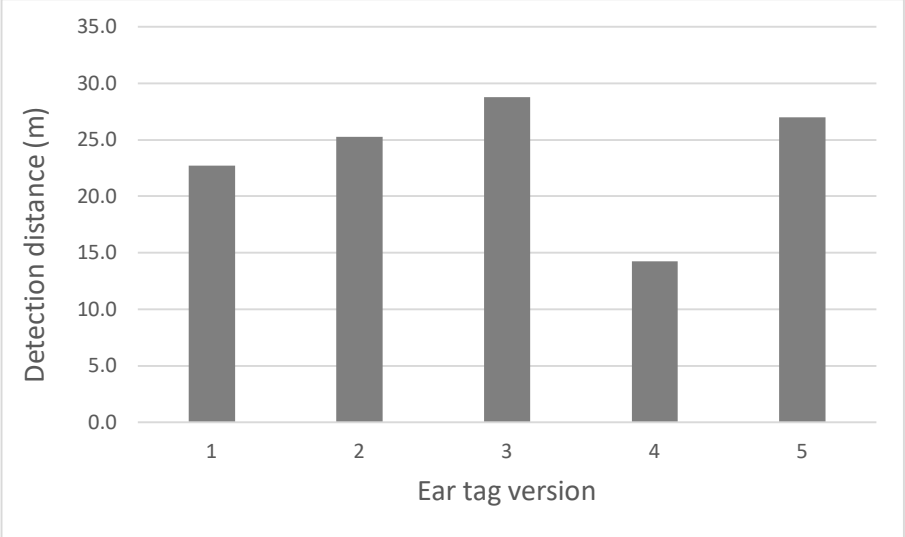

Figure 7 Average detection distance from the koala (in metre) for each ear tag version

Part 2 – Designing a Monitoring Program at Sentinel Sites to Enable Population Trend Estimates

This component will be a methodological investigation, in partnership with CSIRO, focusing on establishing sentinel sites to accurately and efficiently measure koala population trends.

Population trend estimates are a fundamental data requirement for informing conservation management initiatives (Caughley and Sinclair, 1994). However, because the koala is a cryptic species that often occurs at low and/or patchy densities within the landscape (that can also be difficult to access), accurate population estimates are difficult to quantify (Sullivan et al., 2002, Dique et al., 2003a, Dique et al., 2001).

Remotely piloted aircraft (RPA), also known as unmanned aerial vehicles (UAV) or drones, are a rapidly advancing technology with promising potential for wildlife detection and monitoring (Anderson and Gaston, 2013, Linchant et al., 2015, Chabot and Bird, 2015, Wich and Koh, 2018).

Another survey method is the use of detection dogs which, for koala scat detection, has proven to be effective and efficient (Cristescu et al., 2015, Cristescu et al., 2020). Detection dogs and drones were deployed at trial bushland and urban sentinel sites for comparison, with dogs predominately deployed in more urban locations due to flight restrictions for drones. Finally, acoustic monitoring, which has recently been applied to estimates of koala densities, was also trialled at some sites (Appendix 3).

Methods

1- Drone sentinel sites

Study sites

Some of the Redland Drones sentinel sites (Figure 8) were included in a method comparison project (Figure 9), which included acoustic monitoring and line transect surveys.

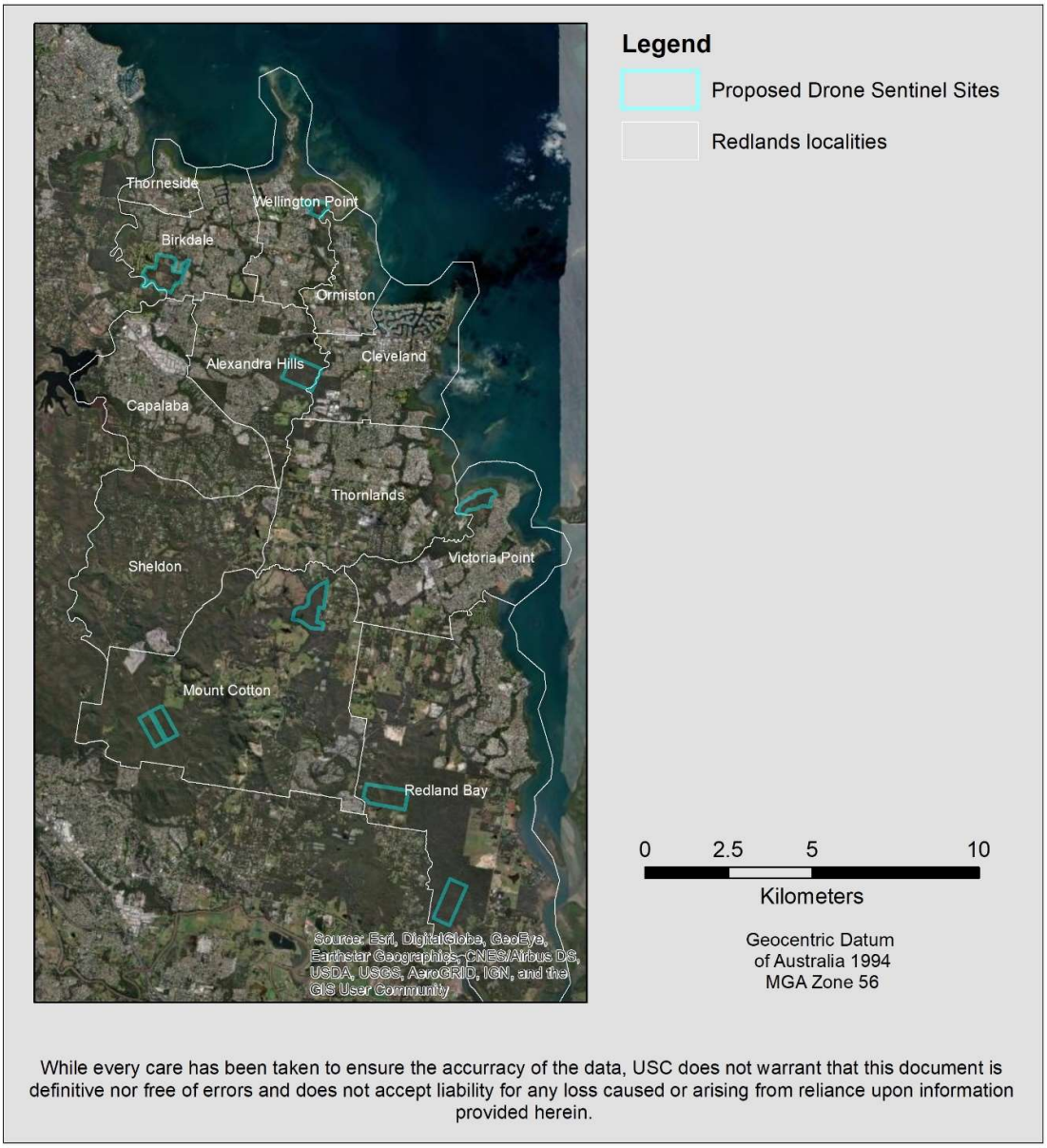

Figure 8. Location of drone sentinel sites

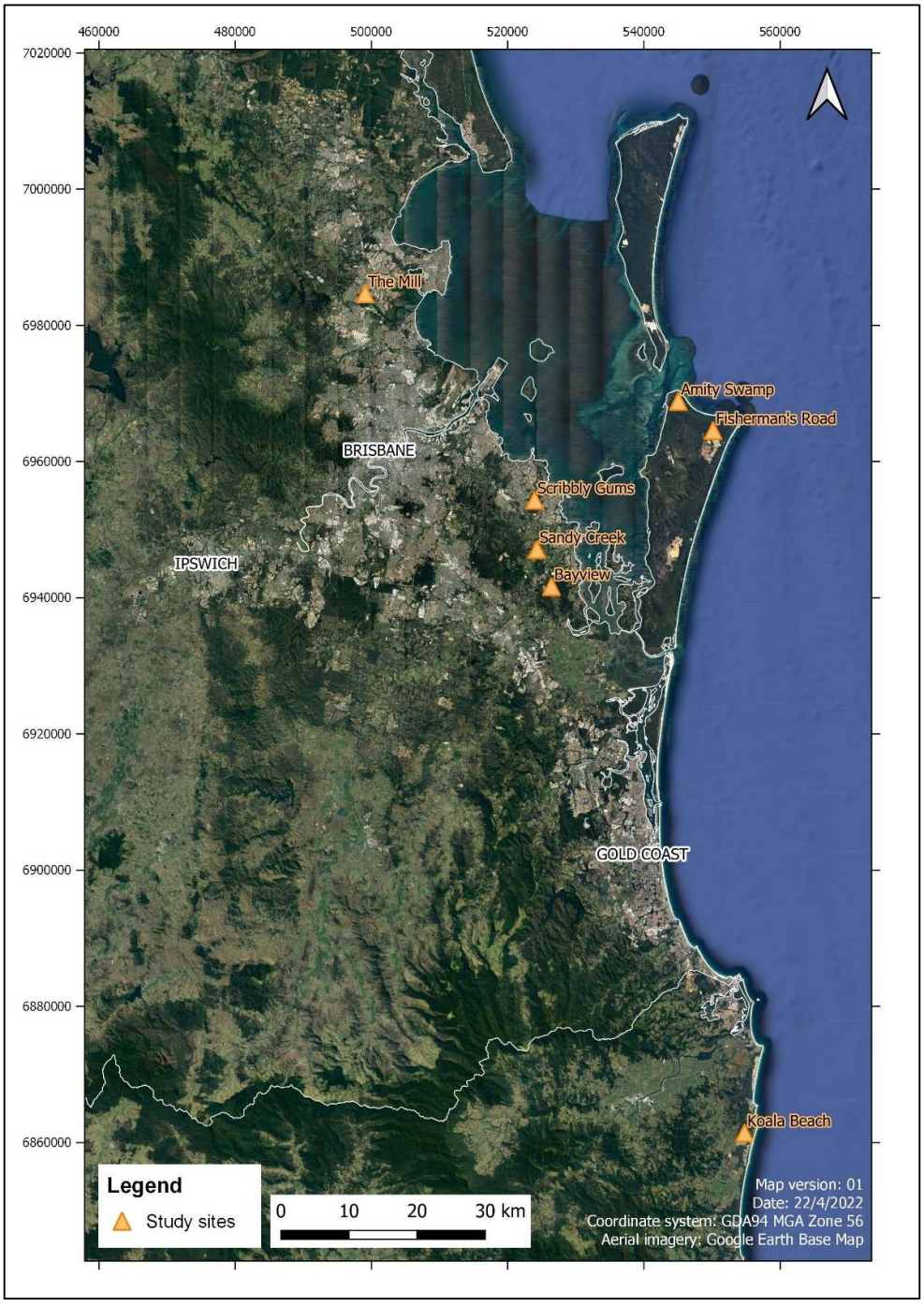

Figure 9. Map of study sites

Drones survey protocol

Pre-dawn thermal drone surveys were undertaken a minimum of 2 hours after sunset (to allow landscape features to cool) using a DJI Matrice 210 quadcopter (approx. 4kg flying weight) equipped with a Zenmuse XTS thermal camera (19mm lens, highest 640 × 512 resolution, fastest 30Hz frame-rate and fully stabilized and controllable gimbal). This provided a real-time thermal video stream of the highest possible quality and permitted variable oblique viewing angles (not just directly downwards) to maximize koala detection rates (koala body heat signatures are easily blocked at some angles by dense foliage). The drone was flown in a slow and steady search grid pattern ('lawn mowing' pattern) at a height of approximately 20-30 metres above the tree canopy (altitude adjusted with terrain). The search grid was spaced with a minimum 50% overlap between passes (at canopy level), meaning any given tree canopy was systematically viewed obliquely at least two times, from two opposing angles. The speed of flights was manually varied according to the operator's perceived detection confidence, slowing in poorer weather conditions (e.g. high humidity) or dense habitat. Manual flight control, while viewing a high quality real-time thermal video stream, enabled almost complete elimination of false-positives (detections of animals/objects other than koalas) by pausing and repositioning the drone as required until positive identification was achieved. Once a koala was positively detected, the drone was flown directly overhead (camera pointing directly downwards) and accurate GPS coordinates recorded. Drone flight paths were recorded to ensure complete and thorough coverage of designated search areas (search polygon boundaries viewable on pilot's base map during flights).

Mean koala density (number of koala detections divided by area of survey site), and standard deviation, were estimated through repeat surveys. Repeat site surveys were conducted a minimum of one week apart to ensure independence (koalas able to move anywhere within their home-range).

2- Dog sentinel sites

Detection Dogs

Upon arrival on site, information was recorded including location name, survey unique identifying number and GPS coordinates. The detection dog was fitted with a GPS collar. The GPS tracking of the dog enabled us to quantify the survey effort and enhance the accuracy of our repeat. Here we aimed to conduct three repeat surveys at a minimum of two week intervals. Fresh scats (age 1 and 2) found during surveys were collected for genetic analysis. From the genetic fingerprinting, mark recapture framework will be applied to calculate a population size.

Genetic Analyses

Scats were collected in a sterile tube without direct skin contact to avoid potential contamination, and loss of koala DNA from the scat. Tubes were kept on ice until they were stored in a -80 freezer. DNA from the scats was extracted using protocol described in (Schultz *et al.* 2018).

3- Ethics and scientific permit numbers

All fieldwork was conducted under the Animal Ethics Permit number ANE2171 and Scientific Purposes Permit number WA000078.

Results

Both drone and dog surveys were delayed by heavy rains (which washes genetic material from scats) and flooding which prevented access to sentinel sites. A total of 71 drone surveys were conducted between late March and early July (Table 4) in collaboration with multiple partners. Drone surveys were conducted at five sentinel sites on Minjerribah, including four pre- and post-burn surveys at Beehive East and Beehive West. Surveys were repeated eight times at Amity Swamp, Fisherman's Road, and Flinders. Drone surveys were conducted at eight sites within the mainland section of Redland. Repeat surveys were conducted at mainland sites with more than six koalas, i.e. Bligh Street and Sandy Creek. At most sites, koala population density remained relatively stable across repeated surveys (Table 5). Individual locations of koalas are given in

Figure *10*, Figure 11, Figure 12, Figure 13,

Figure 14

Figure 15,

Figure 16, Figure 17.

Table 4. Drone survey koala counts at sentinel sites

Site	Area_ha	Count1	Count2	Count3	Count4	Count5	Count6	Count7	Count8
Minjerribah									
Beehive East pre-burn	65	11	10	11	12				
Beehive East post-burn	65					8	8	8	7
Beehive West pre-burn	65	10	7	10	15				
Beehive West post-burn	65					11	10	11	7
*Amity Swamp	53	24	22	25	17	19	21	13	20
*Fisherman's Road	40	3	1	1	1	4	0	1	0
Flinders	40	11	15	15	13	11	6	9	8
Extra site in Moreton									
*The Mill	37	21	31	23	28	38			
Redland Mainland									
Bligh St	22	8	7	8	8	9	9		
*Sandy Creek	70	11	8	8	5				

*Scribbly Gums	70	2							
*Bayview	70	2							
Native Dog	70	3							
Point Halloran	41	3							
Birkdale	85	4							
Venman	70	1							

*method comparison site (e.g. acoustic recorders, visual, spotlighting, thermal drone AI)

Table 5. Koala densities at sentinel sites

Site	Density1	Density2	Density3	Density4	Density5	Density6	Density7	Density8	DensityMean	DensitySD
Minjerribah										
Beehive East pre-burn	0.17	0.15	0.17	0.18					0.17	0.01
Beehive East post-burn					0.12	0.12	0.12	0.11	0.12	0.01
Beehive West pre-burn	0.15	0.11	0.15	0.23					0.16	0.05
Beehive West post-burn					0.17	0.15	0.17	0.11	0.15	0.03
*Amity Swamp	0.45	0.42	0.47	0.32	0.36	0.40	0.25	0.38	0.38	0.07
*Fisherman's Road	0.08	0.03	0.03	0.03	0.10	0.00	0.03	0.00	0.03	0.04
Flinders	0.28	0.38	0.38	0.33	0.28	0.15	0.23	0.20	0.28	0.08
Extra site in Moreton										
The Mill	0.57	0.84	0.62	0.76	1.03				0.76	0.18
Redland Mainland										
Bligh St	0.36	0.32	0.36	0.36	0.41	0.41			0.37	0.03
*Sandy Creek	0.16	0.11	0.11	0.07					0.11	0.04
*Scribbly Gums	0.03									
*Bayview	0.03									
Native Dog	0.04									
Point Halloran	0.07									
Birkdale	0.05									
Venman	0.01									

*method comparison site (e.g. acoustic recorders, visual, spotlighting, thermal drone AI)

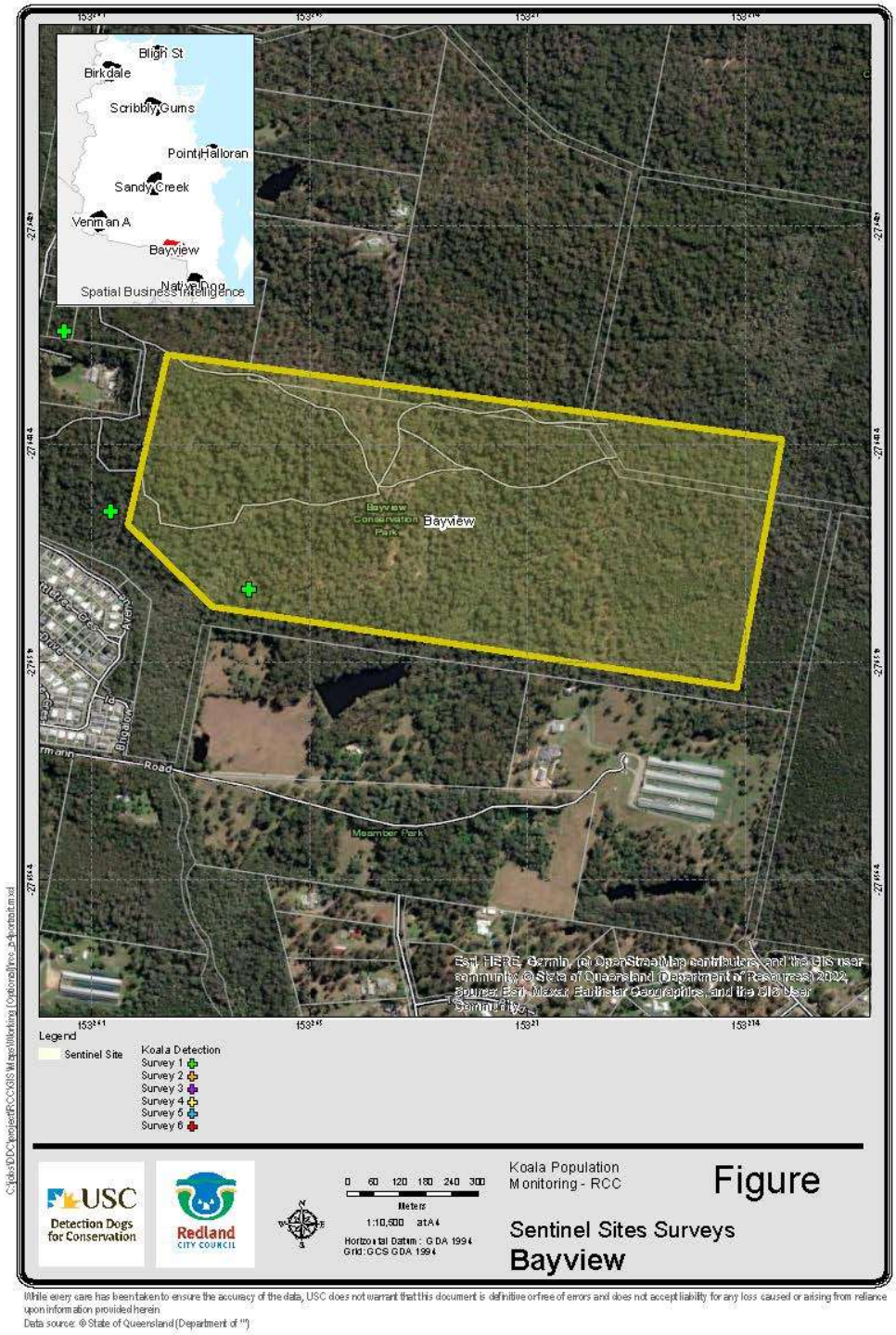

Figure 10. Bayview

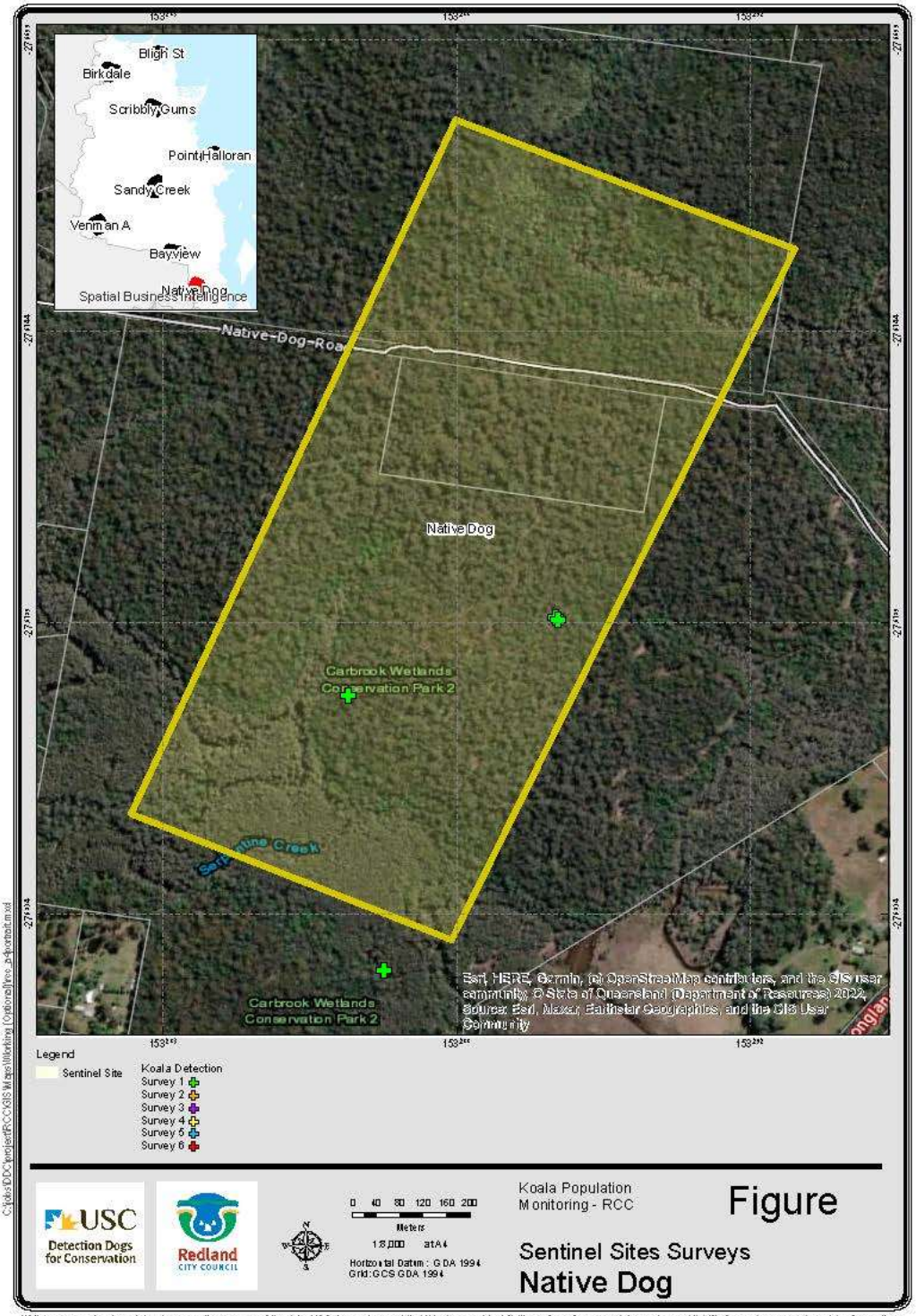

Figure 11. Native Dog

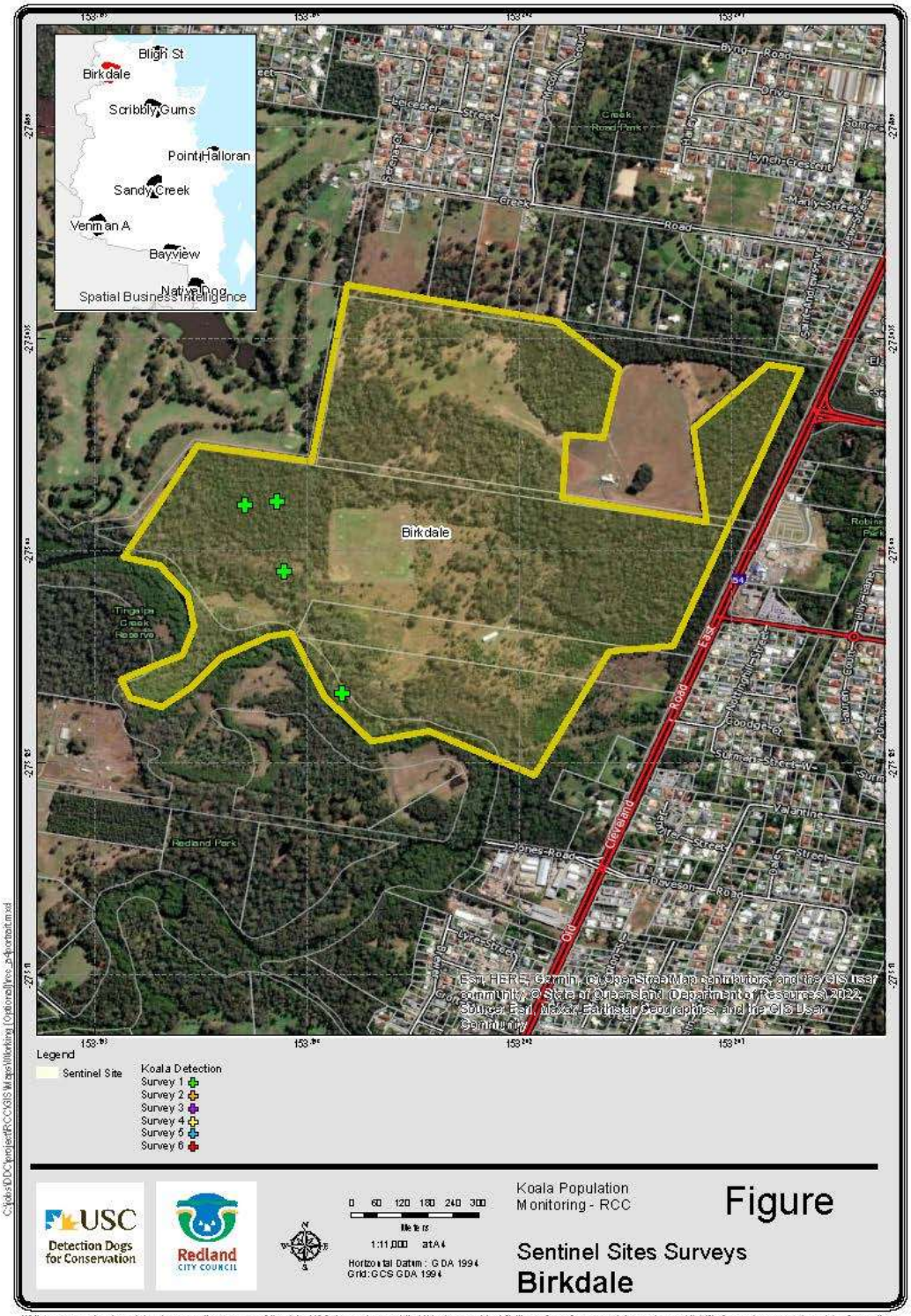

Figure 12. Birkdale

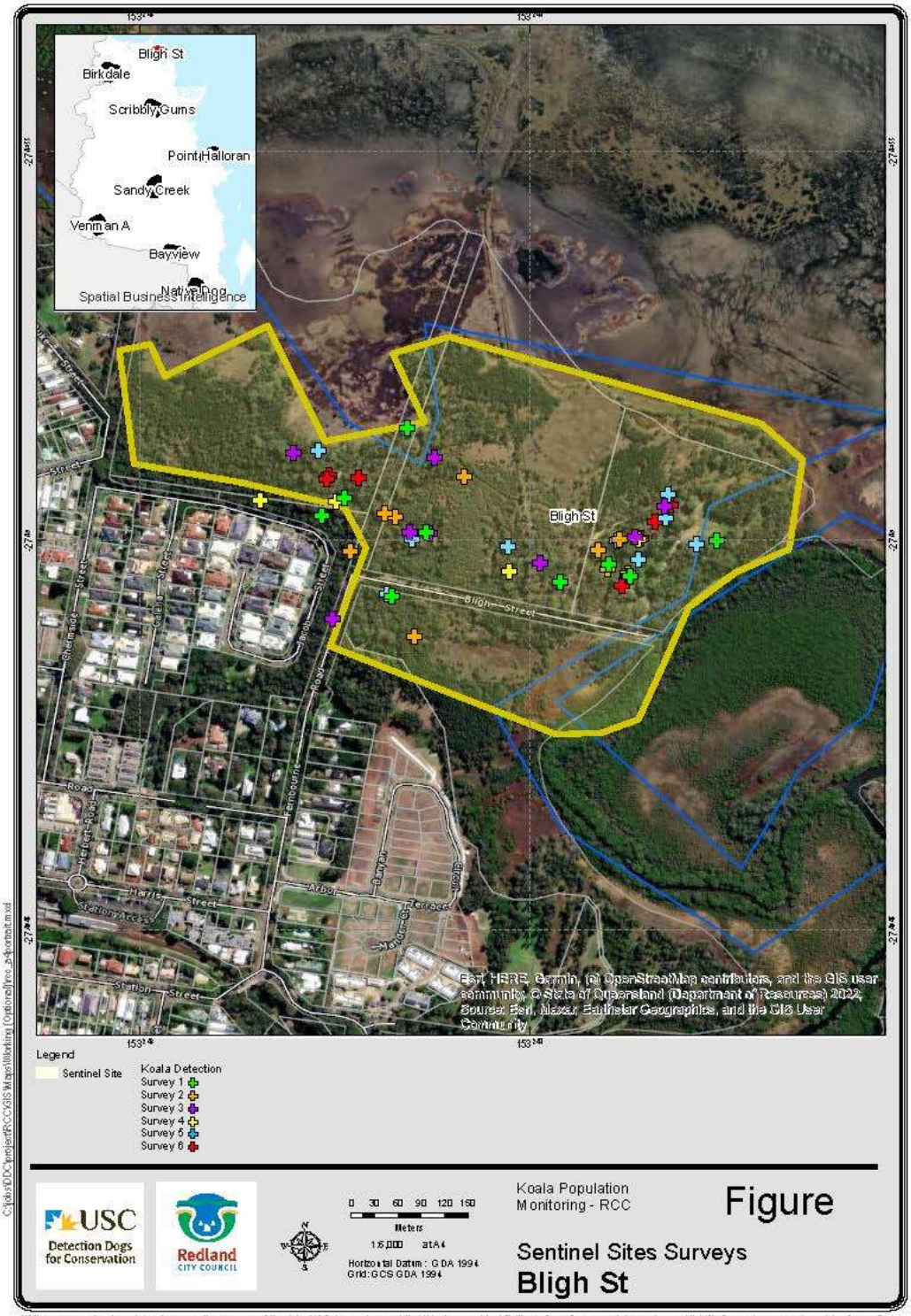

Figure 13. Bligh Street

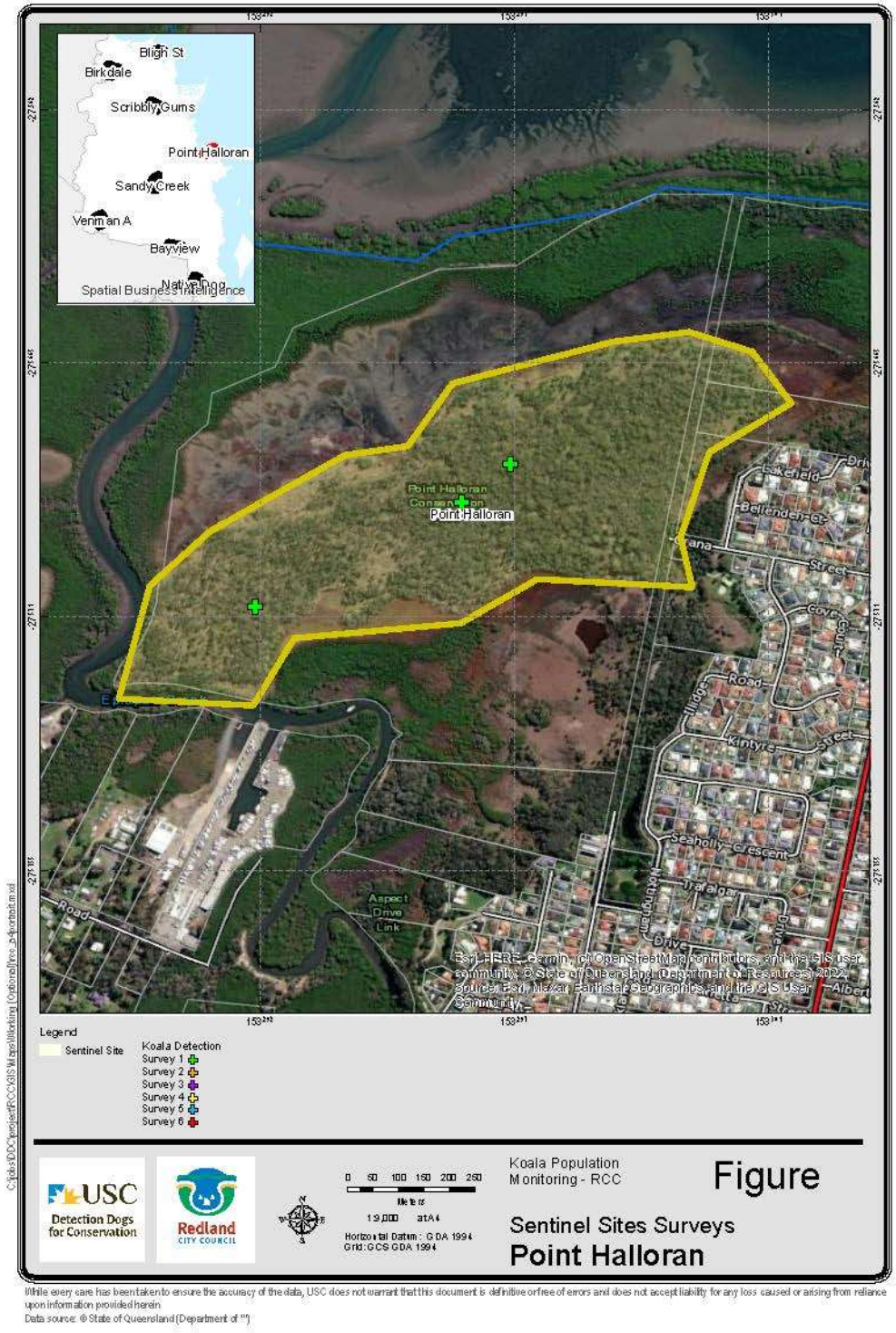

Figure 14. Point Halloran

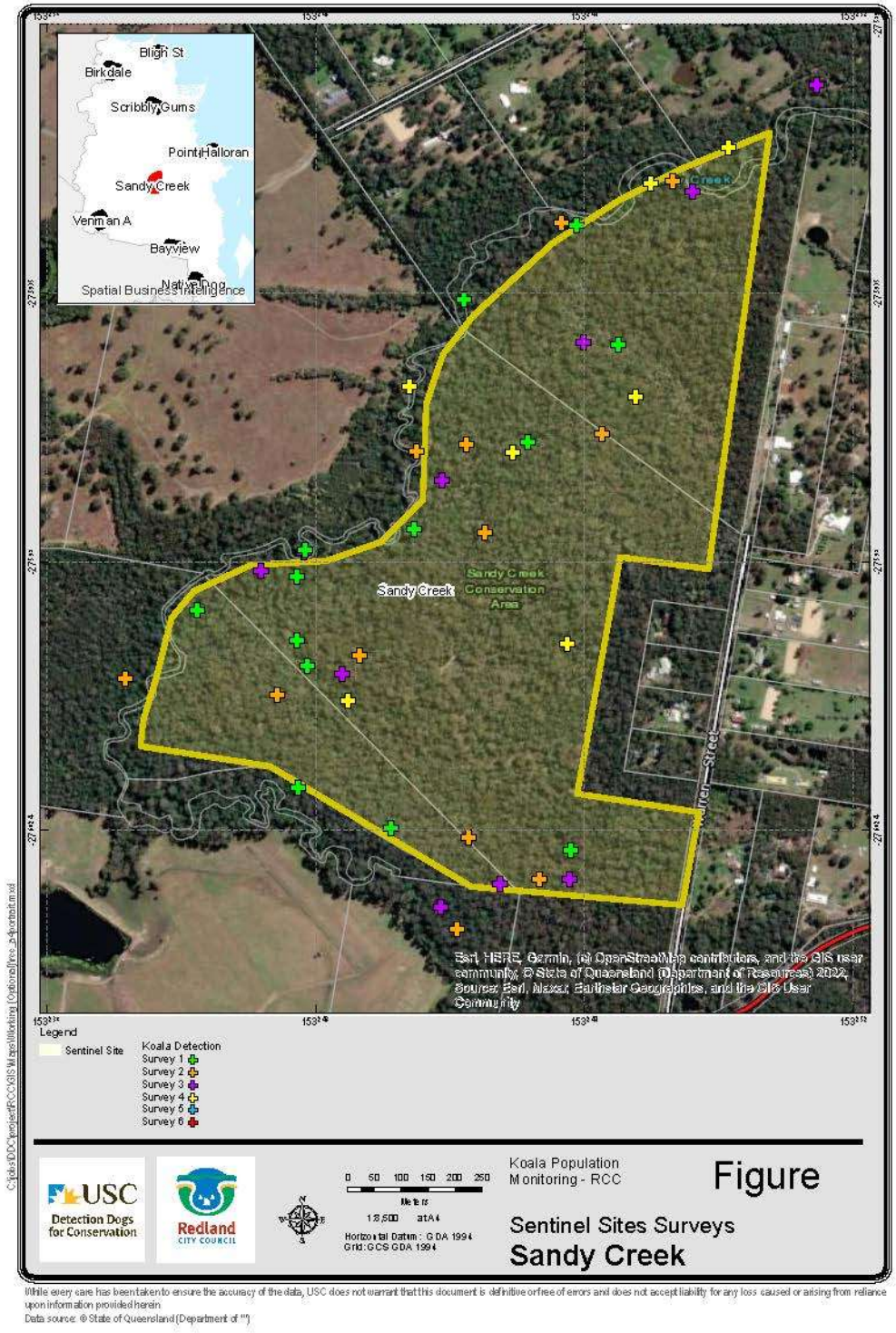

Figure 15. Sandy Creek

Figure 16. Scribbly Gums

While every care has been taken to ensure the accuracy of the data, USC does not warrant that this document is definitive or free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
Data source: © State of Queensland (Department of ")

Figure 17. Venman

The first detection dog survey of the sentinel site was conducted with fresh scat detection dog, Billie Jean, (Figure 18) on 5th of May. The survey covered 13 km and 19 fresh scats were detected Figure 19. Repeat surveys were conducted on 1st (Figure 20) and 11th of June (Figure 21), with 17 and 14 fresh scats detected, respectively.

Figure 18. Fresh scat detection dog deployed to test genetic mark recapture framework

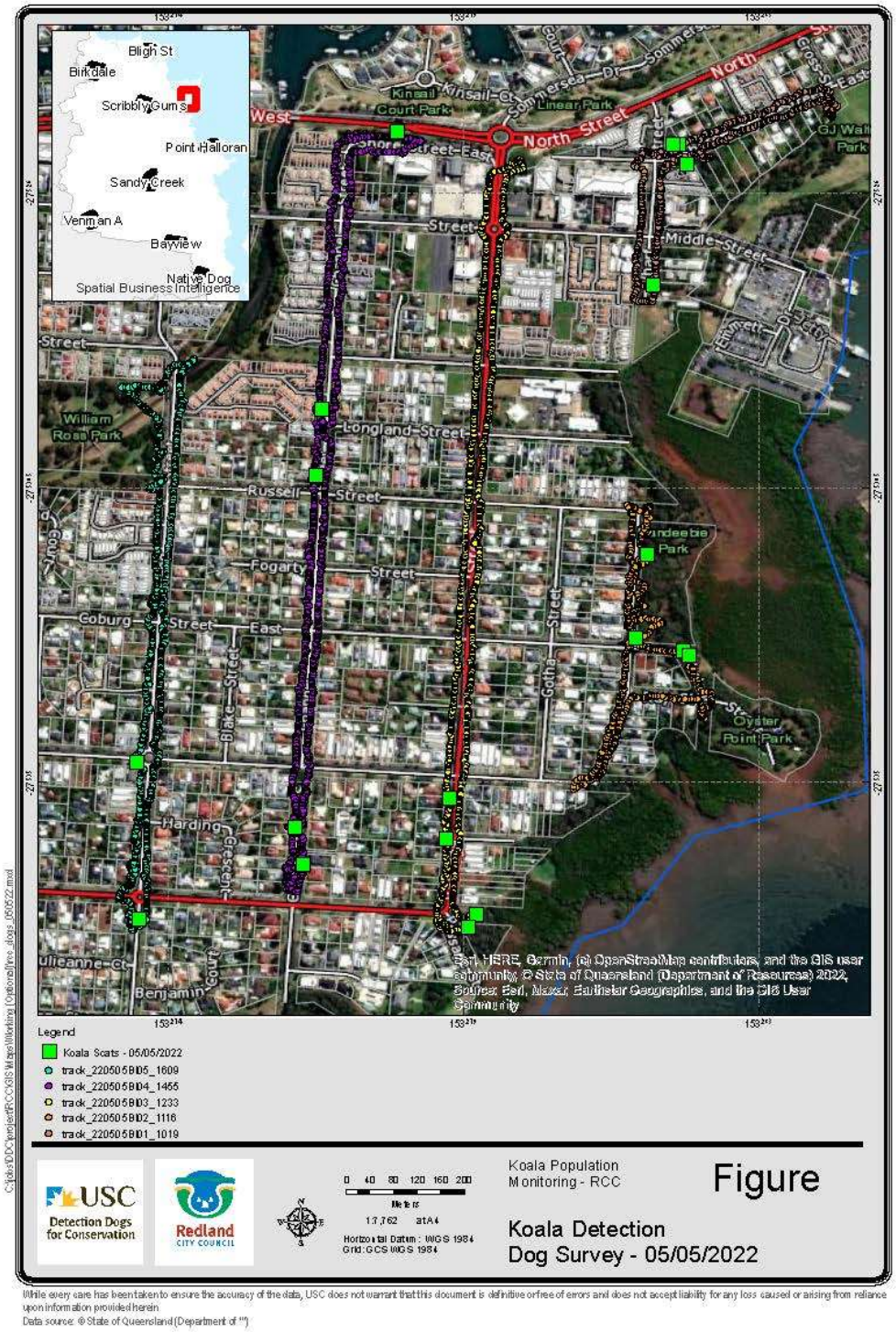

Figure 19. Dog tracks and locations of fresh scats identified by the fresh scat koala detection dog (first repeat)

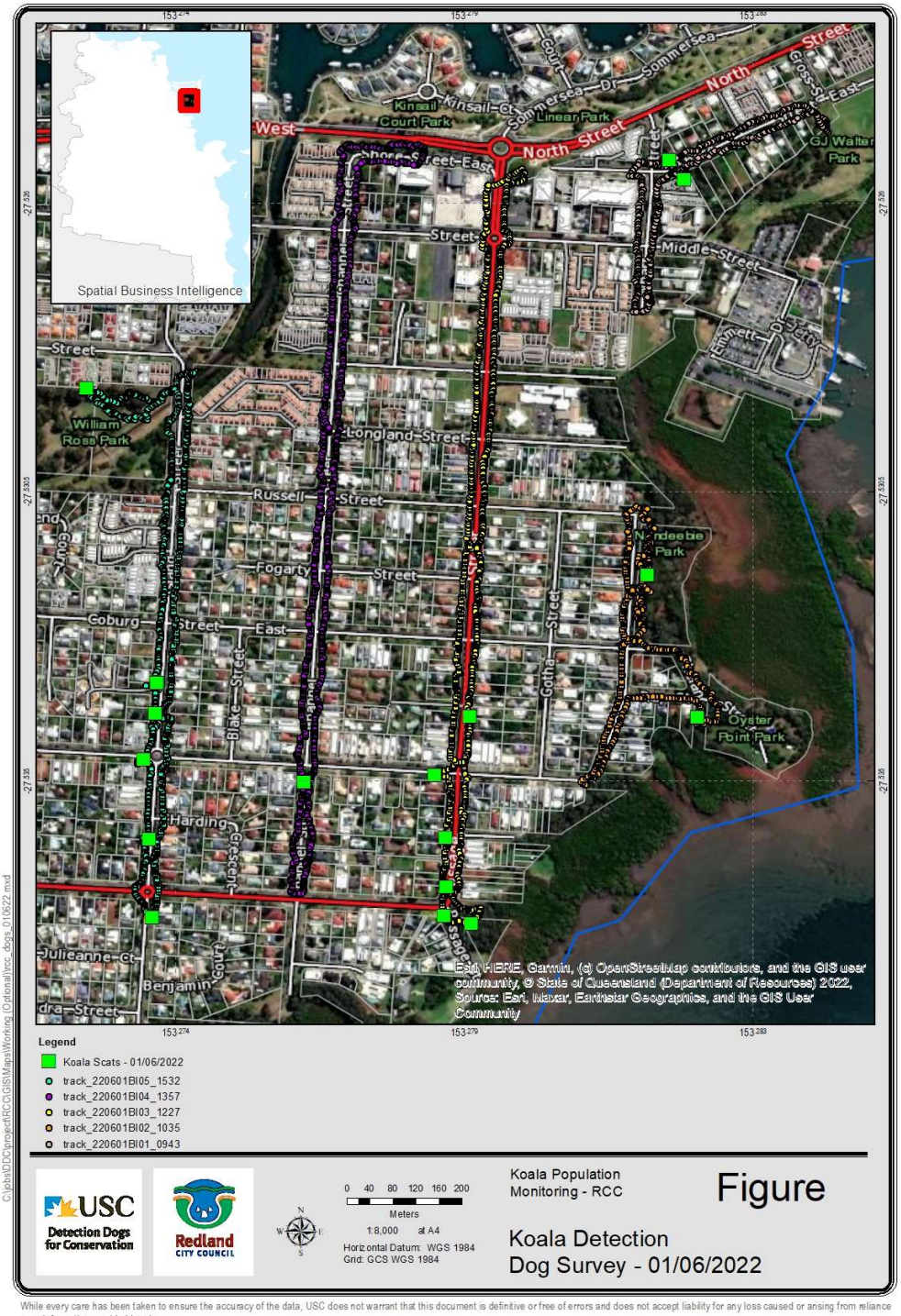

Figure 20. Dog tracks and locations of fresh scats identified by the fresh scat koala detection dog (second repeat)

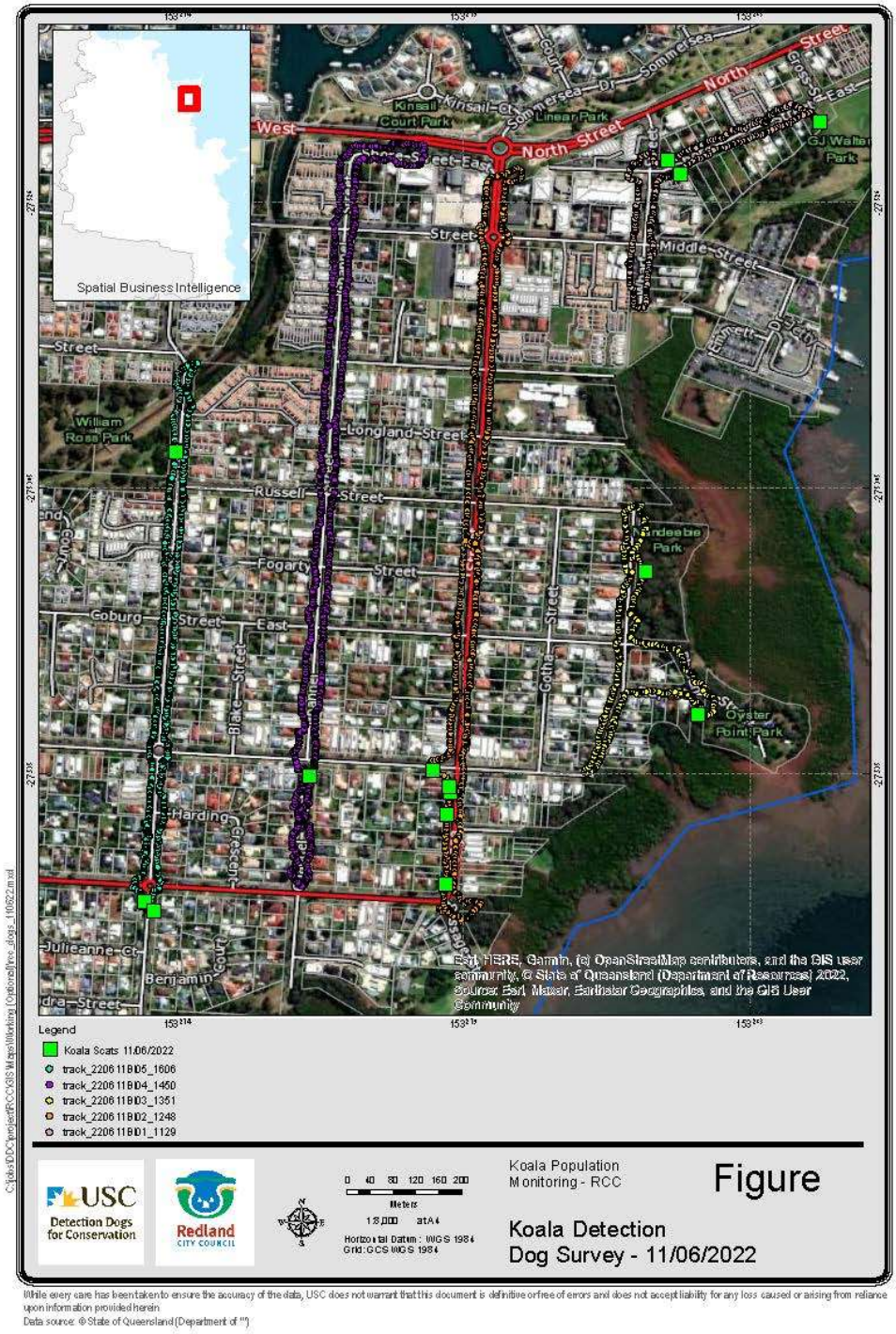

Figure 21. Dog tracks and locations of fresh scats identified by the fresh scat koala detection dog (third repeat)

Part 3 - Facilitation of the KSN citizen science and community engagement activities

This component focused on developing a citizen science and engagement program, again in collaboration with CSIRO. This saw the development of a proof-of-concept mobile App which allows for easy and rapid reporting of koala sightings, interacts with koala Bluetooth ear tags and encourages members of the public to look for signs of koala chlamydial disease. This will be linked to the RCC wildlife rescue services, in an attempt to increase opportunities for rapid rescue of sick koalas which, in turn, translates into higher chances of recovery and release.

Dr Cristescu, Dr Hohwieler and Mr Santos Neto were speakers at the "Let's talk koala research" forum (Figure 22, Figure 23). The event was attended by approximately 150 members of the public, in person and online, and was followed up with a series of questions that were answered in writing (Appendix 4).

Figure 22. Flyer advertising the "Let's talk koala research" forum

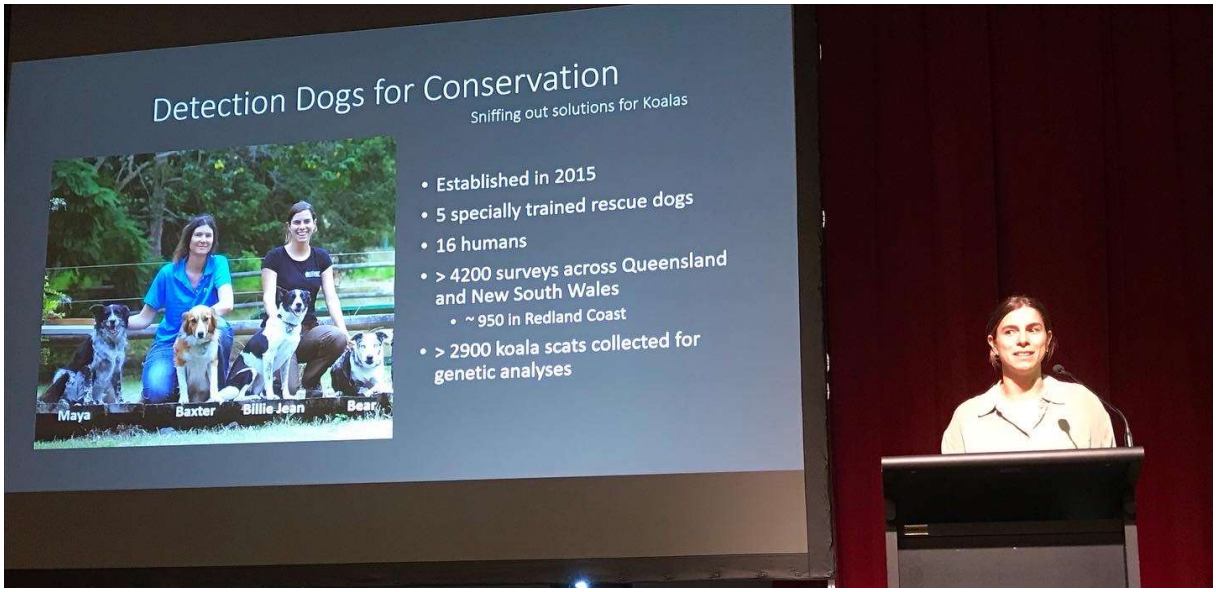

Figure 23. Dr Hohwieler presents the Redland koala genetic results she revealed through her PhD.

The team also provided updates from the ambassador koalas and videos from the field to create content supporting approximately 30 social media posts (Figure 24).


IndigiScapes Centre
April 14 ·
Are you ready for some koala cuteness?
Uka's joey Mistletoe was spotted recently starting to venture away from mum. She made sure mum was within reach though, just in case, before she headed back for some quality snuggle time.
How gorgeous are these two ambassador koalas. Thanks for the photos to brighten up our day Detection Dogs for Conservation.
Michelle Daly, Debbie Pointing and 93 others
4 Comments 18 Shares

IndigiScapes Centre
February 8 ·

Sad news, Oscar has passed away.

Our research team from Detection Dogs for Conservation went looking for Oscar while they were doing health checks on our ambassador koalas recently. Oscar wasn't in his usual spot near Stevens Pl, Ormiston. The team tracked him to the mangroves further along Hilliards Creek and found he had passed away.

A posthumous vet check revealed that Oscar had a small infected ankle wound, likely due to our recent hot, humid weather, and he died of sepsis.

Oscar joined our koala ambassador program in June 2018. He had been raised by a loving foster mother after losing his own mother as a tiny joey. He has been a much loved member of the ambassador team and we will miss him.

If you notice a koala that looks skinny, is sitting on the ground for long periods, has a dirty, wet bottom or red, gunky eyes, please call the Redlands 24hr Wildlife Rescue immediately on 3833 4031. Also remember to submit all your koala sightings to Redlands Coast Koala Watch, the more eyes we have on our koalas, the quicker we can help when needed. You can join at www.redland.qld.gov.au/koalawatch.

Credit: Deidre DeVilliers and Detection Dogs for Conservation

Angela Bell, Debbie Pointing and 296 others 14 Comments 10 Shares


IndigiScapes Centre
March 20 ·
How does our koala ambassador program help us understand our local koala population? What have our researchers discovered about our local koalas?
If you'd like to know, come along to our Science in Action Community Forum – Let's talk koala research to find out. You'll also be able to put questions to the research teams during a Q&A session.
It's free and it's on 23 March from 5pm to 8pm. You can attend online or at the Redland Performing Arts Centre. Registration is essential.
To find out more and register, visit https://redlnd.cc/koala_forum
Miles
Free
Let's talk koala research
Uka
Axle
Michelle Daly and 14 others
9 Shares

IndigiScapes Centre
December 17, 2021 ·

What are our ambassador koalas up to?

Let's start with the biggest gift of this month, Thelma had her vet check and she is carrying a joey. Our first new koala in Mount Cotton. We are really excited to see this joey grow.

Hazel has dropped her collar, but we'll keep an eye on her when we can. Kimo seems to be recovering from her cheek impaction, but it's not completely healed. She crossed Bligh Street and is now on the opposite side of the Geoff Skinner Wetlands Park.

Bruce is completely healed from conjunctivitis and will be released soon. Squirrel has moved quite a bit and is living near Hilliards Creek. He might be looking for new partners in this bachelor season.

Blake and Oscar both had their vet checks and collars resized. Oscar is a real cutie and is looking forward to the holidays, as are we. Axle also had a trip to see the vets and is a healthy, strong boy.

Uka has left the swampy area she frequents, to check out the kids playing during the school holidays. She's now hanging out near the Tulloch Drive Sun Smart Playground.

Grace is looking really healthy at the moment. While Guinevere is as hard to spot as always. Why so hard, Guinevere? Please, allow us just one good picture before the end of 2021.

Silkie, a female that we have monitored for more than two years, was found very sick. We captured her and took her for treatment. Unfortunately, she couldn't be saved. Chlamydia is a devastating disease for koalas. Thank you, girl. You were a great koala ambassador, and the mother of many gorgeous joeys. We'll miss you.

And the sad news don't stop there. Last week, we found Miles a little lethargic. We captured and took him for a check-up. He's in intensive care being treated for a chest infection and we're crossing everything that he pulls through. We'll keep you updated on his progress.

Credit: Detection Dogs for Conservation

Figure 24. Examples of social media posts

Finally, the team has started working on the koala App and developed koala profiles (Appendix 5).

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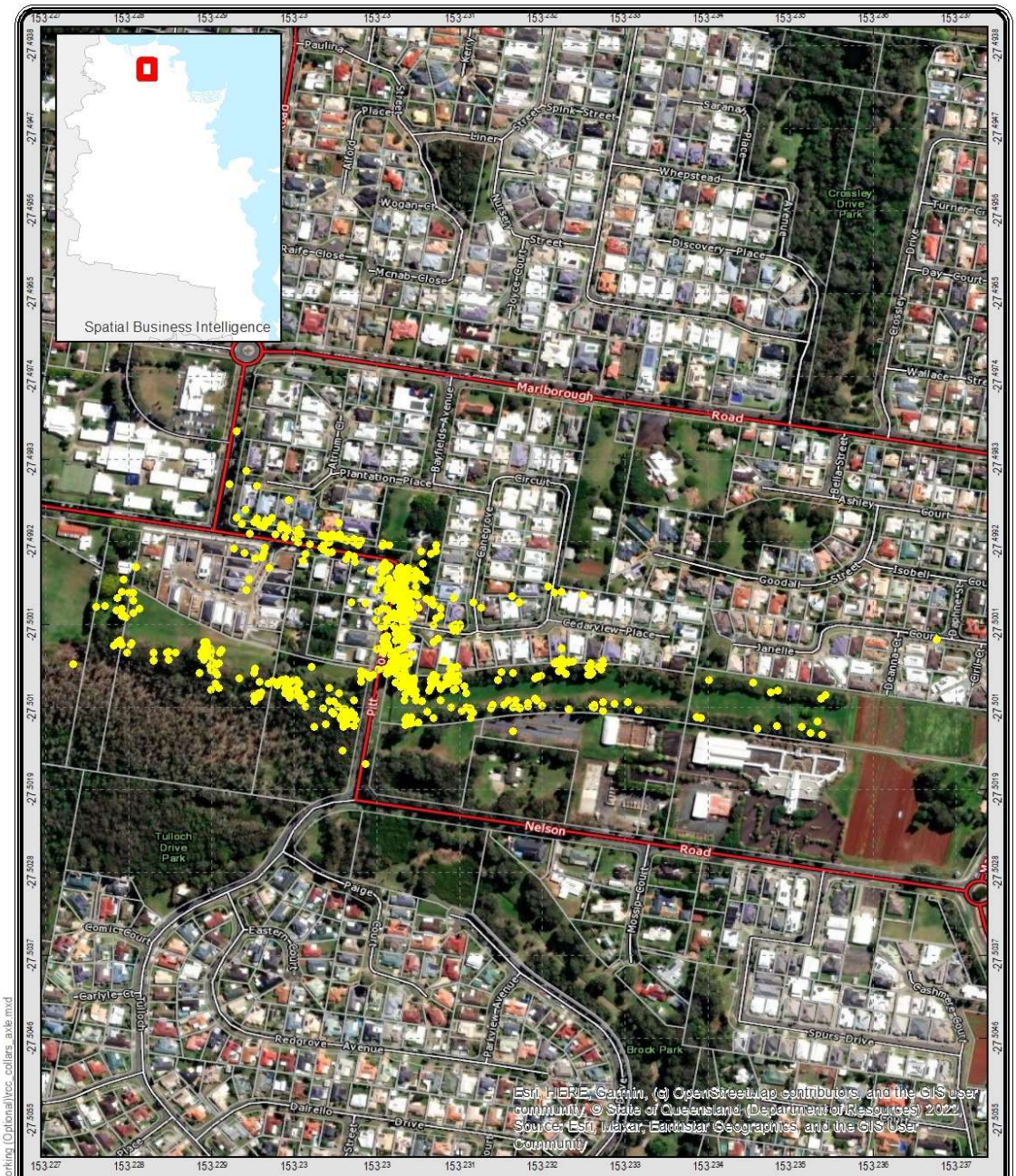
Appendix 1: GPS collar data of koalas

Detection Dogs for Conservation



Legend

- Axle

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USC Detection Dogs for Conservation

Redland City Council

0 30 60 90 120 150
Meters
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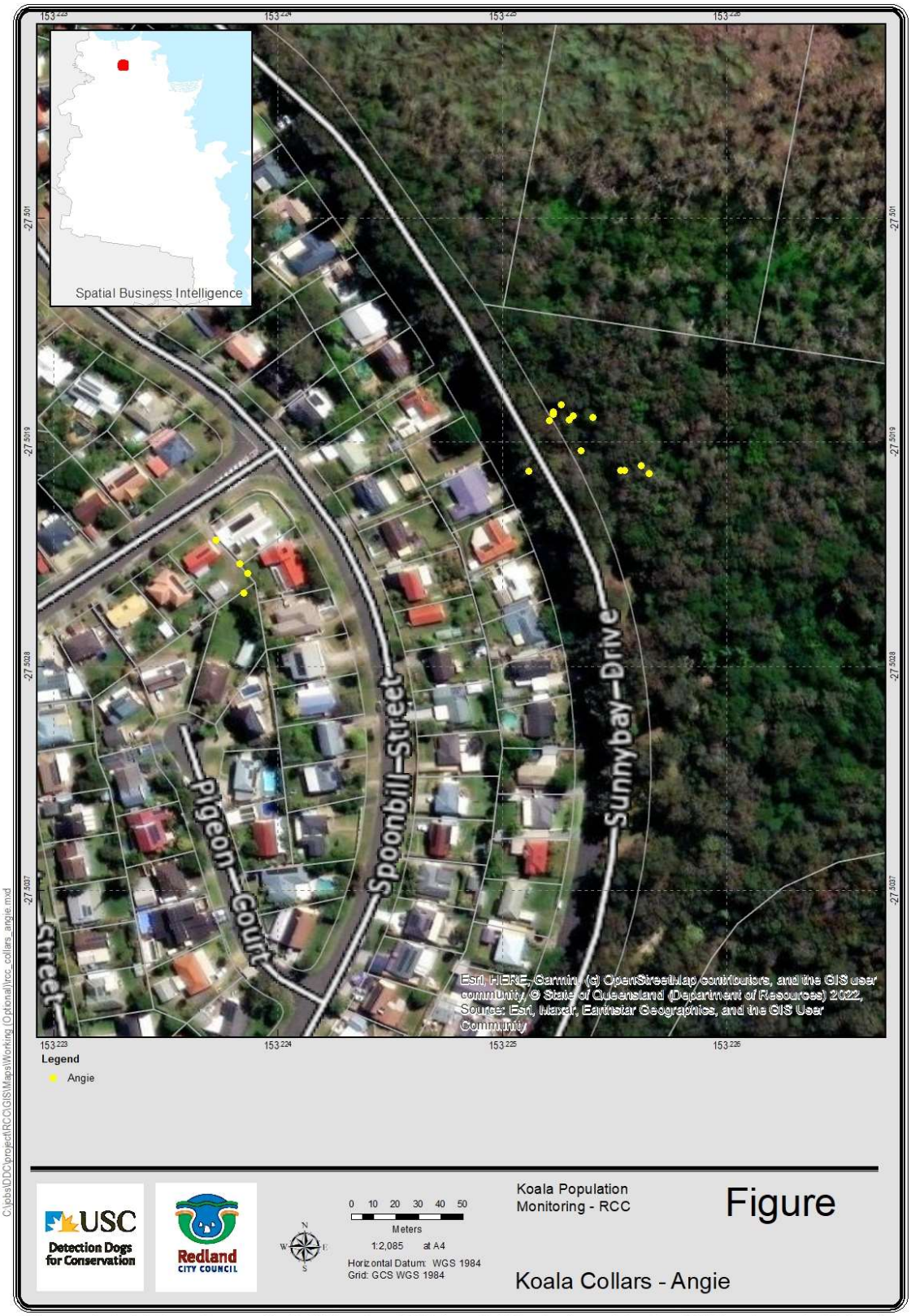
Grid: GCS WGS 1984

Koala Population Monitoring - RCC

Figure

Koala Collars - Axle

USC Detection Dogs for Conservation



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USC Detection Dogs for Conservation

Redland City Council

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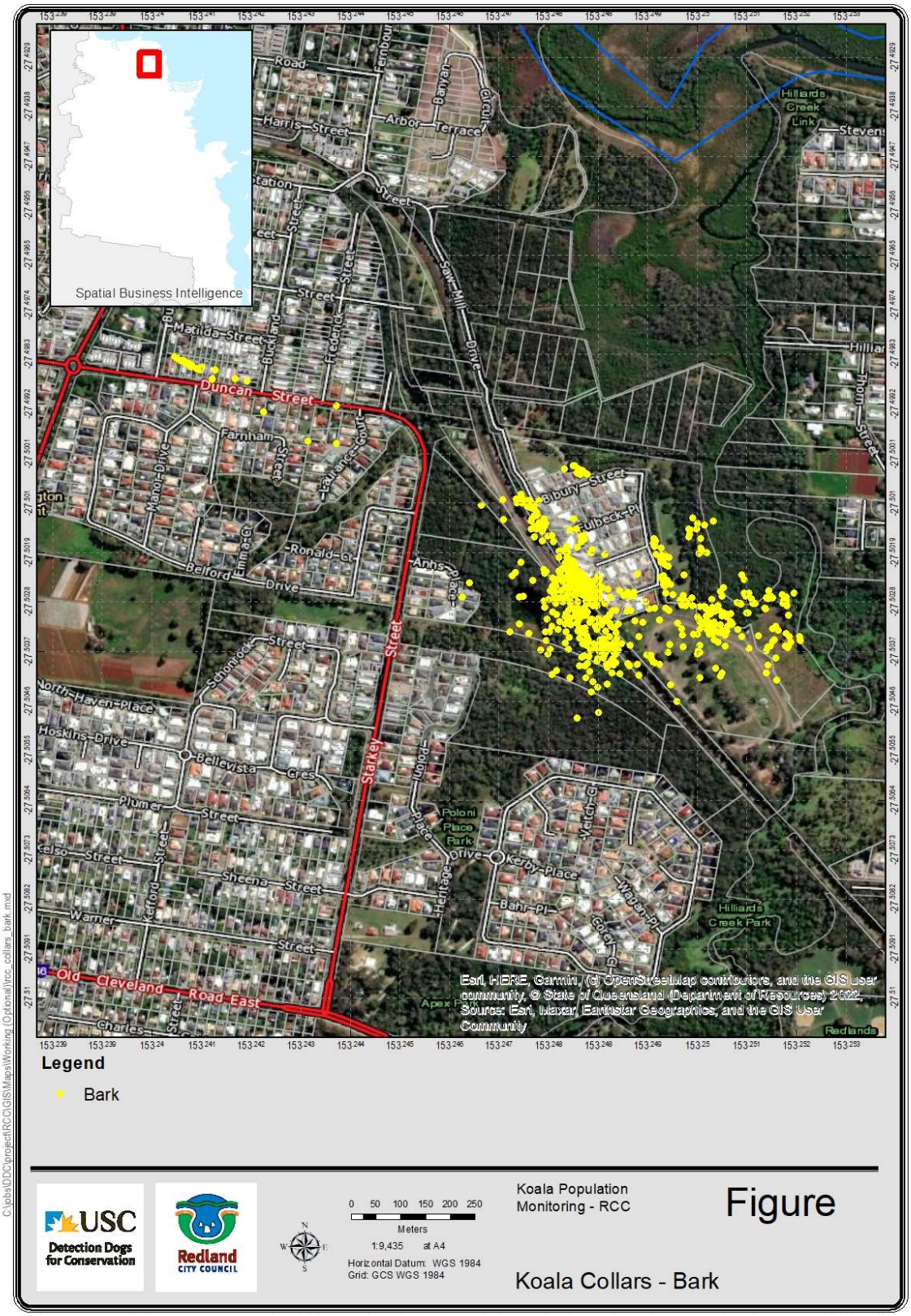
Grid: GCS WGS 1984

Koala Population Monitoring - RCC

Figure

Koala Collars - Angie

Detection Dogs for Conservation



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Detection Dogs for Conservation

Redland City Council

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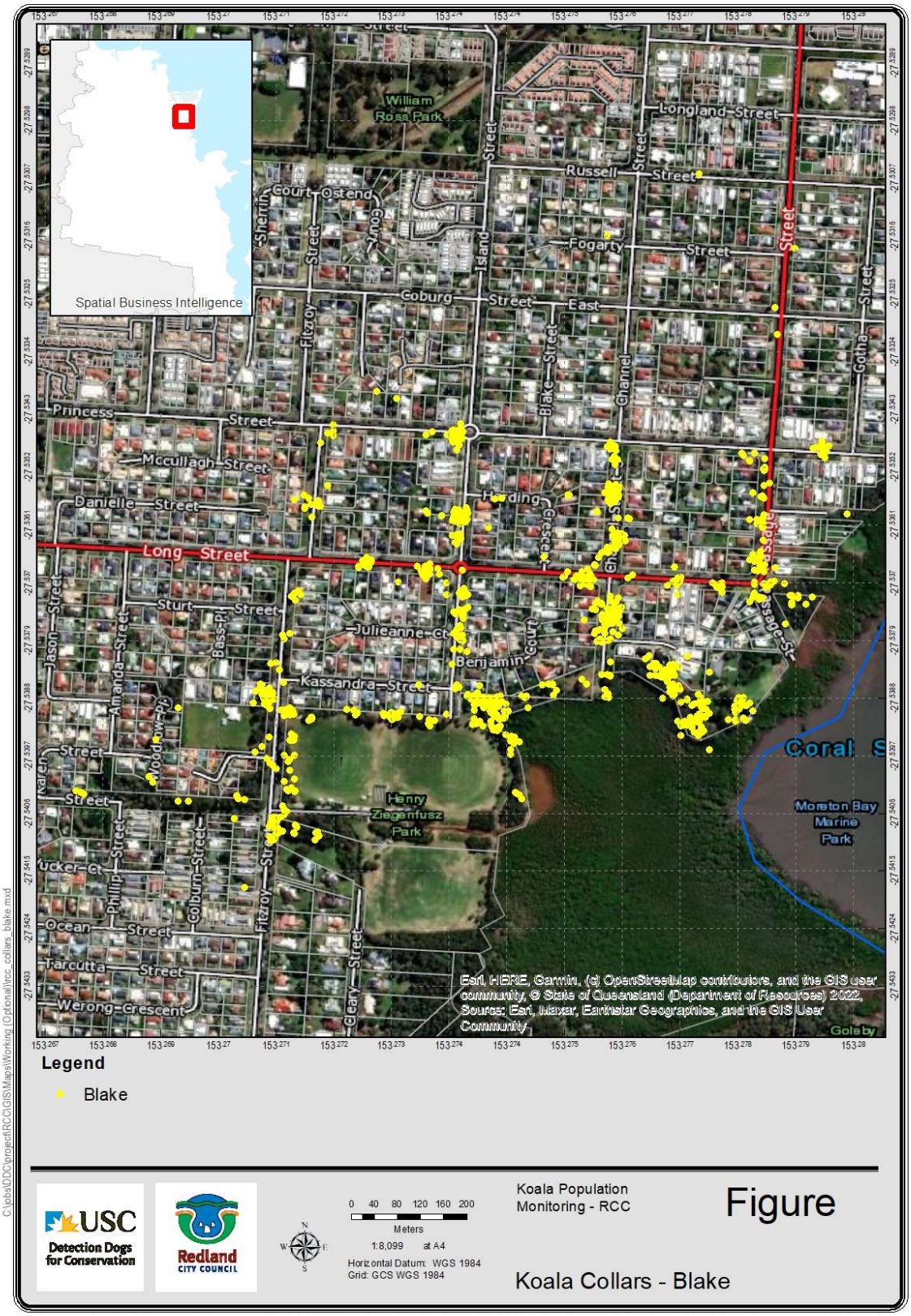
Horizontal Datum: WGS 1984
Grid: GCS WGS 1984

Koala Population Monitoring - RCC

Figure

Koala Collars - Bark

Detection Dogs for Conservation



Legend

- Blake

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USC Detection Dogs for Conservation

Redland City Council

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Meters
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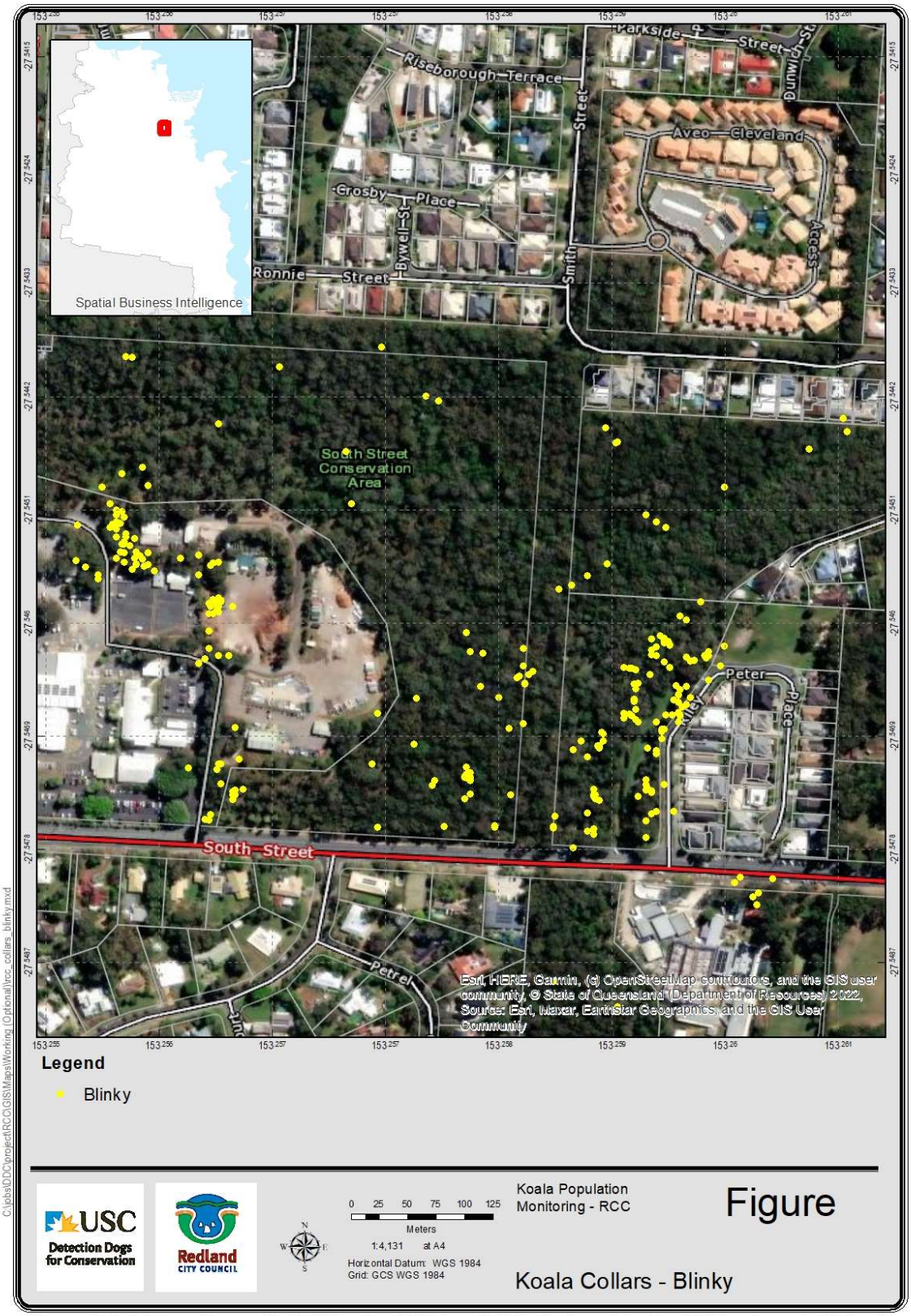
Horizontal Datum: WGS 1984
Grid: GCS WGS 1984

Koala Population Monitoring - RCC

Figure

Koala Collars - Blake

USC Detection Dogs for Conservation



Legend

- Blinky

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USC Detection Dogs for Conservation

Redland City Council

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Meters
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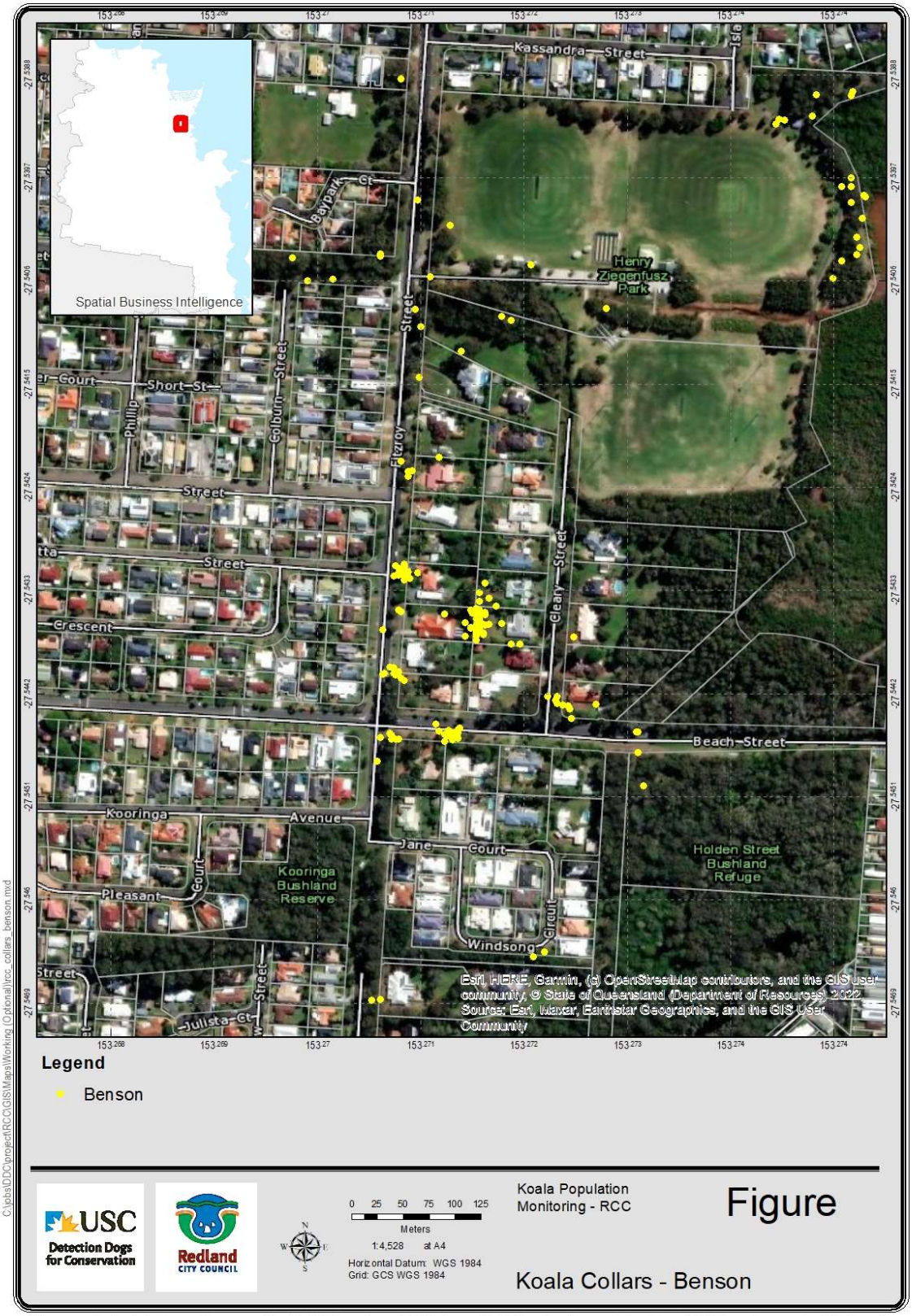
Grid: GCS WGS 1984

Koala Population Monitoring - RCC

Figure

Koala Collars - Blinky

USC Detection Dogs for Conservation



Legend

- Benson

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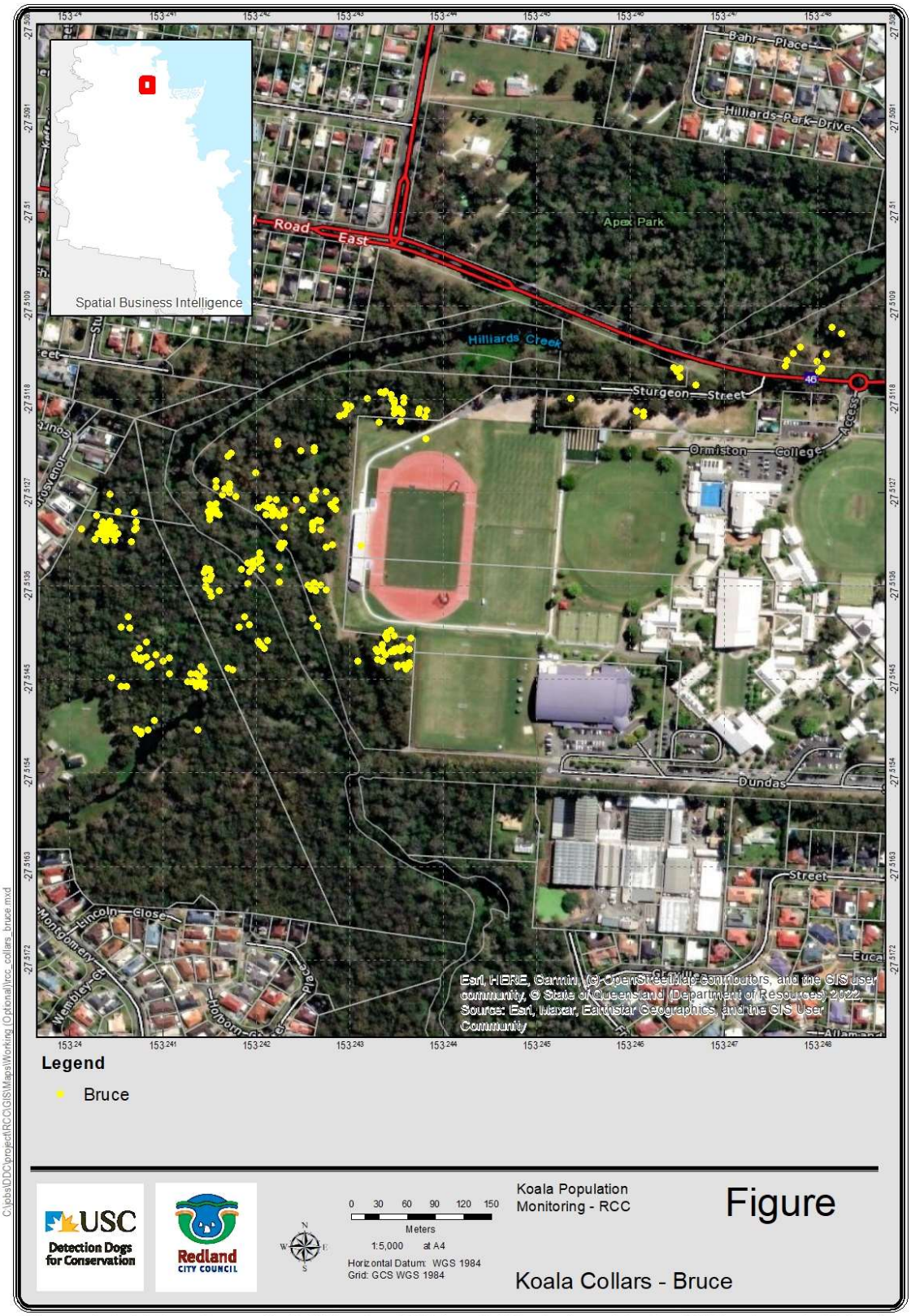
Koala Population Monitoring - RCC

Figure

Koala Collars - Benson

Detection Dogs for Conservation



Legend

- Bruce

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USC Detection Dogs for Conservation

Redland City Council

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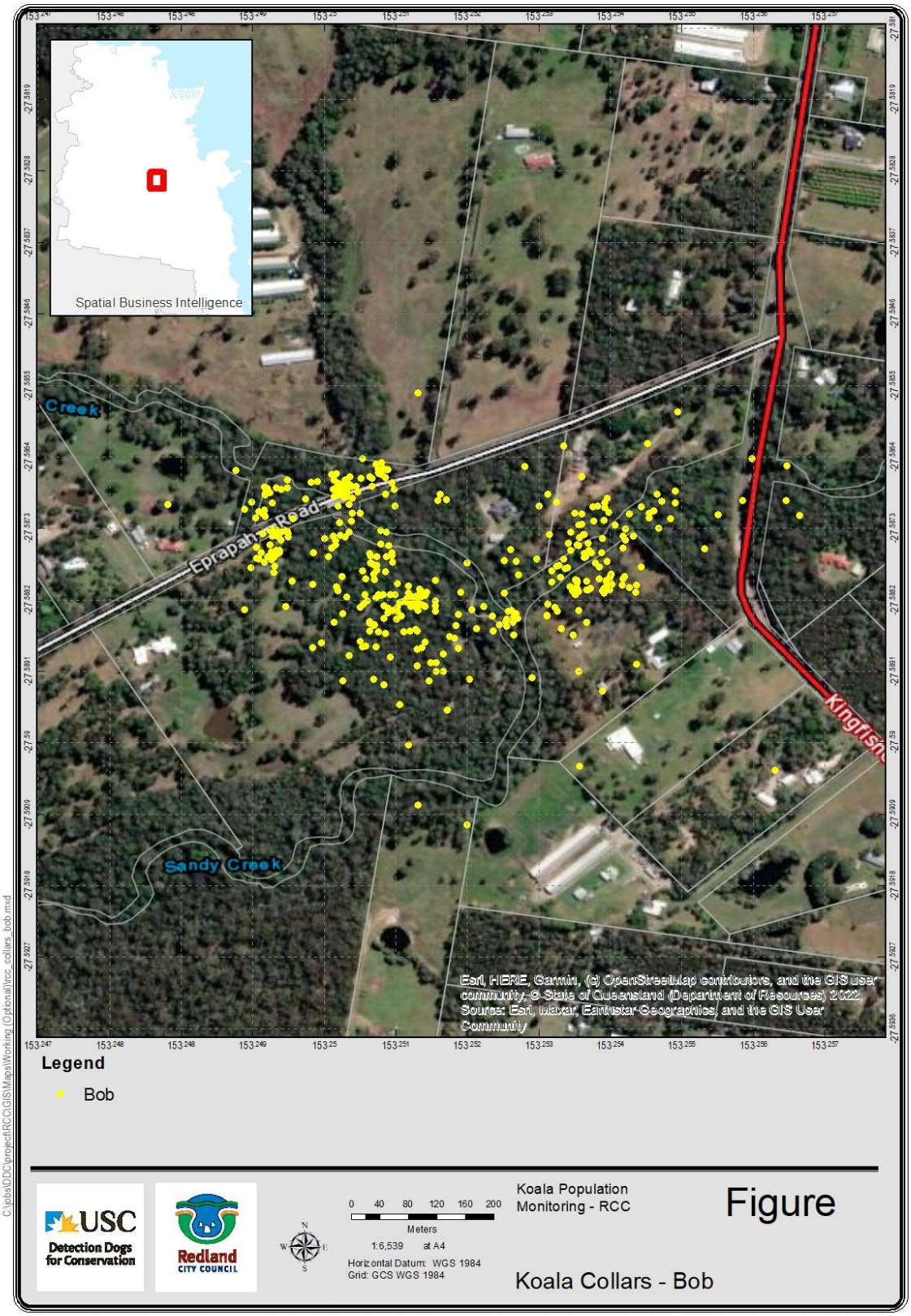
Meters
1:5,000 at A4
Horizontal Datum: WGS 1984
Grid: GCS WGS 1984

Koala Population Monitoring - RCC

Figure

Koala Collars - Bruce

Detection Dogs for Conservation



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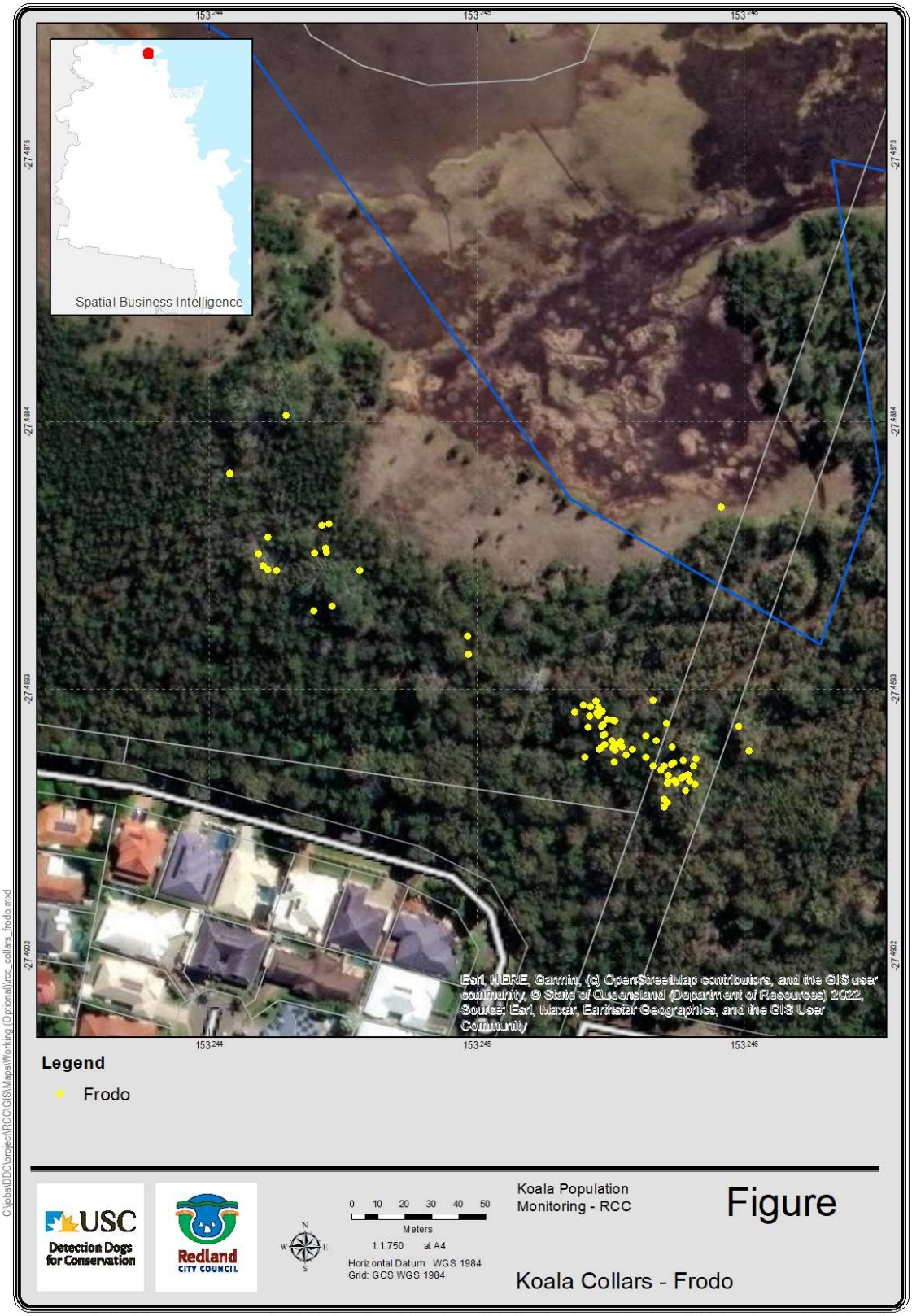
Detection Dogs for Conservation



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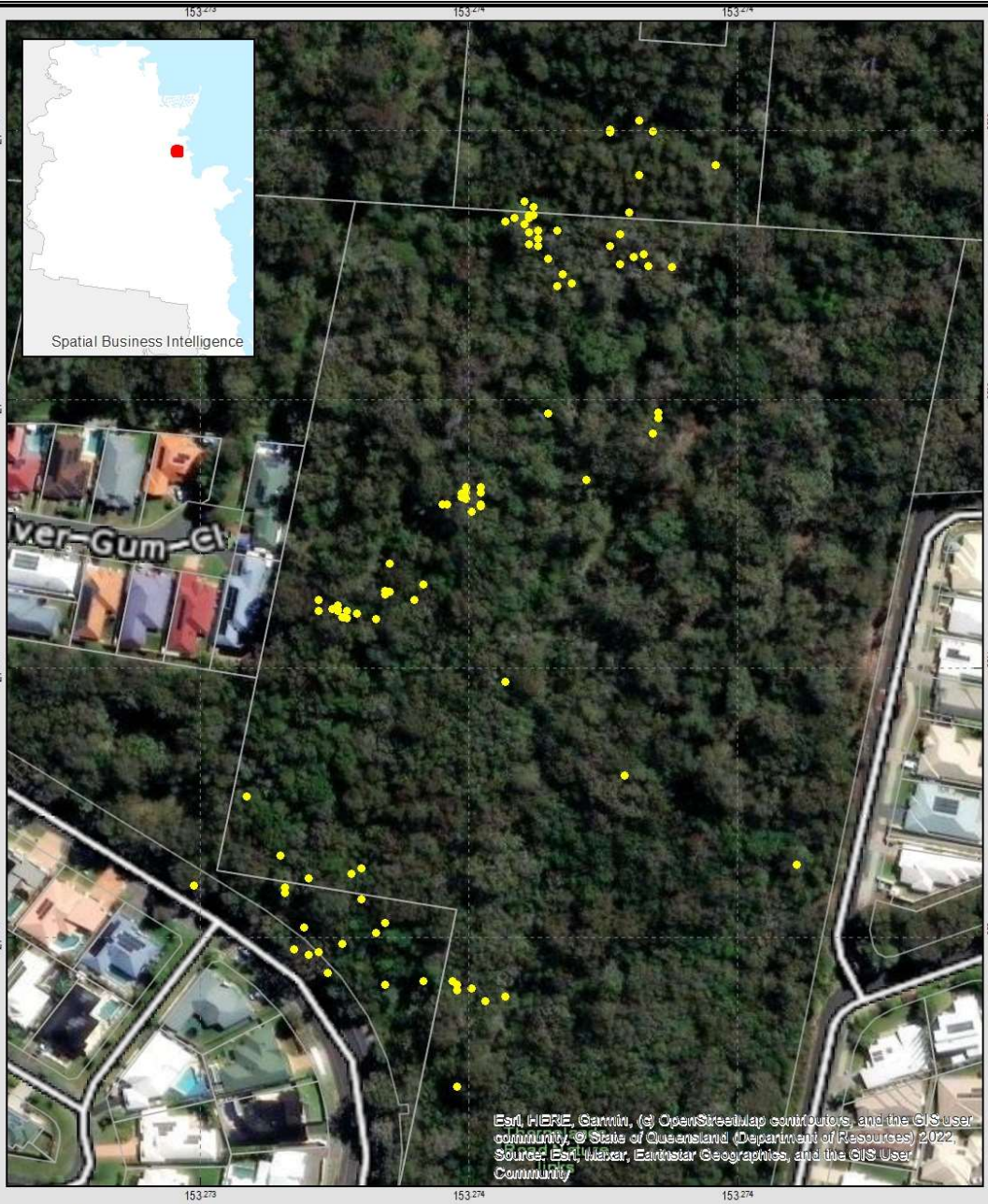

Legend

- Geraldine

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USC Detection Dogs for Conservation

Redland City Council

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Meters
1:2,000 at A4
Horizontal Datum: WGS 1984
Grid: GCS WGS 1984

Koala Population Monitoring - RCC

Figure

Koala Collars - Geraldine

Detection Dogs for Conservation

Legend

- Grace

C:\jobs\DDC\project\RCC\GIS\Maps\Working (Optional)\rcc_collars_grace.mxd

USC Detection Dogs for Conservation

Redland City Council

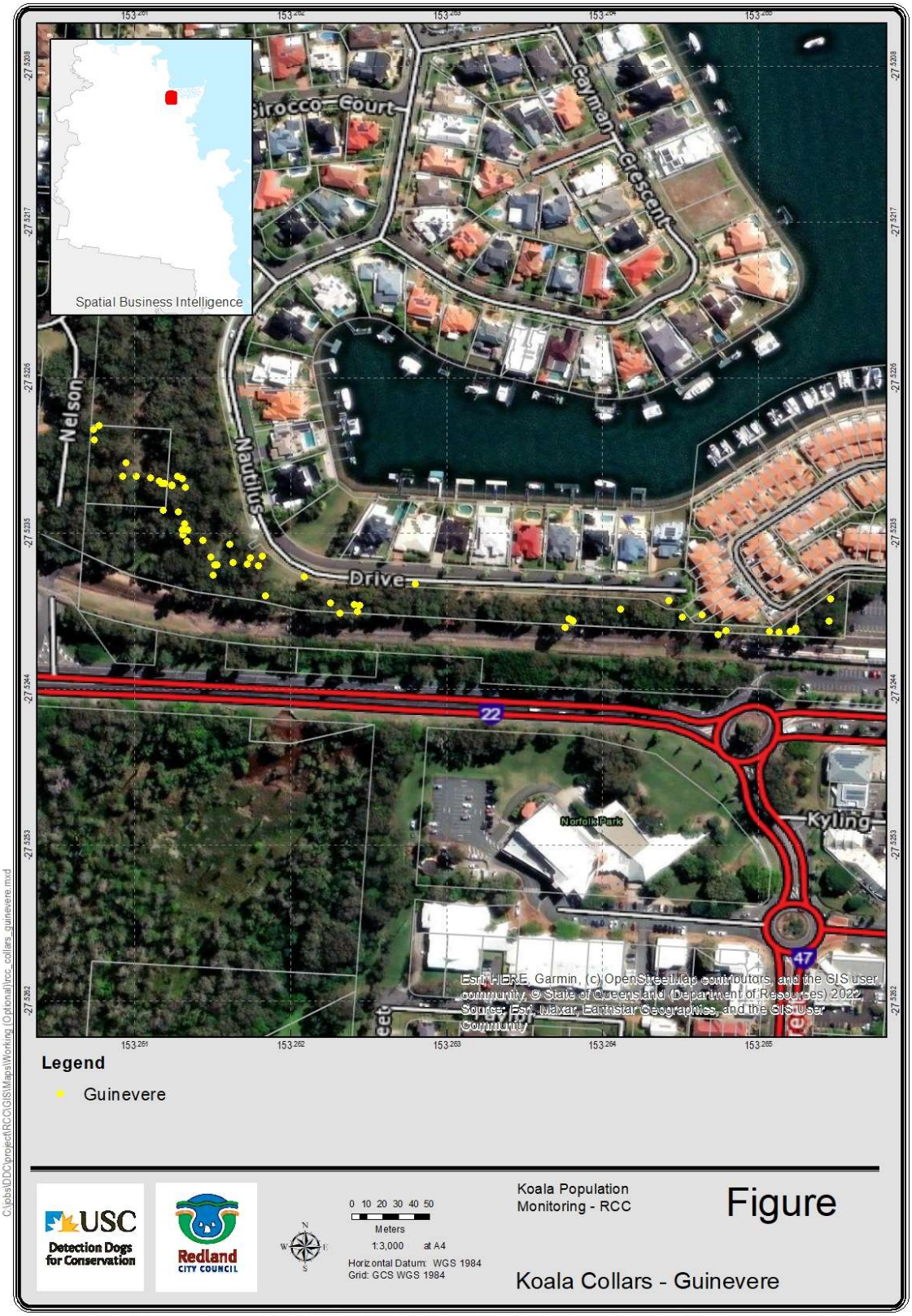
0 10 20 30 40 50
Meters
1:3,000 at A4
Horizontal Datum: WGS 1984
Grid: GCS WGS 1984

Koala Population Monitoring - RCC

Figure

Koala Collars - Grace

Detection Dogs for Conservation



Legend

- Guinevere

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USC Detection Dogs for Conservation

Redland City Council

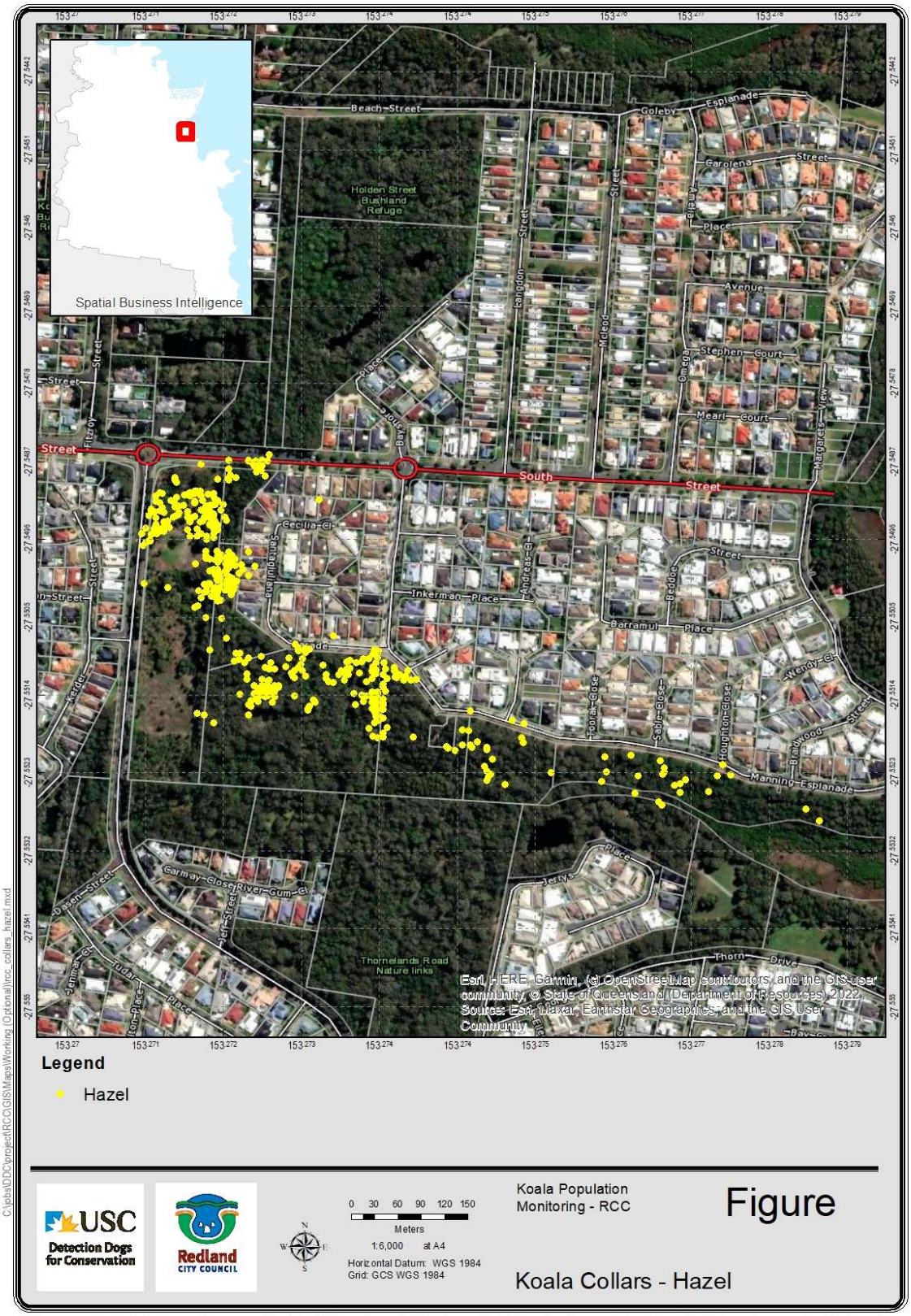
0 10 20 30 40 50
Meters
1:3,000 at A4
Horizontal Datum: WGS 1984
Grid: GCS WGS 1984

Koala Population Monitoring - RCC

Figure

Koala Collars - Guinevere

Detection Dogs for Conservation



Legend

- Hazel

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Detection Dogs for Conservation

Redland City Council

0 30 60 90 120 150
Meters
1:6,000 at A4
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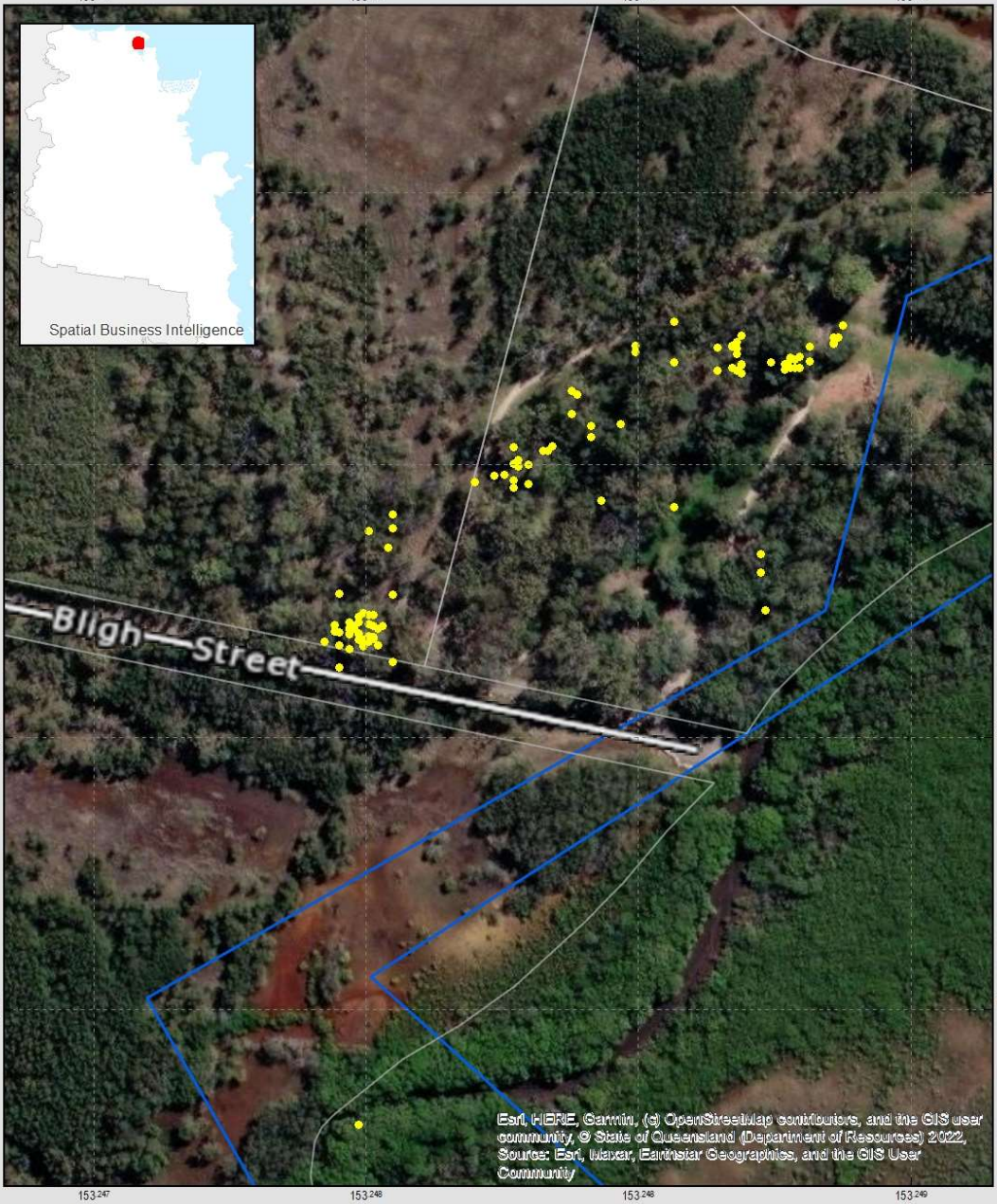
Grid: GCS WGS 1984

Koala Population Monitoring - RCC

Figure

Koala Collars - Hazel

Detection Dogs for Conservation



Legend

- Gummi

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USC Detection Dogs for Conservation

Redland City Council

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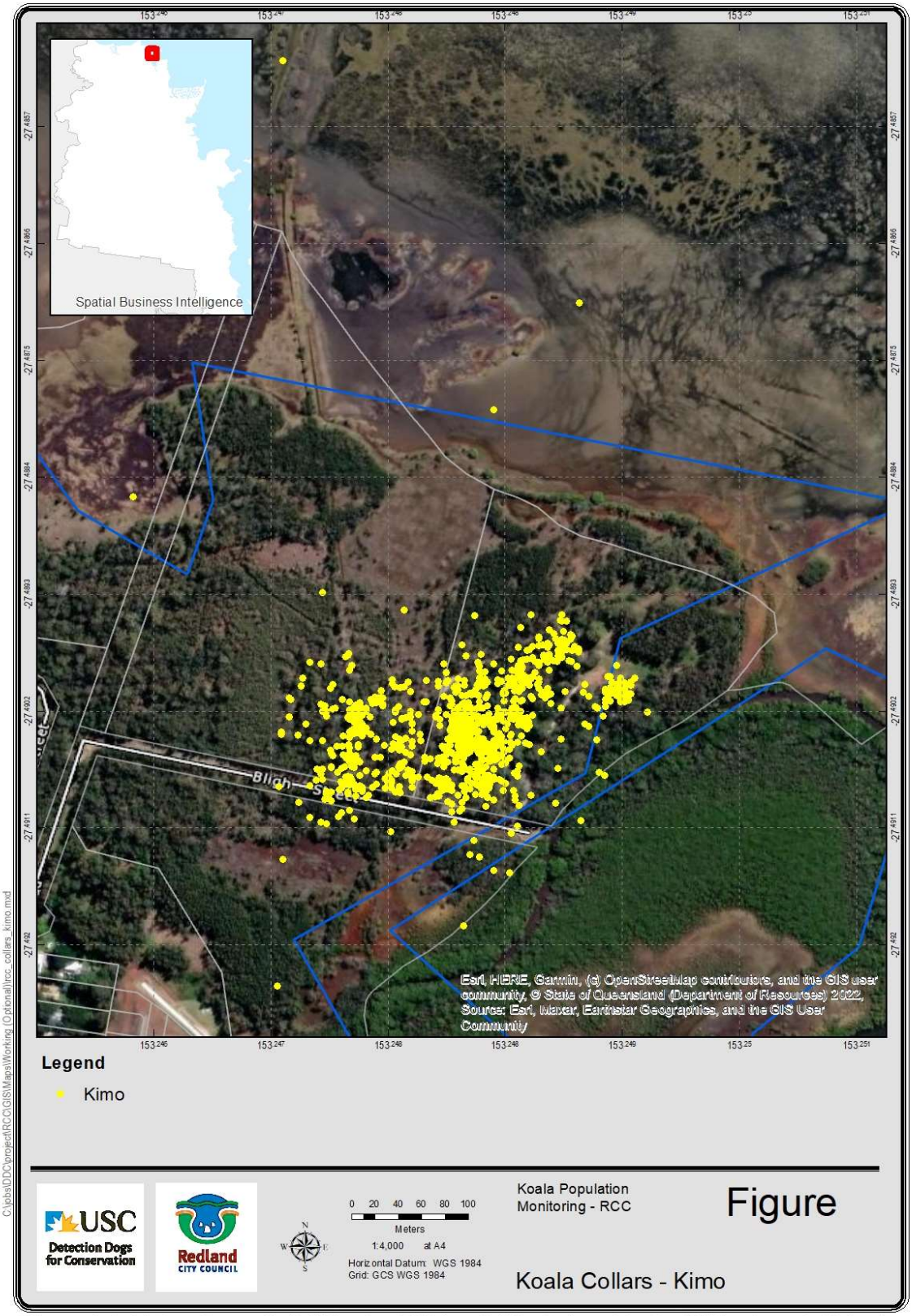
Meters
1:2,000 at A4
Horizontal Datum: WGS 1984
Grid: GCS WGS 1984

Koala Population Monitoring - RCC

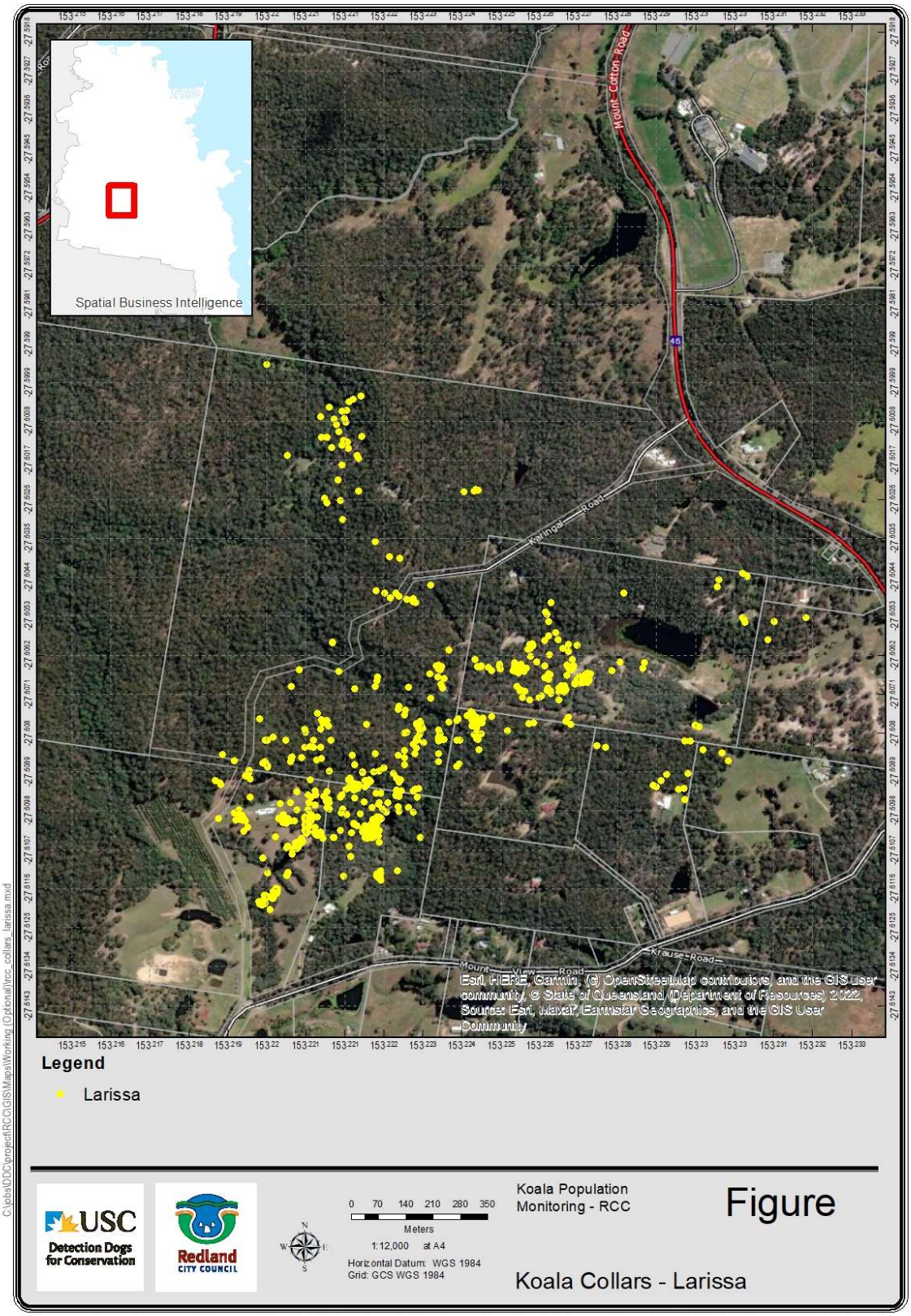
Figure

Koala Collars - Gummi

Detection Dogs for Conservation



Detection Dogs for Conservation



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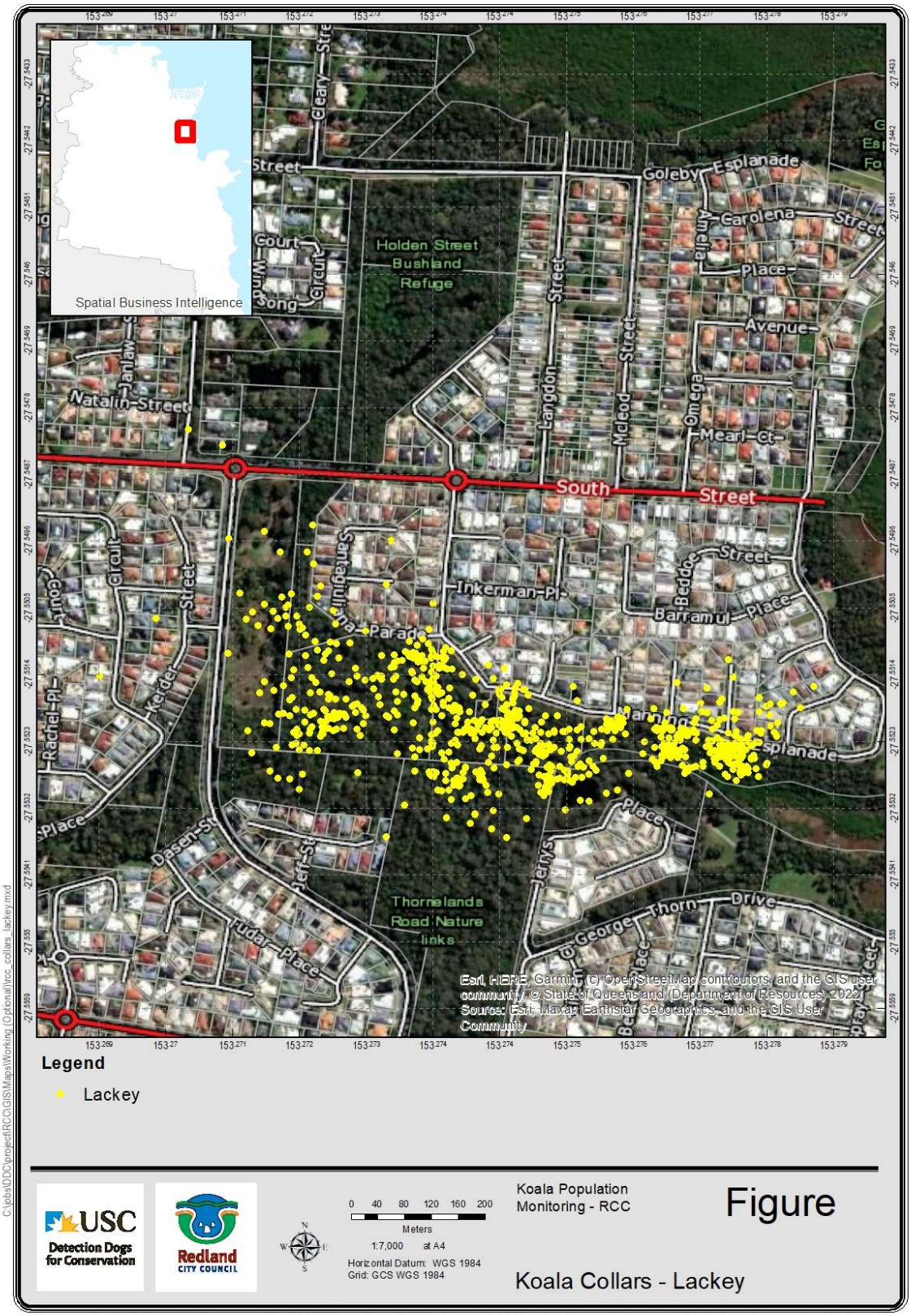

Legend

- Lackey

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USC Detection Dogs for Conservation

Redland City Council

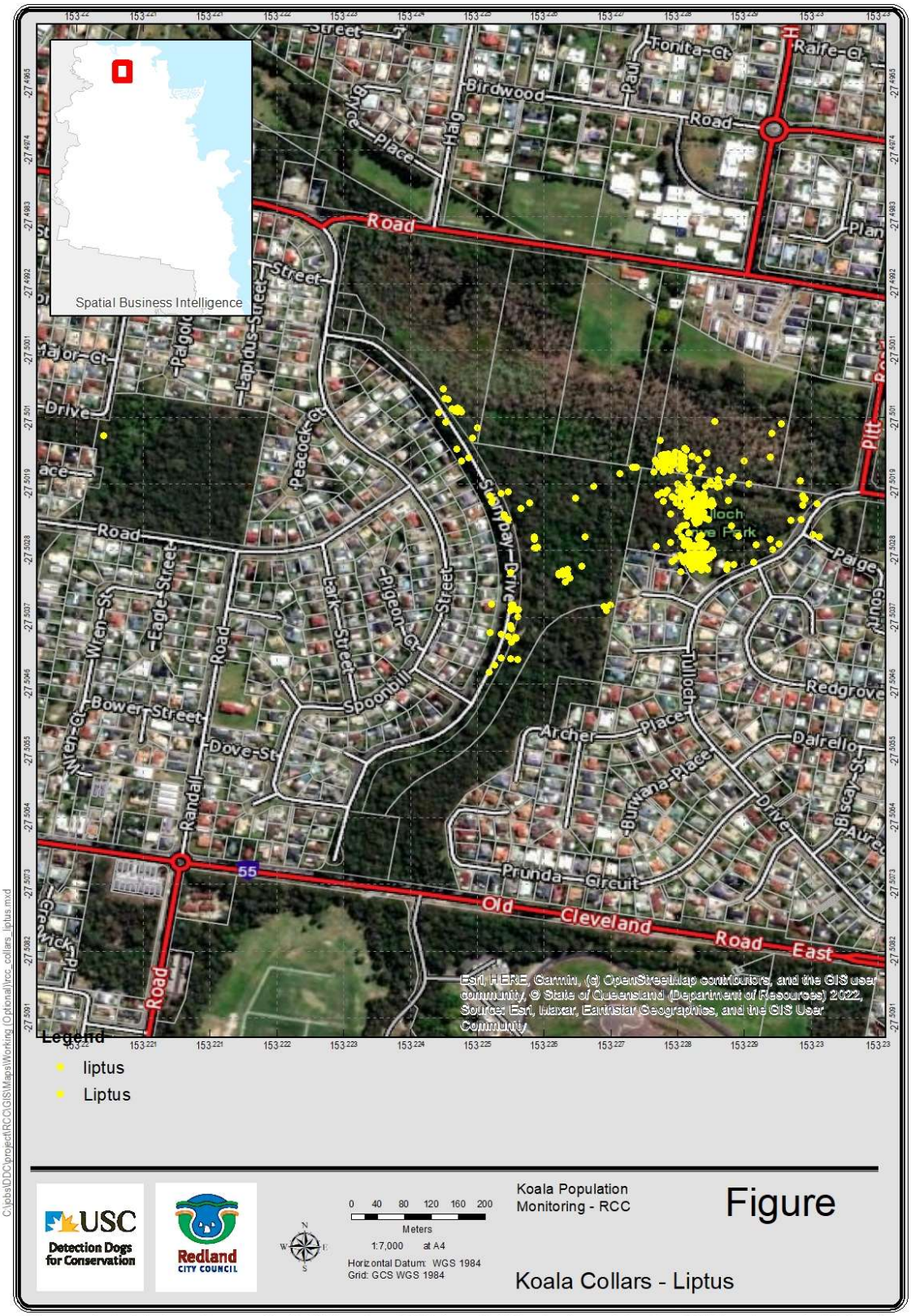
0 40 80 120 160 200
Meters
1:7,000 at A4
Horizontal Datum: WGS 1984
Grid: GCS WGS 1984

Koala Population Monitoring - RCC

Figure

Koala Collars - Lackey

Detection Dogs for Conservation



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USC Detection Dogs for Conservation

Redland City Council

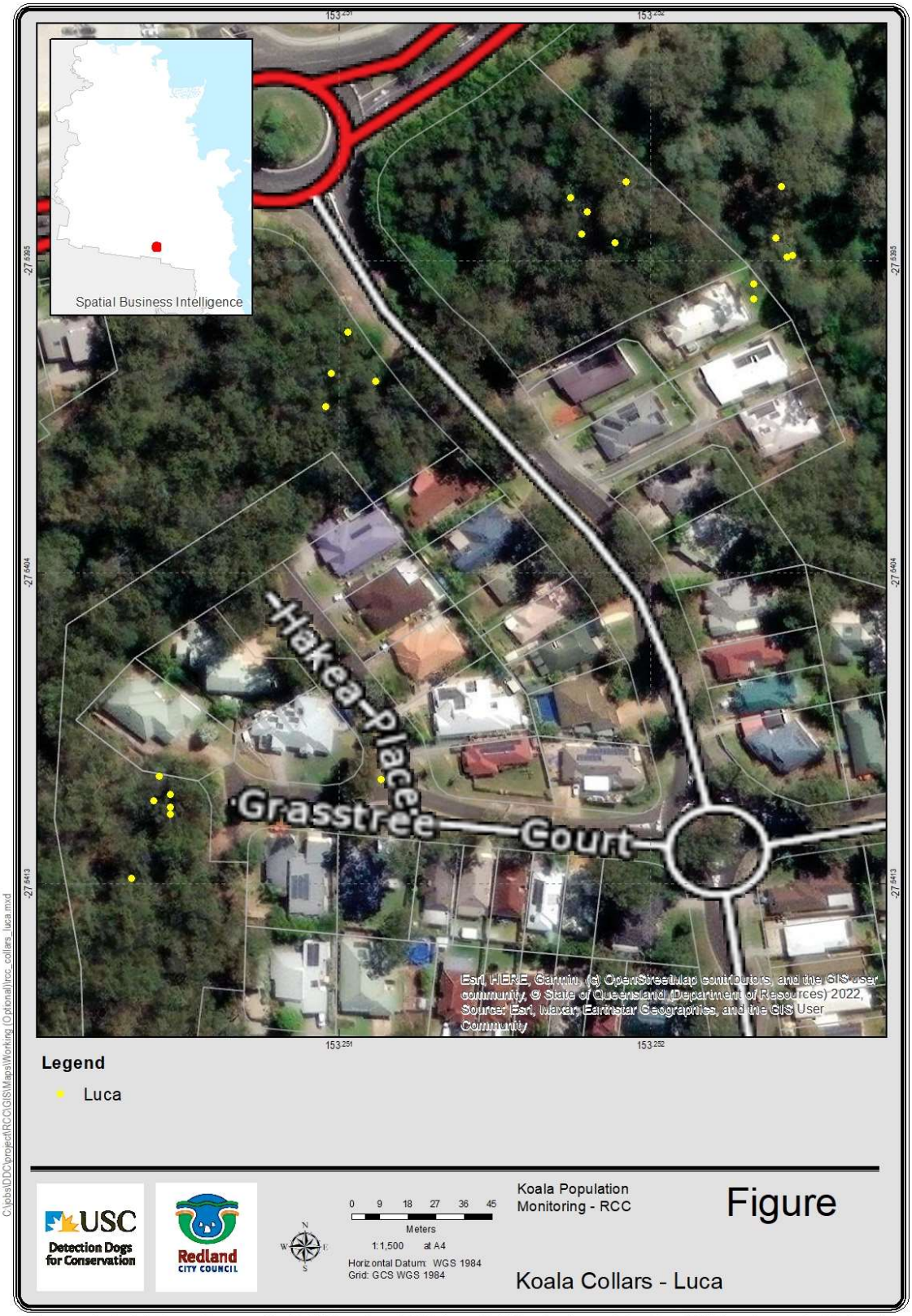
0 40 80 120 160 200
Meters
1:7,000 at A4
Horizontal Datum: WGS 1984
Grid: GCS WGS 1984

Koala Population Monitoring - RCC

Figure

Koala Collars - Liptus

USC Detection Dogs for Conservation



Legend

- Luca

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USC Detection Dogs for Conservation

Redland City Council

N W E S

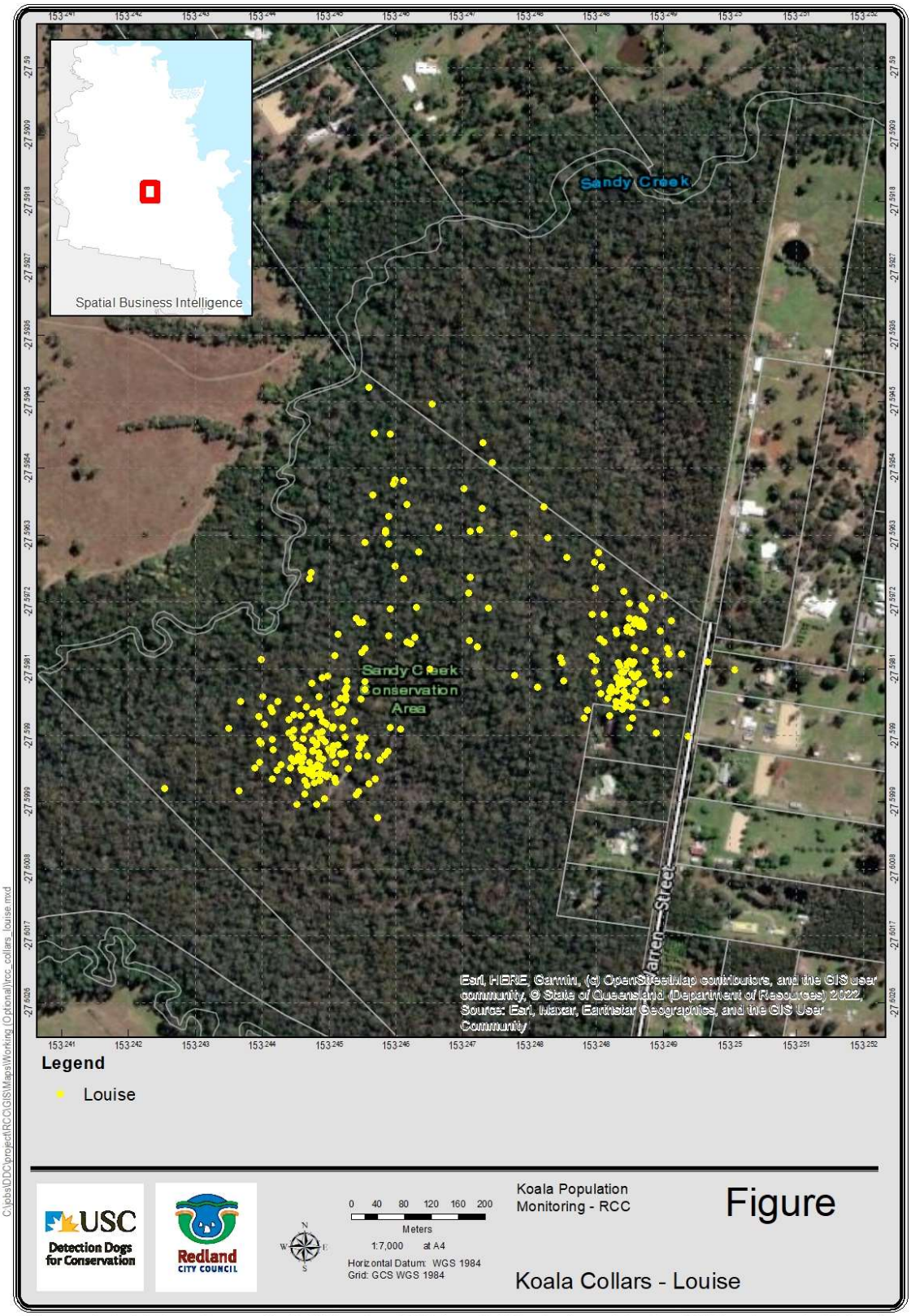
0 9 18 27 36 45
Meters
1:1,500 at A4
Horizontal Datum: WGS 1984
Grid: GCS WGS 1984

Koala Population Monitoring - RCC

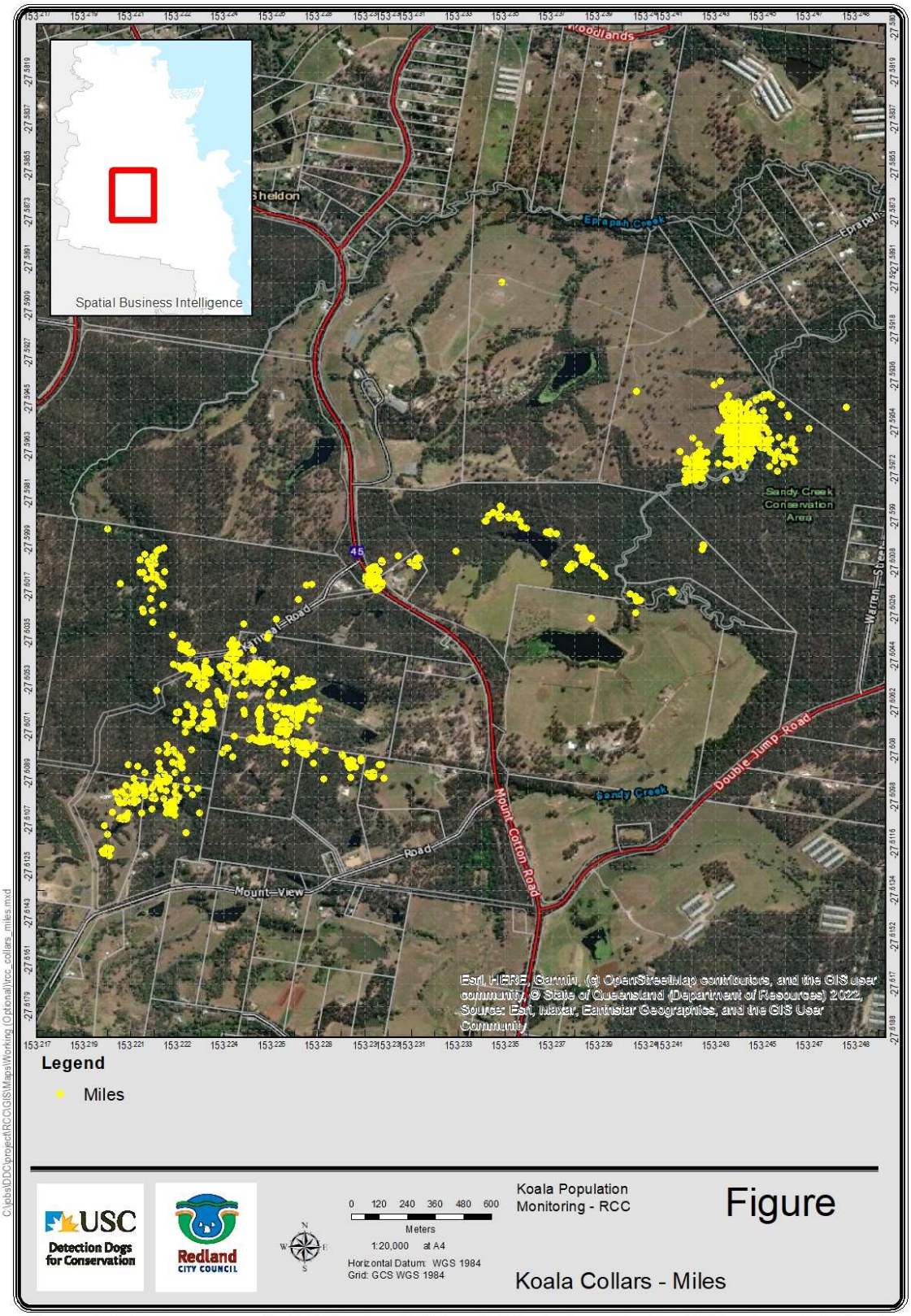
Figure

Koala Collars - Luca

Detection Dogs for Conservation



USC Detection Dogs for Conservation



Legend

- Miles

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USC Detection Dogs for Conservation

Redland City Council

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Meters
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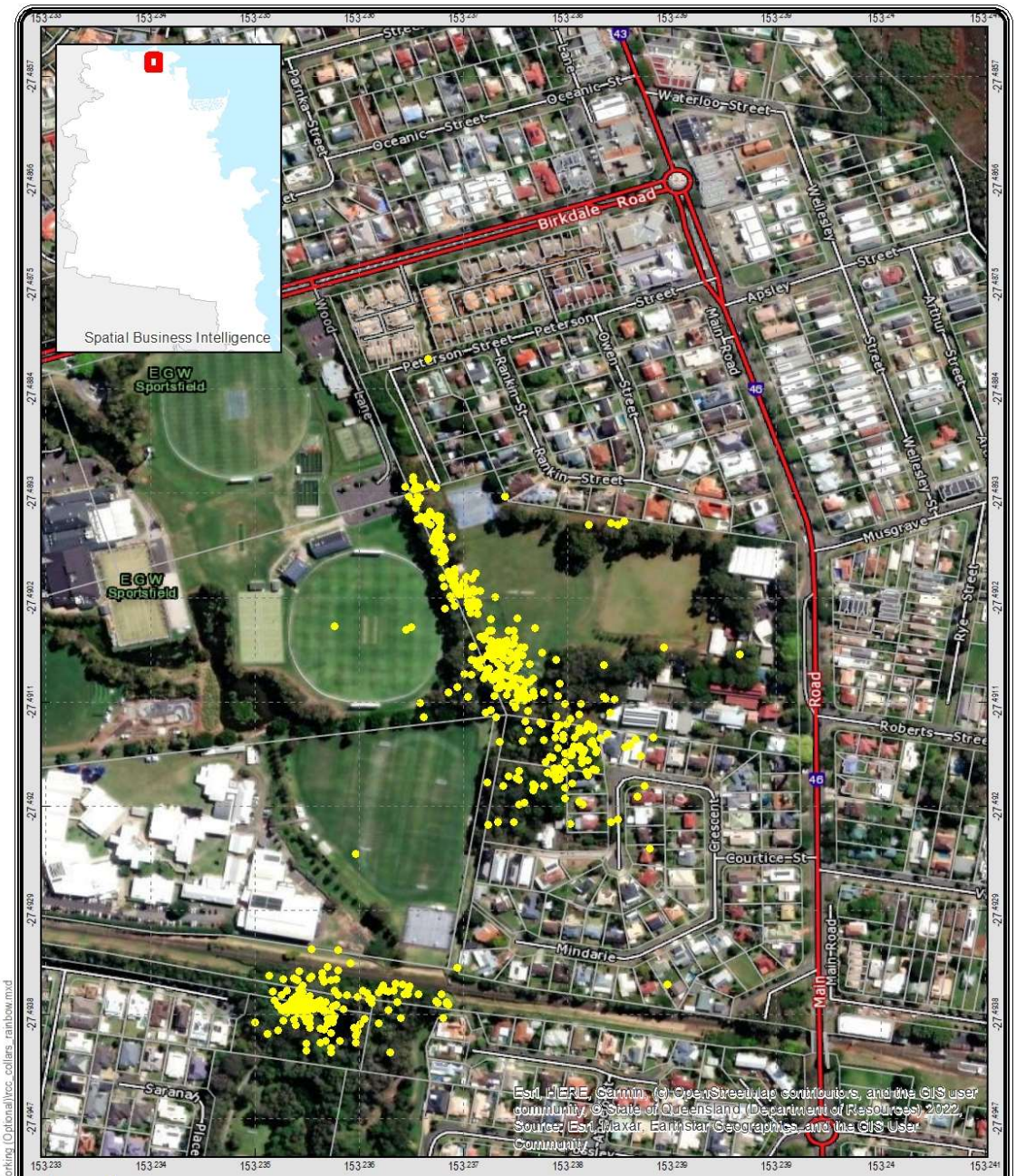
Horizontal Datum: WGS 1984
Grid: GCS WGS 1984

Koala Population Monitoring - RCC

Figure

Koala Collars - Miles

Detection Dogs for Conservation



Legend

- Rainbow

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USC Detection Dogs for Conservation

Redland City Council

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Meters
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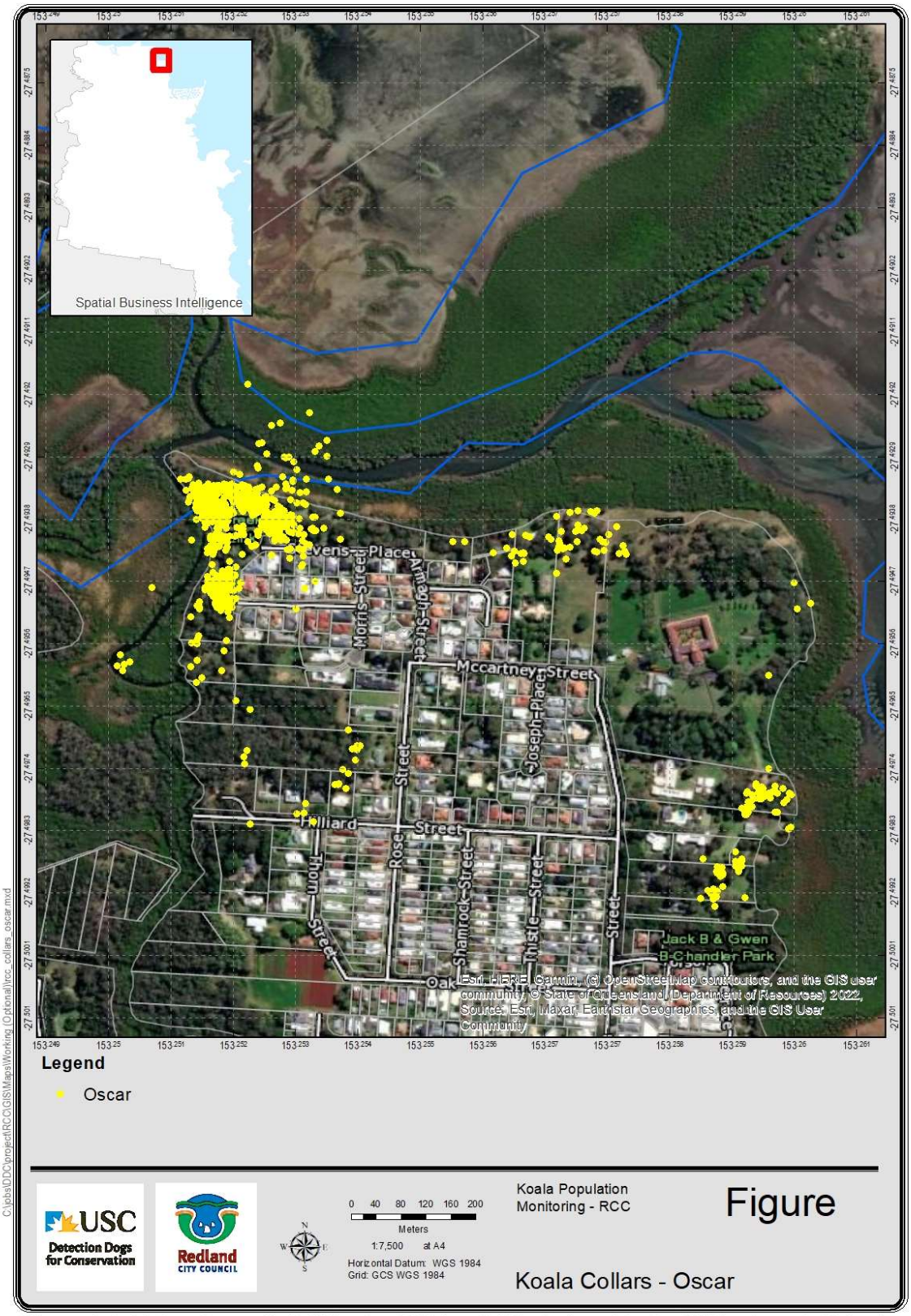
Horizontal Datum: WGS 1984
Grid: GCS WGS 1984

Koala Population Monitoring - RCC

Figure

Koala Collars - Rainbow

Detection Dogs for Conservation



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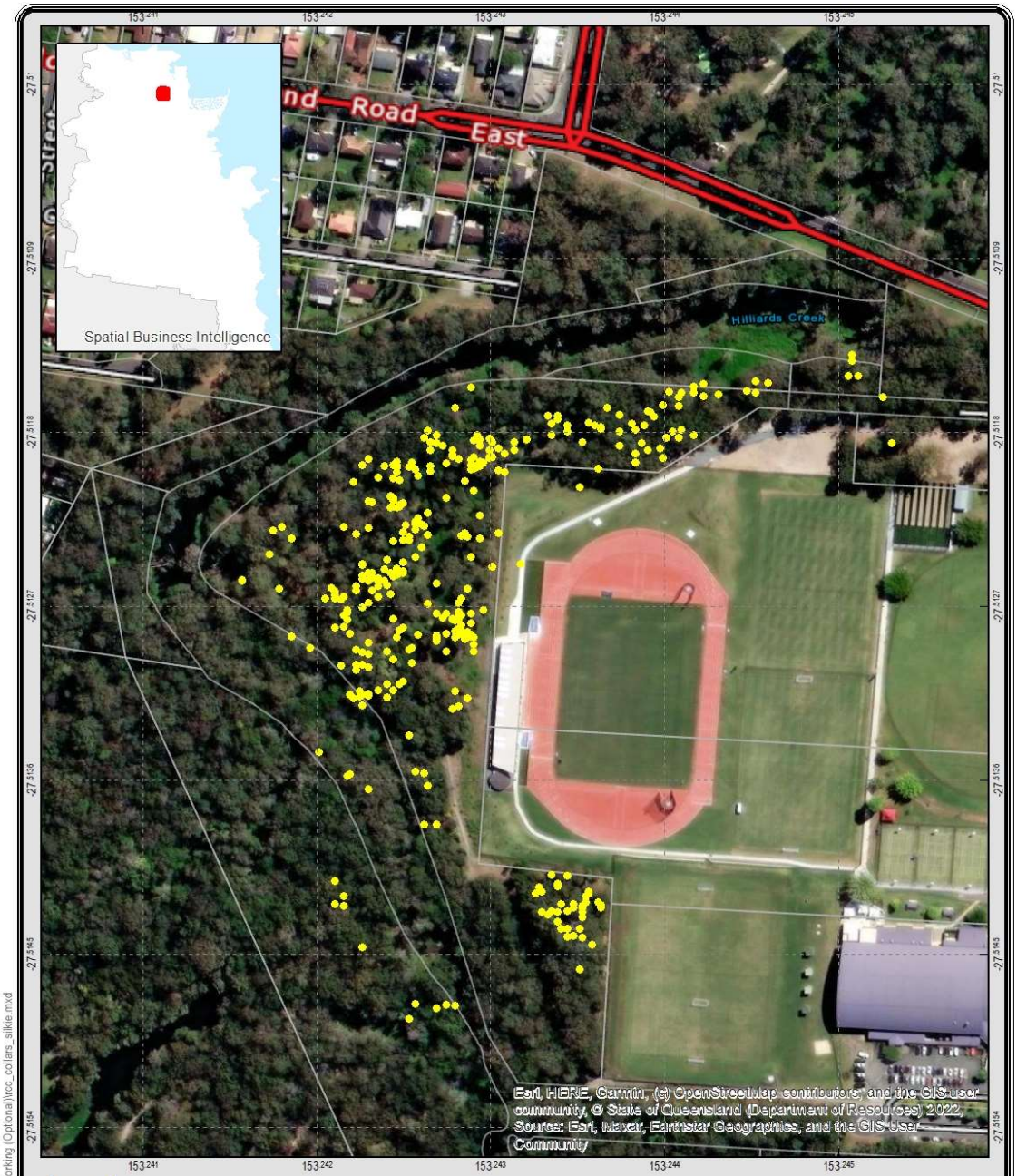
USC Detection Dogs for Conservation



Legend

- Silkie

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USC Detection Dogs for Conservation

Redland City Council

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Meters
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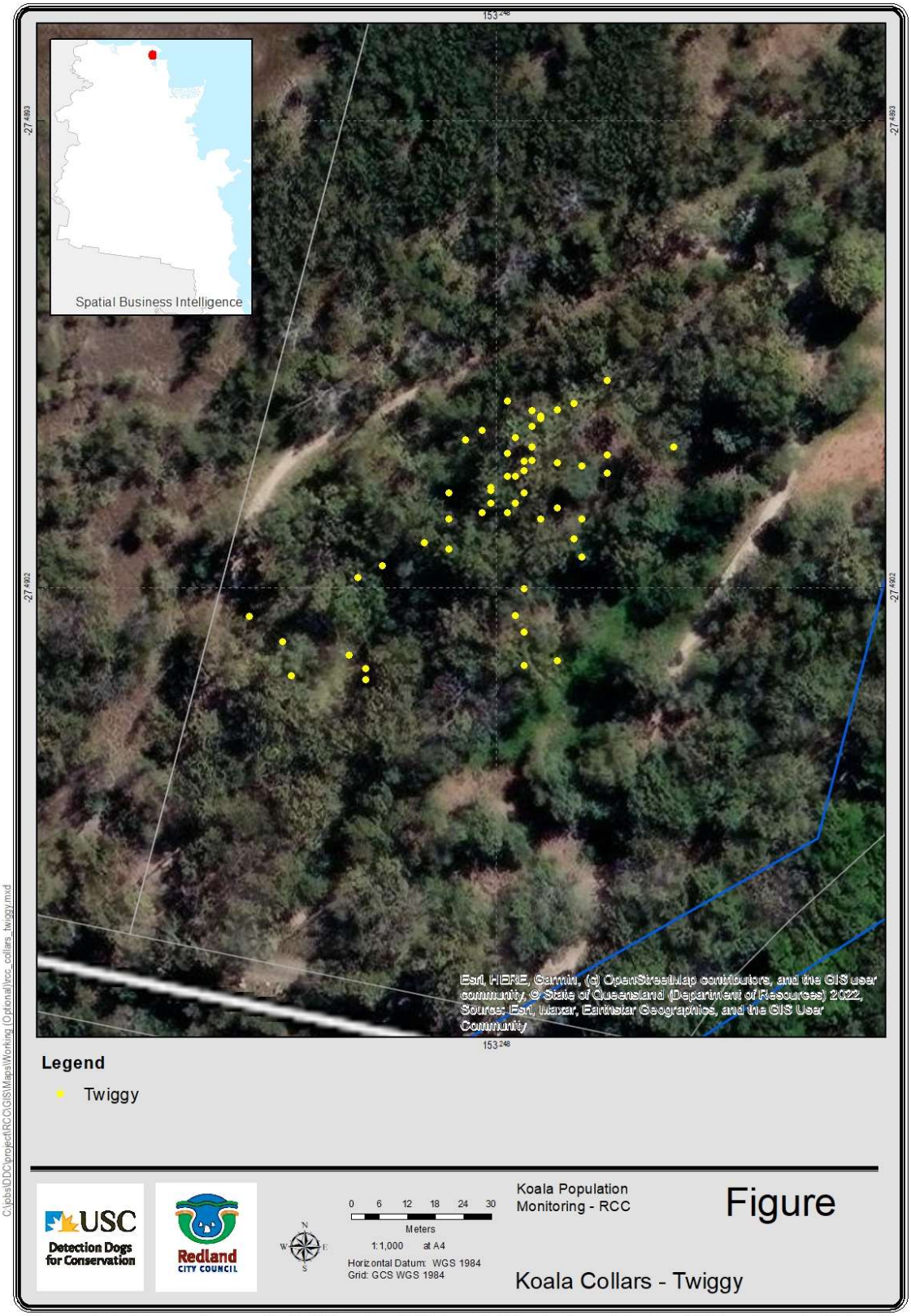
Horizontal Datum: WGS 1984
Grid: GCS WGS 1984

Koala Population Monitoring - RCC

Figure

Koala Collars - Silkie

Detection Dogs for Conservation



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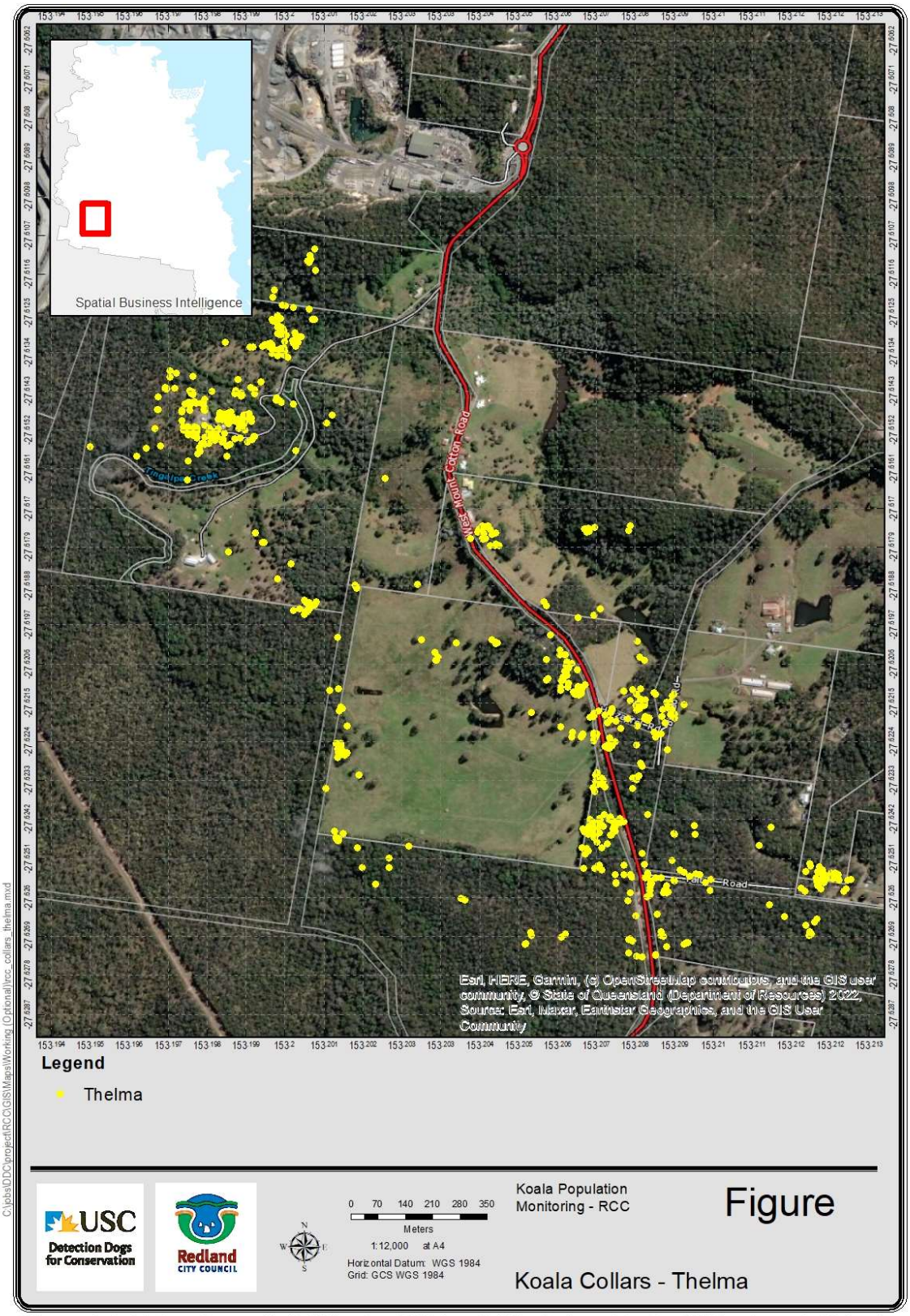
Detection Dogs for Conservation



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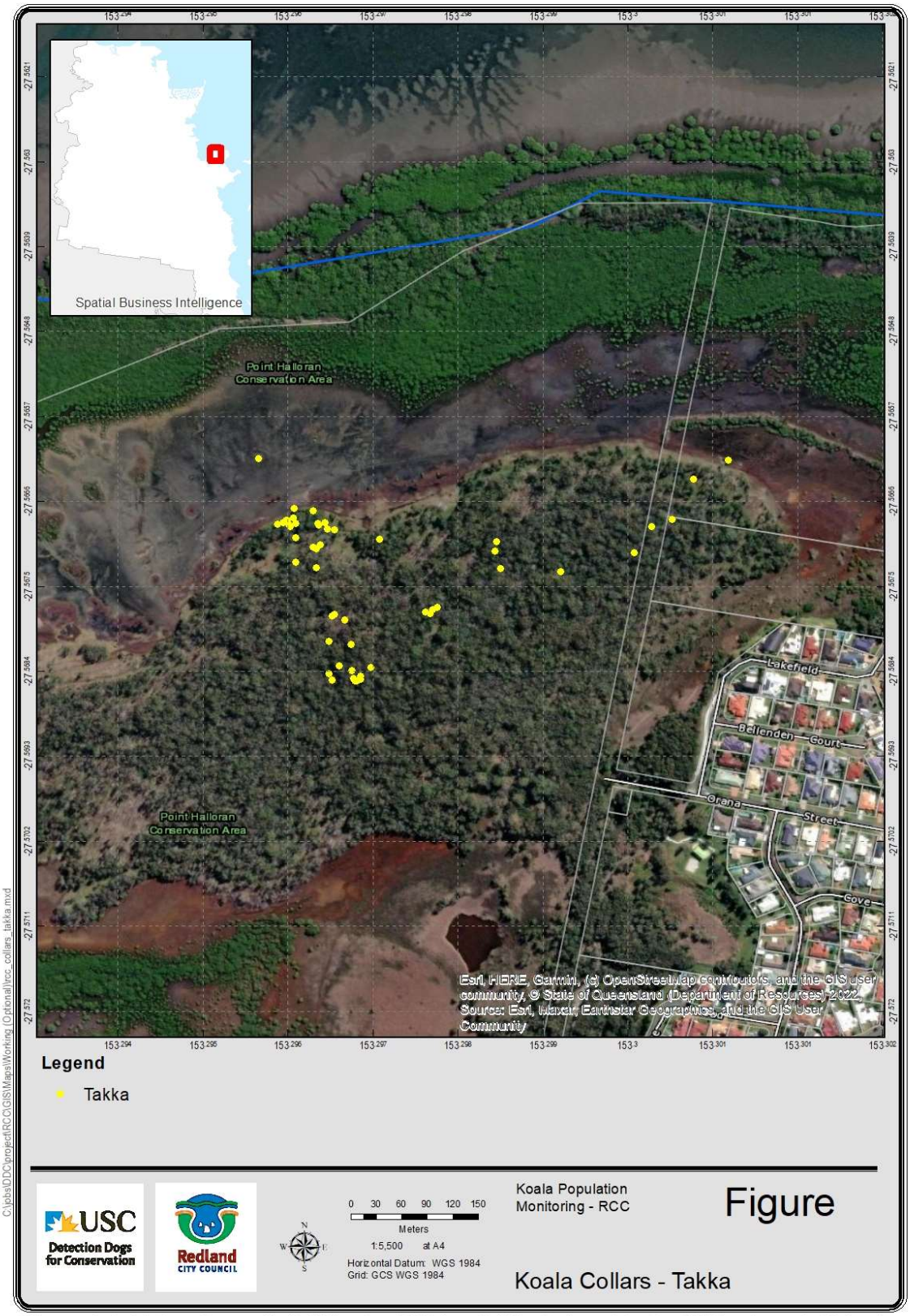
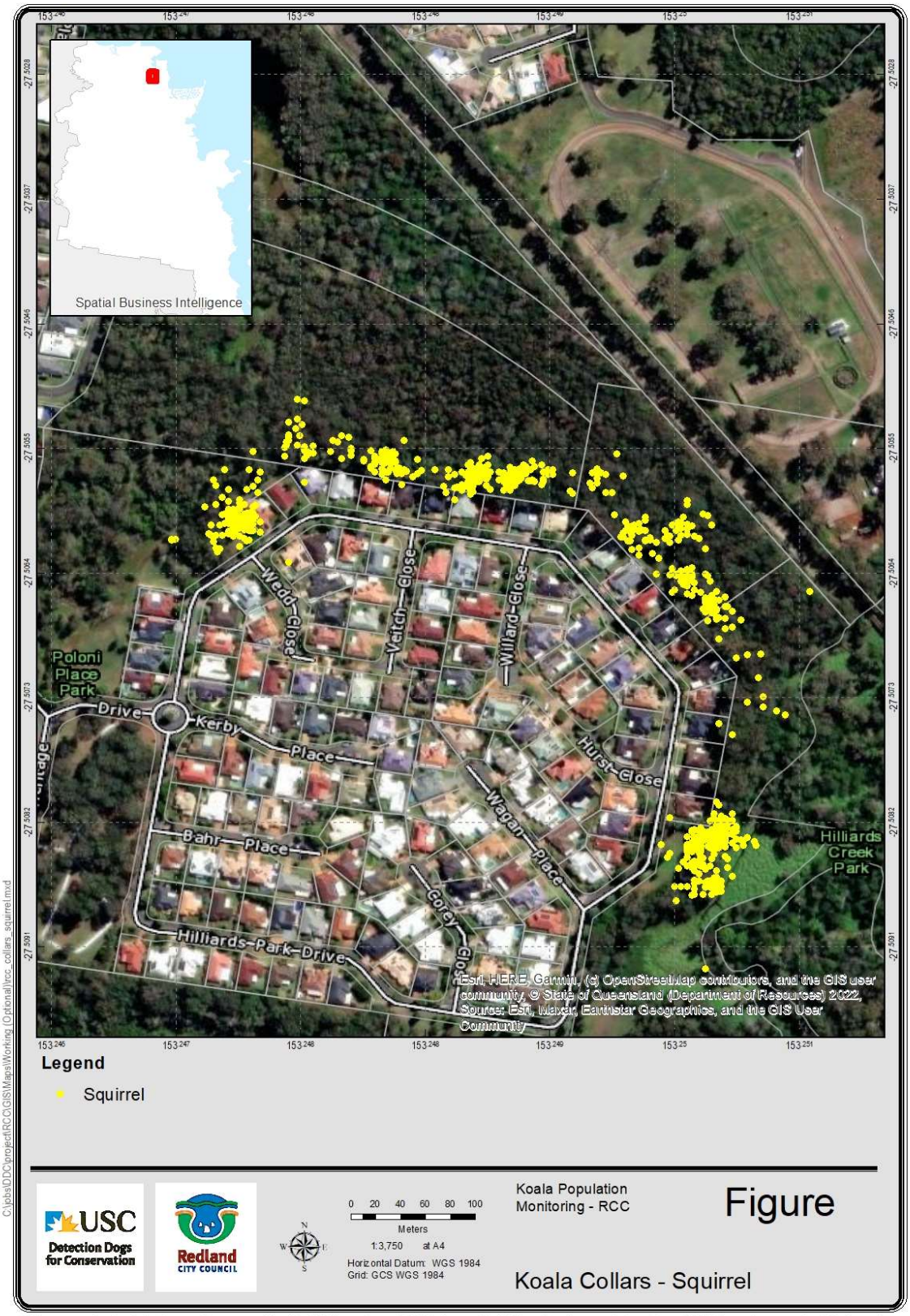
Detection Dogs for Conservation



USC Detection Dogs for Conservation



Legend

- Squirrel

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USC Detection Dogs for Conservation

Redland City Council

0 20 40 60 80 100
Meters

1:3,750 at A4

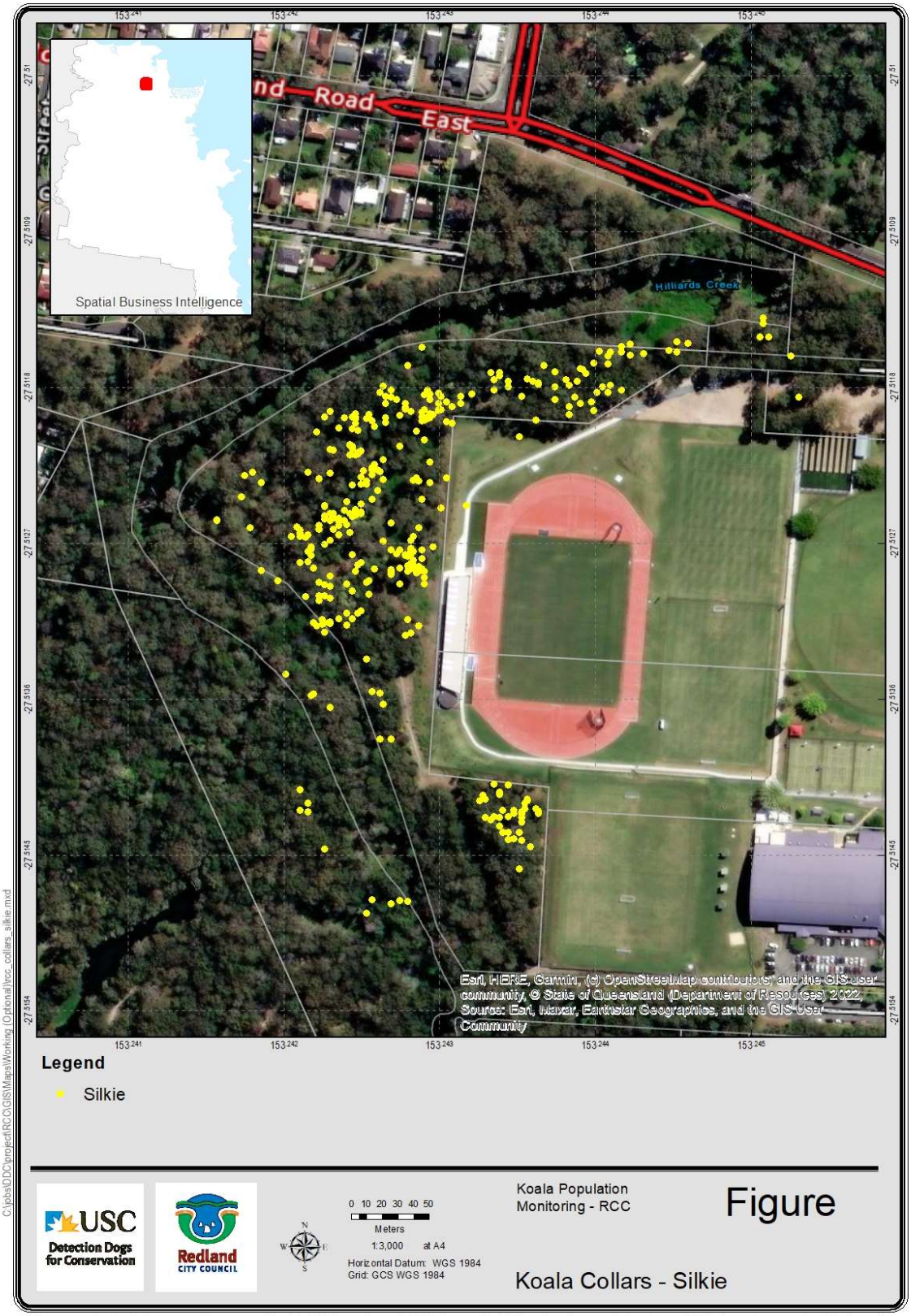
Horizontal Datum: WGS 1984
Grid: GCS WGS 1984

Koala Population Monitoring - RCC

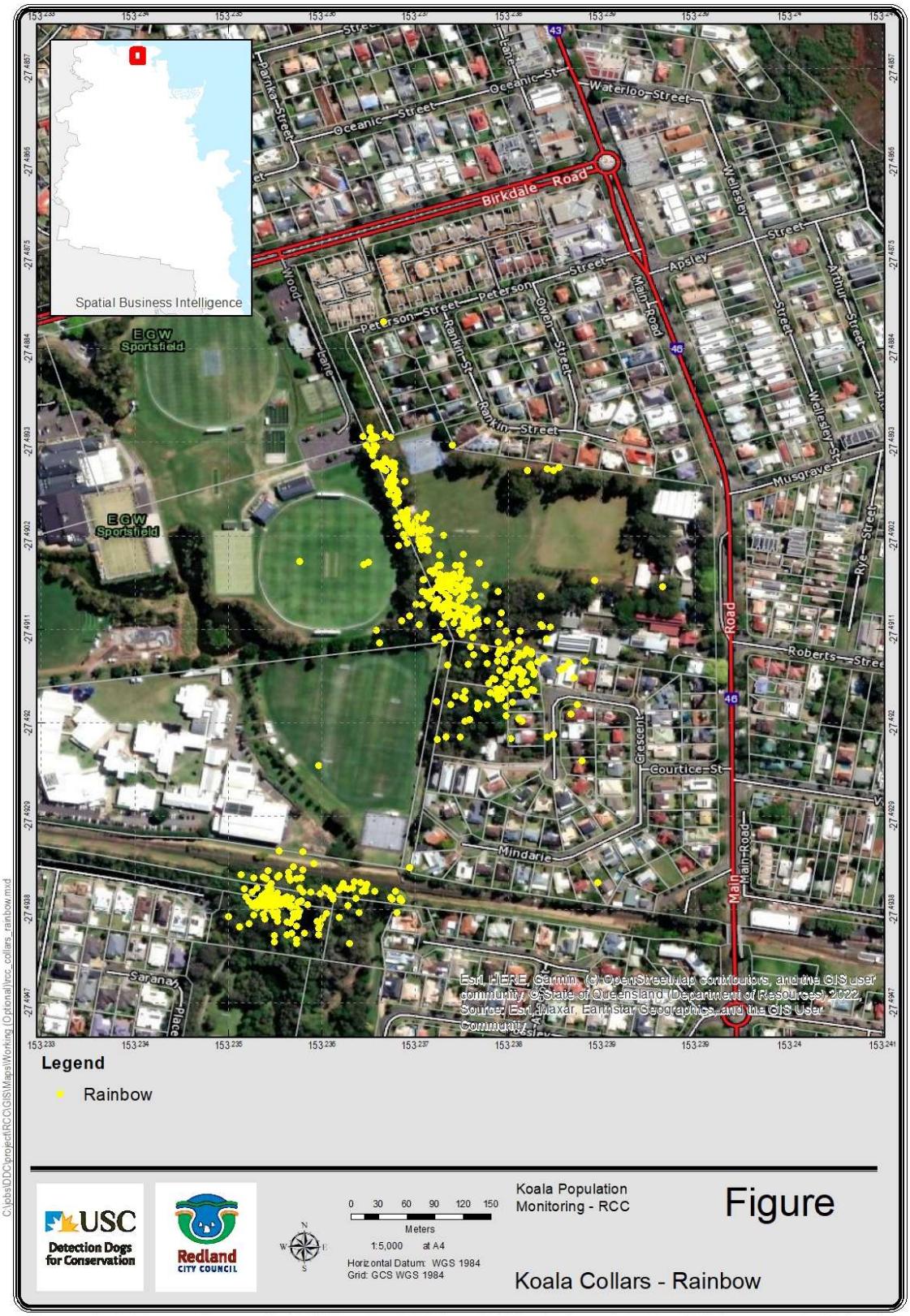
Figure

Koala Collars - Squirrel

USC Detection Dogs for Conservation



Detection Dogs for Conservation



Legend

- Rainbow

C:\jobs\DDC\project\RCC\GIS\Maps\Working (Optional)\rcc_collars_rainbow.mxd

USC Detection Dogs for Conservation

Redland City Council

0 30 60 90 120 150
Meters

1:5,000 at A4

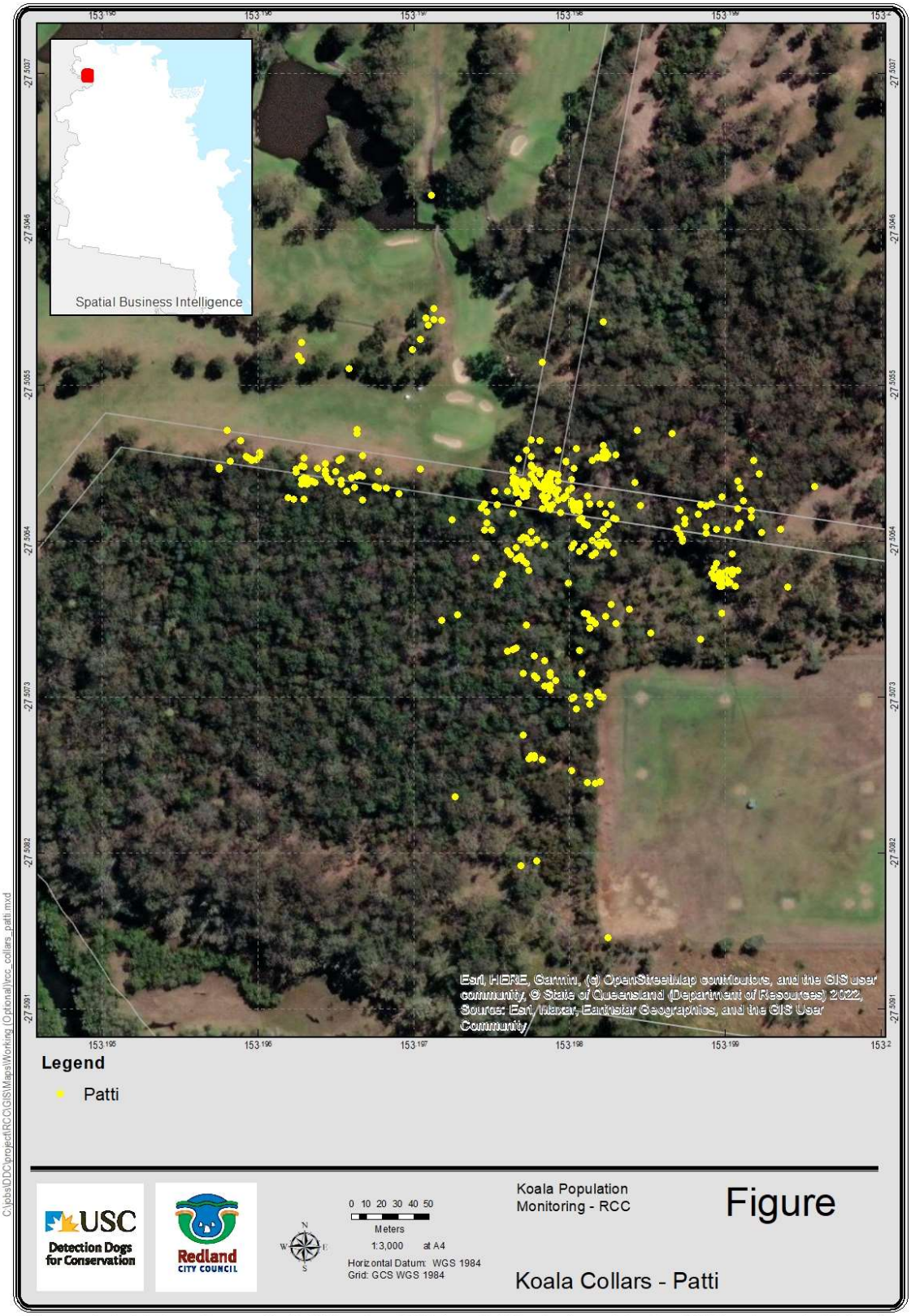
Horizontal Datum: WGS 1984
Grid: GCS WGS 1984

Koala Population Monitoring - RCC

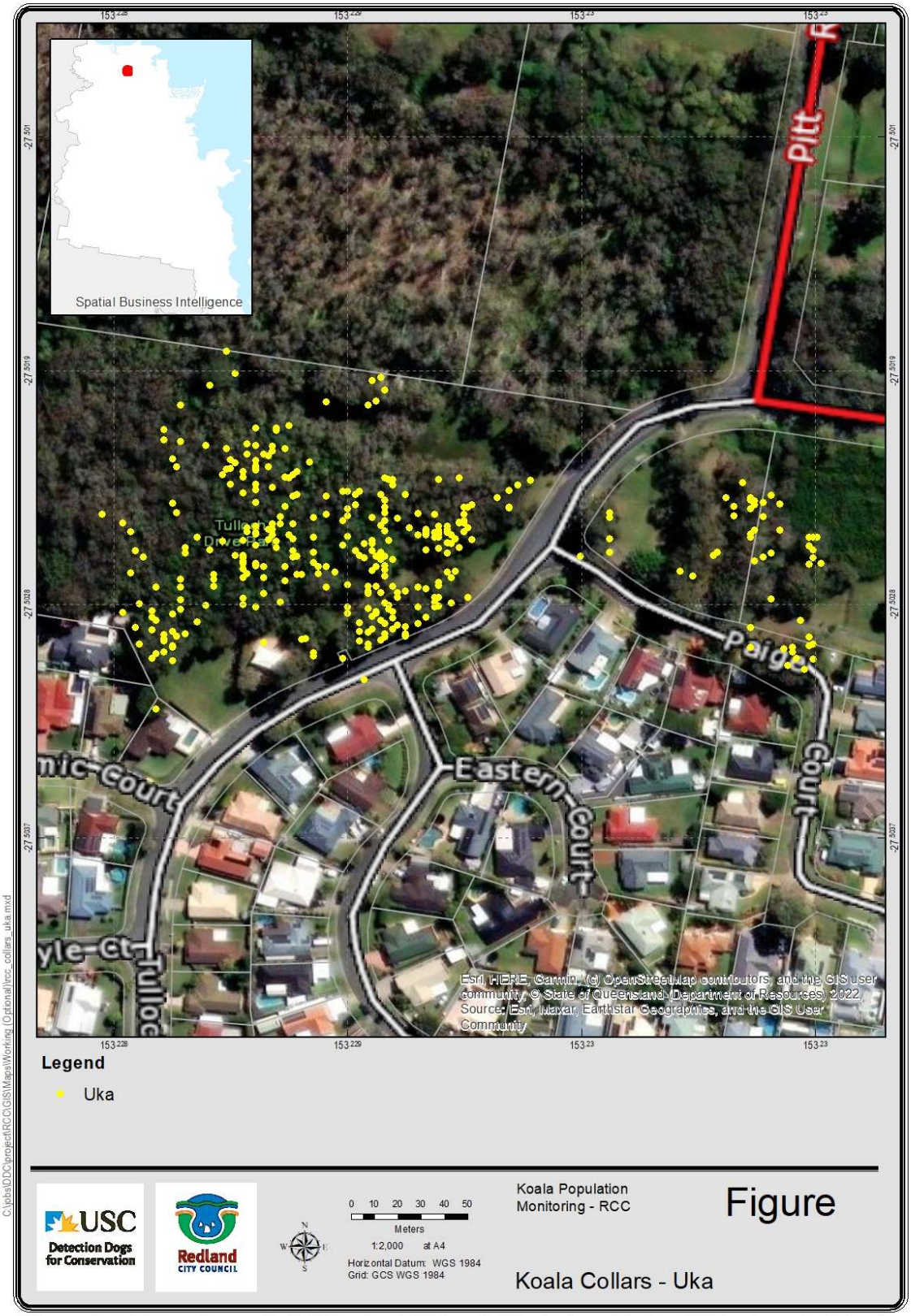
Figure

Koala Collars - Rainbow

Detection Dogs for Conservation



Detection Dogs for Conservation



C:\jobs\DDC\project\RCC\GIS\Maps\Working (Optional)\rcc_collars_uka.mxd

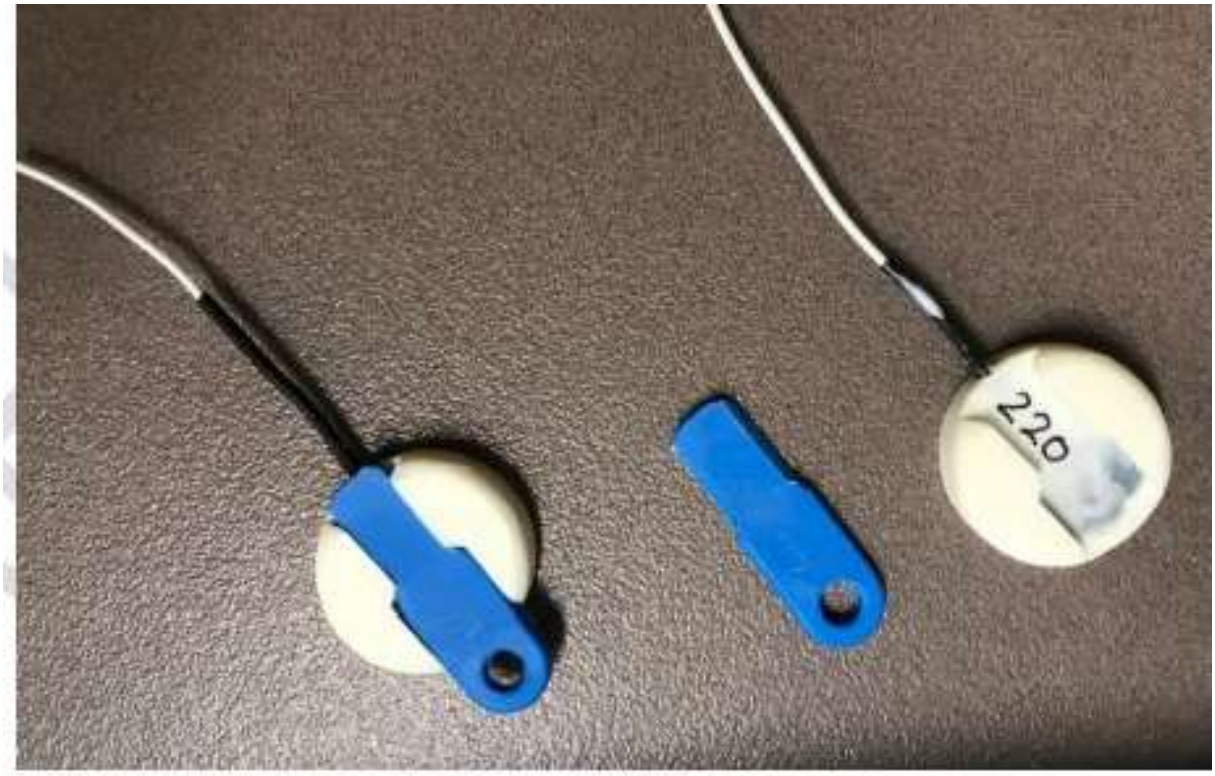
Appendix 2: Previous Bluetooth ear tags version

Version 1

- Deployed from 17 April 2019 to September 2019.
- Proof of concept working: ear tag can be detected in the field.
- Design issues: Bluetooth component was detaching from the ear tag and had limited transmission range.

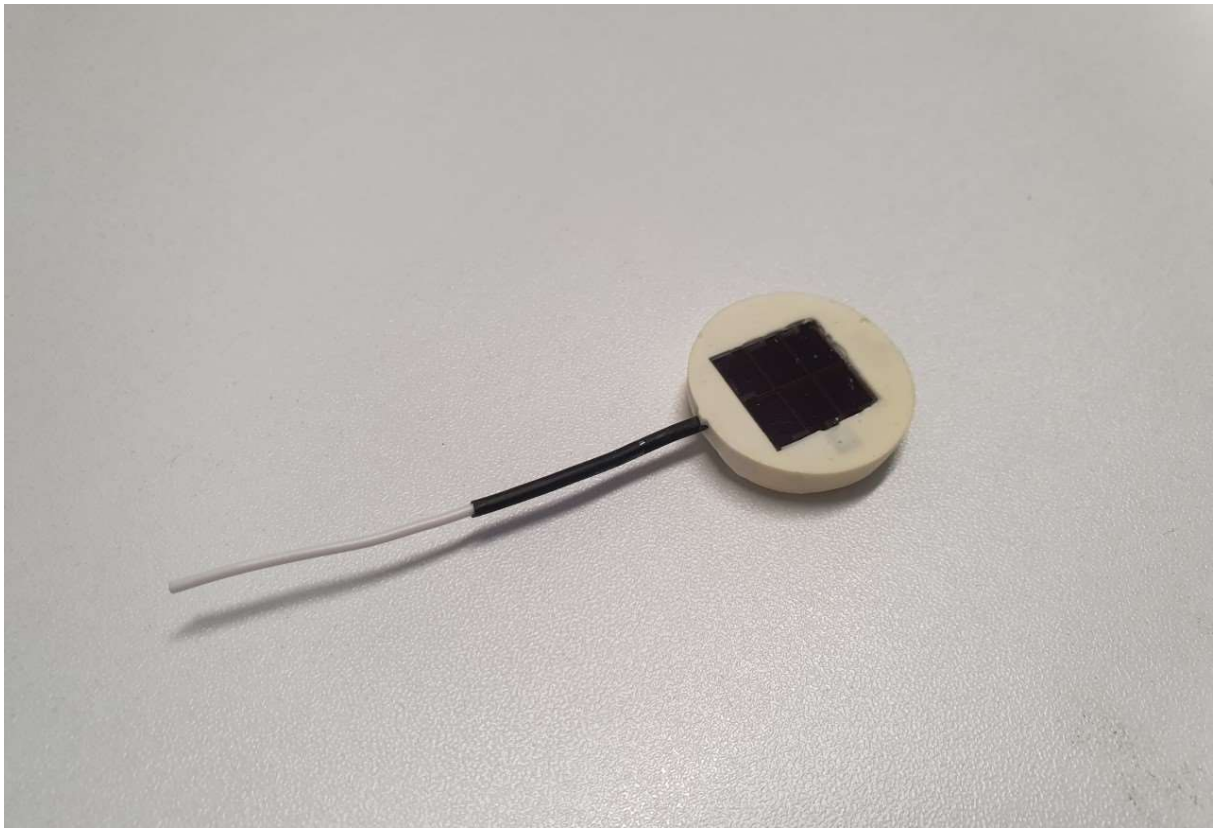
Version 2

- Deployed from 25 September 2019 to 24 August 2020.
- Successful transmission range and stayed attached to the ear tag.
- Design issues: durability, antenna breakage which resulted in loss of or limited transmission range.



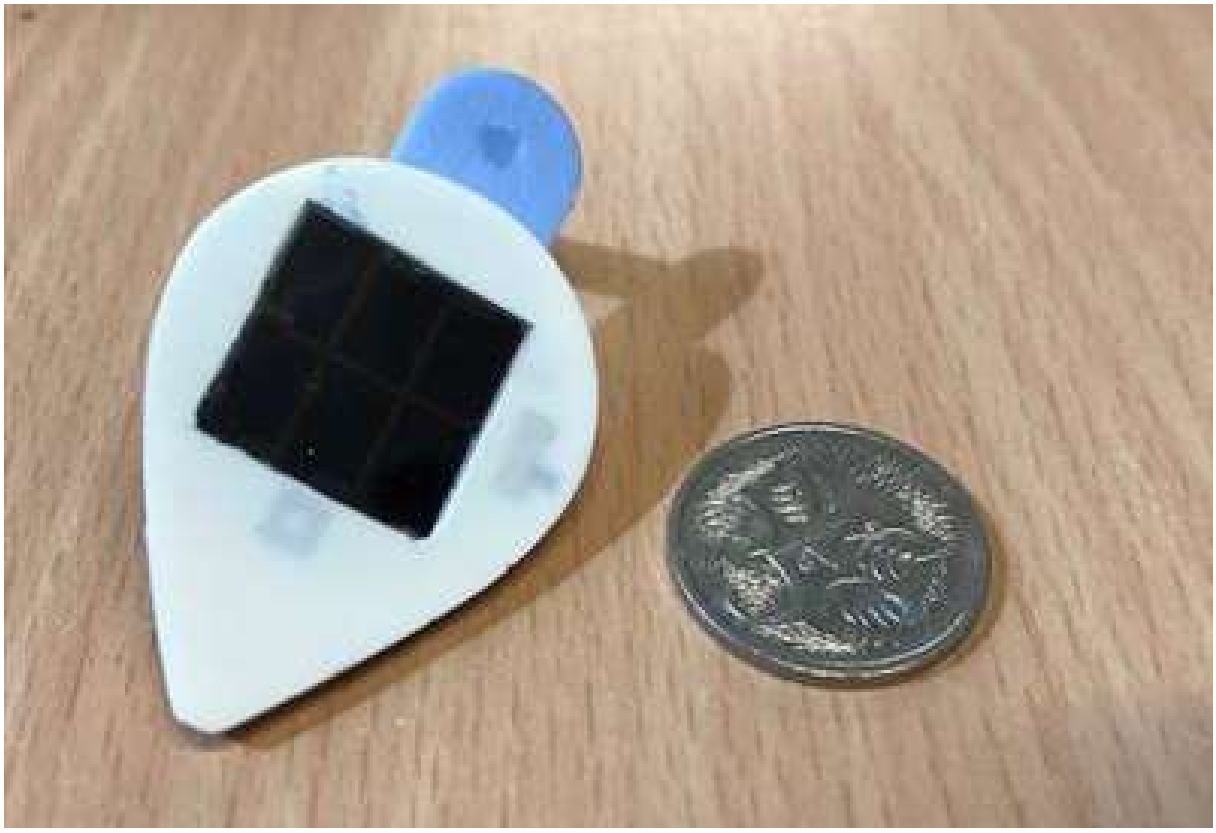
Version 3

- Deployed from 25 August 2020 to 11 April 2021.
- Successful transmission range and stayed attached to the ear tag.
- Design issues: durability, still some antenna breakage which resulted in loss of or limited transmission range.



Version 4

- Deployed from 12 April 2021 to 11 March 2022.
- No breakage.
- Design issues: transmission range was too limited with the internal antenna.



Appendix 3: Larger study design and method comparison

Materials and methods

Study sites

Seven study sites were selected across parts of South-East Queensland (SEQ) and northern New South Wales, Australia. From north to south, these were 'The Mill', Amity Swamp, Fisherman's Road, Scribbly Gums Conservation Area, Sandy Creek Conservation Area, Bayview Conservation Area and Koala Beach (Figure 9. Map of study sites).

The Mill in Petrie, Queensland is a unique site where the koala population has been monitored since 2017 by Endeavour Veterinary Ecology (EVE) (Hanger et al., 2021). As part of council redevelopment, all koalas occupying the site were captured and tagged with satellite telemetric tags and continuously monitored. The monitoring has been intensive in the last 5 years, with personnel on site for radio tracking at least twice a week, and any new koalas recruited in the program. Therefore, a very accurate koala density estimate is known for this site. This allows a comparison of method accuracy between passive acoustic monitoring, diurnal line-transects, nocturnal line-transects and RPAS thermal imaging technology. The six other sites were chosen to represent diverse geographic locations, forest types (Eucalypt, Casuarina and Melaleuca) and population density (based on previous work).

Acoustic sampling design: array and sensor specifications

The acoustic sampling design for density estimates involved the deployment of an array consisting of twenty-five acoustic sensors (Song Meter Micro, Wildlife Acoustics, Maynard, MA, USA), typically arranged in a 5 × 5 rectangular grid with a 150 m spacing at each study site (Figure A1). The exception was The Mill which due to space restrictions could only accommodate twenty sensors in a 4 × 5 array. Additionally, at The Mill, a second model of acoustic sensor, the open-source AudioMoth was also tested; twenty AudioMoths were deployed at the same locations as the Song Meter Micros.

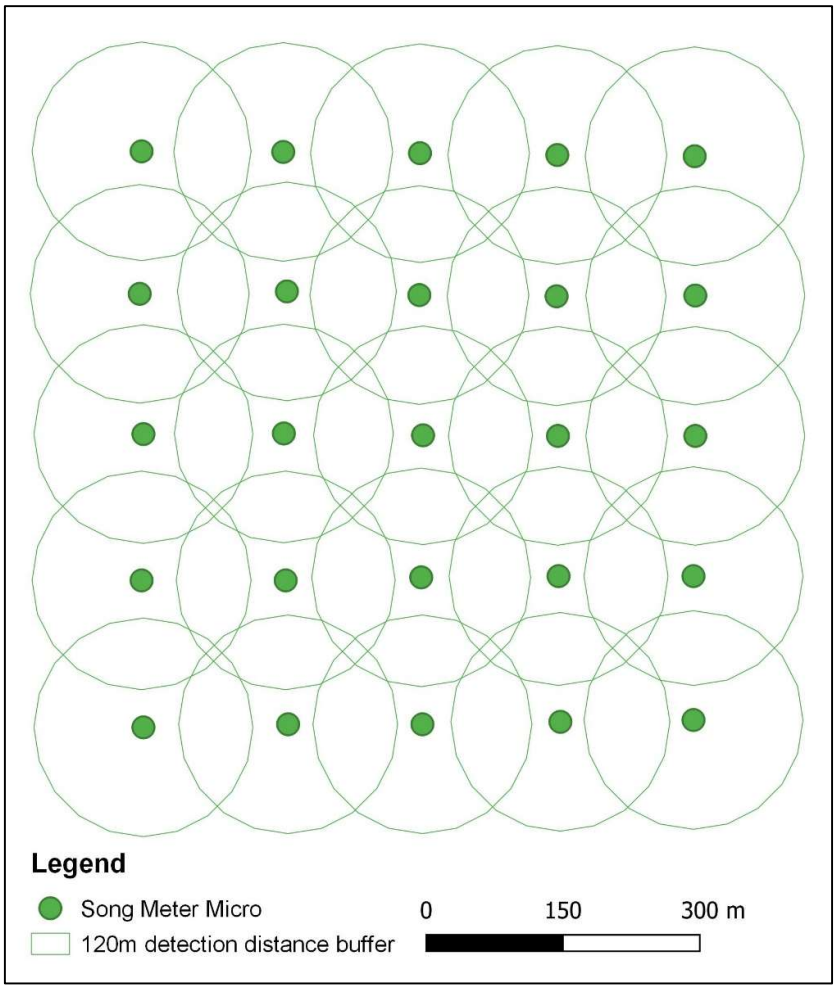


Figure A1. Example of acoustic design deployed at each study area

The 150 m spacing between sensors was selected to allow for correlated detections between adjacent sensors as required for spatial count models, given the detection distance of Song Meter Micros was found to be 120 m (~150 for AudioMoths, Law, B., pers. comm.) in open forest under ideal conditions. This spacing ensured a koala would be detected on multiple sensors as koala home ranges in SEQ are typically >200m radii (de Oliveira et al., 2014). Acoustic sensors were deployed for 14 nights in spring and summer (from October 2021 – January 2022), the breeding season for koalas and

when males are most vocal (Ellis et al., 2011, Hagens et al., 2018). The sensors recorded sounds from sunset until sunrise, the peak time for koala calls (Ellis et al., 2011, Law et al., 2020). Both the Song Meter Micro and AudioMoth had sampling rates of 32 000 Hz and a resolution of 16 bits per sample; the gain for the Song Meter Micros was 24 dB while for the AudioMoths it was 30.6 dB. Acoustic sensors were attached to trees at a height of 1.5 m above ground level using lockable bands, rope or screws and were oriented to face south. For this study, 64GB microSD cards and Eneloop© NiMH batteries were used. The batteries on the Song Meter Micros lasted nine nights so were replaced halfway through deployment (during the day when not recording), while the batteries in the AudioMoths lasted the full 14 nights and were not replaced.

Automated analysis of koala bellows

Recordings were scanned using AviaNZ acoustic software (Marsland et al., 2019) using a koala recogniser (Towsey et al., 2012). This recogniser was developed using a deep learning procedure (Himawan et al., 2018). Recordings matched by the recogniser were validated manually by visualising spectrograms of the audio and listening to recordings to check for false positives using the open-source software AviaNZ.

Spatial count model specifications

The spatial count density model uses the spatial correlation (*r*) in temporally replicated counts to estimate the number and location of the activity centres instead of identification of individual animals. Each night is a sampling occasion (*K).* Abundance (*N*) is a latent variable that is not directly observed but rather estimated by summing inferred activity centres. Density (*D*) is calculated by dividing *N* by the estimated study area, or state-space (*S).* We consider the detector locations, plus a 120 m buffer around the minimum rectangle envelope defined by the detector locations *J,* as the state-space *S.* In addition to estimating density, spatial count models also estimate the baseline encounter rate, λ_0, the probability of encounter of an individual if their activity centre is at the detector location, and a spatial scale parameter, σ, a measure of the rate of decay of encounter as the distance between the activity centre and the detector location increases (Royle et al., 2013). The σ parameter is therefore related to home range size.

Our models do not consider potential habitat differences within state-space *S.* We will apply spatial count models using Poisson encounter models, assuming bivariate normal movement in a Bayesian framework (Chandler and Royle, 2013).

We will run spatial count models using the *rjags* package in R (Plummer, 2021) and will specify a λ_0 prior with a uniform distribution between 0 and 100, a ψ prior with a beta distribution, shape and scale set to 1. We will use a range of priors including uninformative, weakly informative (e.g. min-max male home ranges expected for the study area based on the literature) and strongly informative priors (e.g. site-specific mean male home range from radio-tracking data).

Other survey methods

Diurnal line-transect surveys

Diurnal line-transect surveys were conducted at each site to determine density via distance sampling. Within each site, six line transects were established with a spacing of ~200 m. Transects were walked during the day by three search teams with varying levels of koala spotting experience: University of the Sunshine Coast (USC) ecology students (considered as beginner level), CSIRO general field ecologists with no prior koala survey experience but very experienced in other animal surveys (considered as intermediate level) and Department of Environment and Science (DES) dedicated koala spotting team (considered as advanced level). Two spotters from each organisation surveyed each site.

USC and CSIRO also had a double count design, whereby the two observers walked independently of each other along transect lines (approximately 150 m apart), whereas for DES both team members were walking together with one person navigating with a handheld GPS while the other was searching. When a koala was sighted, GPS position of the observer and the perpendicular distance of the koala from the transect using a laser range finder were recorded. Sex of the koala (if known) and tree species were also noted.

To determine the effective search area, each team estimated a buffer distance from the transect they felt they would have been able to detect a koala within if one was there. This then allowed a density estimate and detection rate to be calculated.

Nocturnal line-transect surveys (spotlighting)

Appendix 4: Responses from the Detection Dogs for Conservation team at the koala forum

Question	Answer
Genetics	
I am especially interested in genetic research. How can we ensure habitat connection to avoid in-breeding?	Habitat connectivity means leaving tree corridors for koalas, so that habitat patches can be travelled between. These paths also need to be safe and not risky to the koala. So it is a combination of leaving remaining corridors and creating new, safe corridors where koala movement is naturally occurring already or should be increased if there are evident barriers. These can also be underpasses underneath roads or other migration options suitable to the koala's biology. Other methods that Redlands is using to make migration and movement of koalas safer is the road sign projects and public education. All these things combined should help to ensure habitats stay and become connected and reduce inbreeding risk to a minimum.
Is there one group collecting the koala scat information or many? We have had someone twice at our place and I'd like to know the information is combined centrally somewhere.	In the Redlands, it is usually only the DDC surveying properties and collecting scats. However, we have a few different people working in the team, so it is possible that different people have come to collect scats. Also, sometimes local people collect scats for us and send them to us for analysis. All scats for genetic analysis should end up with us and all information should be combined.
Does stress cause disease?	In general, it is known that stress can increase disease susceptibility as it can affect the efficiency of the immune system. It is however not clear yet to what extent stress might increase susceptibility of koalas to Chlamydia. This is a question of ongoing research.
Genetic diversity - is this evident in Minjeribbah koalas?	Naturally, island population show lower levels of genetic diversity due to the lack of external immigration. Minjerribah koalas show diversity levels similar to the mainland koalas and there is some substructure in the population on the island which can maintain some levels of diversity.
How fresh is 'fresh' poo (hours, days, weeks old)?	Fresh poo is defined by research from Schultz et al (2018) which was conducted in the DDC team. We usually differentiate between "very fresh" which is hours (<24h) and the "fresh" which can be anything between a few days to maximum a week, depending on the environment the scat has been exposed to. It is challenging to tell exactly how old a scat is, but by assessing the smell, look and texture of the scat we are able to narrow it down to those rough categories.

Question	Answer
Can we improve genetic diversity by introducing koalas from other areas, e.g. Moreton Bay region?	Artificial introductions are often somewhat tricky and risky as it can cause new issues such as introducing new disease etc. Also, koalas from other populations, depending on how distant they are, could have issues adjusting to living in a different place, as they have very specialised gut microbiota that are suitable to their own location, they could also have other local adaptation we are not aware of. It requires thorough genetic assessment and planning to do introductions / translocations. Some conservationists are really pushing us to think along these lines though, as some populations might need it. Assessing historical connections and movement paths, and potentially working on reconnecting any historically connected populations to allow natural migration and therefore "gene flow" would be a less risky alternative. If genetic diversity becomes severely low, artificial breeding programs could be a safer option for a koala population. However, by increasing population size and improving connectivity of habitats, genetic diversity can naturally increase within the population - over time.
Tracking/population surveys/ambassadors	
How many local koalas have tracking collars and/or tagged ears currently?	Although the number is constantly changing, currently, 12 koalas have collars and an additional 5 have tags.
Why when an injured koala has been rescued from a "dangerous" and urbanised area, can it not be relocated to somewhere safe when it is healthy again.	This is a question constantly revisited. The answer is, it depends. Even within the urban area, there are good locations for koalas. And even in the less fragmented bush, there are dangers (heatwave, drought, fires, dogs and disease to name a few). The wildlife rescue, wildlife hospital, and government usually discuss the pros and cons case by case.
I have heard a lot of koalas that are being monitored have died during the recent extreme weather. Nearly all of the koalas who have died have found to have septicaemia. Can you please tell us a little about why this occurs	We have been discussing this recently as we noticed it with the koalas we are monitoring - which really shows how the collaring informs us of what is happening for wild koalas. We think cuts and abrasions have issues healing with the wet conditions, which also favours microbial growth. So small infections easily combatted in drier weather becomes overwhelming for koalas.

what we can do to help?	

Question	Answer
Please comment on the use of koala tracking devices including any risks to the tracked koalas, any animal welfare considerations and the decision making process used to decide the duration of an individual koala being fitted with a tracking device? For example we know that Blake has been wearing a tracking device (not the same one) for about 18 months. Is there ongoing benefit from continuing to track him? If yes, what are the benefits?	The current collars deployed have been tested for thousands of koala/days, and have proven to be safe, in the sense that there was no lesions and no entrapment. They are fitted with a weak link that breaks easily to avoid koalas being caught on a branch for instance. The collars are also of a weight recommended by animal ethics. The duration of the monitoring is case by case and project dependent. Currently in the Redlands the koalas are not monitored with the primary goal of research - although we do collect very worthy data - but to inform their management and engage with the community. However, we have found in the Redlands the benefit for the koalas wearing a collar has been very high - as we have been able to identify and rescue koalas at the beginning of their sickness, giving them a higher likelihood of successful treatment. Blake was one of these koalas.
If you find koalas other than ambassador koalas, do you take them for health checks and tagging?	Any sick koala we encounter we attempt to rescue or organise rescuing. But healthy koalas that are not ambassador are not caught or receive health checks.
What is their estimate of koala numbers on the Redlands mainland? How many koalas are in the Redlands and other areas? Roughly how many koalas are on the mainland?	We are currently working on drone surveys and design to estimate density and hopefully gain some understanding of koala numbers - but this is the hardest ecological data to gather (habitat, distribution, genetics and disease are easier)

What is the % decline of the koalas in Queensland - Redlands, Gold Coast.	The QLD government data (analysed by Rhodes et al 2015) showed the following: "There was strong evidence for a rapid decline in population densities between 1996 and 2014 in the Koala Coast and Pine Rivers populations, with an estimated 80.3% (95% credible interval: 70.8% to 86.2%) decline in the Koala Coast sites and an estimated 54.3% (95% credible interval: 20.1% to 74.4%) decline in the Pine Rivers sites. There was also evidence that the rates of decline have increased over time."

Question	Answer
Some councils tend to dismiss the importance of urban koalas to concentrate on the ones in new planted areas or secured forests (e.g. Yurol and Ringtail new acquired forests in Noosa Shire). Why? Doesn't an urban koala and a "wild" koala have the same importance? We were the ones who invaded their territory, not the other way round and we owe them protection, wherever they are. We know that urban koalas require additional protection infrastructure. That's the price we have to pay if we don't want them to get extinct around our towns, being hit by cars, mauled by dogs and stressed to resulting sickness.	We thoroughly agree! Urban koalas are just as wild as koalas in National Parks. They do deserve and need protection. Although management in urban areas and National Parks will be different, they both need specific, adapted management actions. We also think that for some threats - such as wildfire - urban koalas are well protected, whereas as the Black Summer showed us, we can quickly lose very large bush populations.
I have not seen a Koala in my local area for 7 years. While I understand populations have plummeted due to development, road deaths and dog attacks - I'm wondering how much feral predators and weedy undergrowth restricting movement have contributed to the decline? How can we do better in this area?	Which area is that? In general, weedy undergrowth has not been showed to slow koala movement - although very little research exists on this, in our surreys we found koalas and other wildlife seem to have their tunnels and network for weed on the ground. Potentially invasive weeds in trees (smothering trees) are more problematic, as well as cactus which are known to koala deaths in certain areas (incidental data from wildlife carers). Feral predators can certainly be a major threat as has been discovered in a population in Moreton Bay Council (linked to the rail line, and as published by Beyer et al).
I know there is tree planting in NSW and Vic... but where can koalas be truly saved for the long term?	Everywhere we put enough efforts in - that is our belief.

Question	Answer
Disease	
Regarding high disease rates - why? Is there a link to loss of habitat and past relocation practices?	The disease issue in koalas is unfortunately still a conundrum to science. There are three obvious players here: 1/ **koala resilience** - are koalas lacking diversity to fight the pathogen, is this due to past bottlenecks / small population sizes such as experienced during the fur trade? 2/ **disease virulence:** are problematic diseases, especially chlamydia, a recent introduction that koalas are not yet able to fight? Did relocation practices make this worse? Will we see natural resilience in the future? 3/ **environmental stressors**: would diseases and koalas live in a balanced relationship, without seeing very sick koalas and population decline, if there weren't that many other threats koalas had to fight? In other words, does our impact on the environment; causing loss of food safety through habitat loss and fragmentation, increase stress through heatwaves, dogs or car interactions; tip koalas and their immune system toward collapse and the inability to fight off diseases? We simply don't know, and we need more funding and research to answer this question.
Is there anything that can be done to reduce the incidence of chlamydia?	Again, we simply don't know. Many people have hypotheses - for example, that reducing other threats will decrease diseases, or that increasing genetic diversity will enable koalas to fight off diseases better, but these are still areas of active research. All we know for now is that if we treat koalas early enough, the chances of recovery are higher than if we treat them late or not at all. This put an enormous emphasis on monitoring koalas and catching and treating them as early as possible.
Population	
What can realistically be done to reverse the downward trend of the number of koalas in the Redlands?	What we are doing now - getting the community pro active in monitoring their koalas. Then linking it to actions, e.g. treating diseased koalas. Reducing human mediated threats: cars, dogs, pools etc. And of course: planting and protecting trees. The larger question of climate chance is still critical to address, but probably less a concern in the Redlands than in other parts of koala distribution.

Recently the classification of the koala in the EPBC act changes to "endangered", what's the point if their habitat (= their home and their food) is not even protected?	This is a good question. Unfortunately, we have seen that 10 years of koalas being classified as vulnerable did nothing to reverse population trends. They are now endangered. If we continue doing the same as we've done in the last decade, the chances are slim that the outcome will change. With pro active programs such as what we see in the Redlands, where real action is taken, we hope we can see a change. We of course also need real environmental protection of habitat - that is in all levels of government hands, as well as individuals. But we also see habitat present and not used: so there are threats to address beside habitat loss.

Question	Answer
Minjerribah (North Stradbroke Island)	
Can you please advise how the koala population on Nth Stradbroke Island is faring and in particular the Amity Point population? Roughly how many koalas on Minjerribah?	We have been closely monitoring population genetics on the island (a collaboration between RCC and QYAC), but numbers are difficult to establish. We have done drone density surveys and hope to calculate density estimates in the next year. From RCC urban count, the koala populations in the townships are good and not declining. From our genetic surveys, the chlamydial disease is still not a concern. So relatively - the island population is strong. Unfortunately, it's also vulnerable - a wildfire, or the introduction of chlamydia, could put it at risk.
Info on uniqueness of Straddy Koalas. When can injured Straddy koalas that are transported Mainland for treatment, return to NSI location? Injured Minjerribah koalas are taken off Island to Mainland Vets for care. Once stabilised, can our koalas be returned to Minjerribah?	This is a very difficult question and one which scientists, veterinarians, wildlife hospitals, rescue groups and many other interested parties have debated for over two decades. In the end - it is a question of risk management and benefits /cost analyses. Very educated, dedicated, koala passionate people have come to opposite conclusions on this one. There are also individual concerns, versus population concerns, to weigh. The welfare cost, cultural cost, etc. of not returning koalas to the island is high. Individual koalas might be put at risk by being released in the mainland where they don't know the habitat, network, potentially food trees and diseases also differ. On the plus side, at the mainland population level, island koalas might bring some support to struggling mainland populations. At the island population level, the number of koalas that are not coming back poses a small risk compared to the risk of chlamydial disease ever been introduced, if a virulent strain existed (we still don't know if it does). On the balance of evidence as we know today, it is a small risk - but it is not a non-existent risk. It is just a very difficult situation - but if one day we introduced a disease that brought the island koala population in as bad health as the mainland, it would be devastating. So currently - it is not a risk that is taken.

Appendix 5: Koala profiles for BLE app

Axle

Axle is a gorgeous [age] year-old male koala. He weighed [weight] kg at his last health check in [recent release date], which is about average size for a male his age. He's usually found relaxing in his favourite Blue Gum trees (*Eucalyptus tereticornis*).

Axle has been monitored since July 2021. Previously, he was admitted to Australia Zoo Wildlife hospital for successful treatment of mild conjunctivitis to his right eye before being released back into the wild. Since his release, his right eye is being carefully monitored for any signs of discharge, redness, or a crusty appearance. Can you notice any abnormalities to his eyes?

Axle considers the area around Pitt Rd, Birkdale his home base, however, keep an eye out for him exploring further afield during breeding season (between August and December) while looking for love.

Have you noticed Axle near any other koalas? Please let us know who this delightful boy is choosing to spend his time with.

Bark (BLE 56252)

Bark is a cheeky 3½ year-old male koala who weighed [weight] kg during his last vet check on [recent release date], which is about average size for a healthy boy at his age.

Bark has been monitored since 8th July 2020, when he was only 18 months old. His mother was from Stevens Place, Ormiston, but as Bark approached the age of two, some dominant males (including his father) felt it was getting a little crowded and encouraged him to find a new place to live. He explored to the south-west over a few months and now seems to have settled into a home range around Bibury Place, Wellington Point.

On 5th December 2021 he was observed to have a dirty wet bottom, so was captured and admitted to Australia Zoo Wildlife Hospital for treatment of cystitis caused by a Chlamydia infection. He received a Chlamydia vaccination injection upon release back into the wild, so now holds the title as our first ambassador koala to be vaccinated. His bottom is still slightly stained (light brown) but dry and is now being carefully monitored for any signs of wetness or darker discolouration. Can you notice anything unusual around his bottom?

Bark has become quite the local celebrity in Ormiston and Wellington Point. His adventurous spirit has taken him along suburban streets and into backyards. Please keep a particularly watchful eye on this young lad during breeding season (between August and December) when he'll be out and about looking for a girl to share a tree with.

Keep an eye for any other koalas near Bark – he is still a young male and might yet face other troubles from the local big boys…

Blake

Blake is a [age] year-old handsome chap who weighed [weight] kg during his last visit to the vet on [recent release date], which is about average size for a male koala his age. He frequents roadside trees, including Blue Gum, Grey Gum, Ironbark and Swamp Mahogany. He seems completely unfazed by the hustle and bustle of suburban living, able to maintain a daytime snooze alongside busy roads and walking paths.

In 2020, Blake spent some time at Australia Zoo Wildlife Hospital (AZWH) being treated for conjunctivitis before being released back into the wild on 11th September 2020 and monitored as an ambassador koala. At the end of January 2022, Blake's right eye was observed to be closed and crusty, so he was once again admitted to AZWH and successfully treated for conjunctivitis. Since his most recent release on 4th March 2022, his eyes are being carefully monitored for any signs of another reoccurrence of conjunctivitis, including swelling, discharge or a crusty appearance. Can you see any abnormalities around his eyes?

Blake considers Henry Ziegenfusz Park, Cleveland, his home. Given his fondness for frequenting the roadside trees along Fitzroy, Island and Channel Streets, he has gained superstar status from local residents and eagle-eyed walkers through the area.

Koala breeding season is between August and December and Blake will be on the move during this time searching for the girl of his dreams. Please take extra care on the roads while driving during this period.

Bruce

Bruce is the CEO of the gum trees. This suave [age] year-old - also known as "Bruce Almighty" - is in the prime of his life and exudes superiority over any koala he meets. He's a big bloke, who weighed in at [weight] kg during his last health check on [recent release date] (which is considerably larger than average). Bruce tends to peer down his nose over the world beneath him from tall Blue Gum trees (*Eucalyptus tereticornis*), often making him tricky to spot.

As befitted to his dominant status, Bruce regularly patrols a large home range along Hilliards Creek, from Montgomery Drive Park up to Old Cleveland Road E, Ormiston.

Back in 2019, Bruce was admitted to the Australia Zoo Wildlife Hospital and was successfully treated for conjunctivitis. He was released back into the wild on 5th May 2019 and has been monitored as an ambassador koala ever since. Unfortunately, he developed mild conjunctivitis in his right eye again, and the team at the Australia Zoo Wildlife Hospital admitted him for treatment again on 13th November 2021 before releasing him back into the wild on 17th December 2021. Since his release, his eyes are being carefully monitored for any signs of swelling, discharge or a crusty appearance. Can you notice any of these abnormalities around his eyes?

Bruce certainly knows how to impress the ladies and will be on the move during breeding season (August to December) searching for a girlfriend or three. Have you noticed Bruce near any other koalas? Please let us know who this charmingly bossy boy is choosing to spend his time with.

Guinevere

Guinevere is a sweet [age] year-old female koala who weighed [weight] kg during her last health check on [recent release date], which is average for her age. She loves perching high in the canopy of large Blue Bum trees (*Eucalyptus tereticornis*) and seems to be an expert at camouflage so can be very tricky to spot.

In 2021, Guinevere and her joey were living in Cowley St, Ormiston, on a block of land that was undergoing development. To ensure their safety, mother and baby were relocated to the Grace Hartley Bushland Refuge on the 8th September 2021 and monitoring since this time has indicated that she has settled well into the area. Guinevere is quite shy and prefers to hide away from the busy world during the day. If you do manage to spot her and get a good look, can you please check if she looks healthy?

Kimo BLE 12549.

Kimo is a beautiful, placid [age] year-old mature lady who weighed [weight] kg during her last health check on [recent release date], which is about average size for a fully grown female. She can quite often be found enjoying her favourite Blue Gum trees (*Eucalyptus tereticornis*) along the tracks at the end of Blight St. Wellington Point.

Kimo has been monitored since 17th April 2019 and has reliably raised a healthy joey each year. Prior to this date, she spent some time at the Australia Zoo Wildlife Hospital being treated for a Chlamydia infection in the form of cystitis, but has remained healthy since this time. Since the end of 2021, Kimo has been observed to have a swollen left cheek caused by leaf impaction (this can happen when the gum leaves that are being chewed become caught inside the cheek instead of swallowed normally) so she received a veterinary check, had her mouth cleaned and has been released with increased monitoring. Can you notice any signs of swelling around her cheek or facial area?

Kimo has chosen the Geoff Skinner Wetlands her home. While she is mostly found in Blue Gums, she occasionally takes refuge from the heat in the swampier areas with Paperbark trees. Do you know what tree she is in today?

Keep an eye out for a “back-rider” joey between April and August, about 8 months after breeding season.

Miles

Miles is an adorable 2½ year-old male who weighed [weight] kg during his last health check on [recent release date]. He can be seen in a wide variety of gum trees and his curious nature has him checking out those walking below him.

Miles was found alone as a little joey on Minjerribah (North Stradbroke Island) in July 2020, weighing just over 500 grams. He was taken into care on the mainland and later released into the wild at Mount Cotton as a healthy 18-month-old in May 2021. Miles later developed a chest infection, which was discovered during a health check in December 2021. After successful treatment and release back into the wild, he has been monitored for any signs of coughing or breathing difficulties. Can you notice anything unusual about his breathing?

Since the time of his release at Sandy Creek Conservation Area, Miles has done some extensive exploring, including crossing Mount Cotton Road, possibly in search of his own territory. His preferred home base now seems to be around the Karingal Rd forested areas, including the Mt Cotton Scouts property. Miles will be on the move again during breeding season (August to December), searching for the girl of his dreams so keep a watchful eye on this adventurous young lad.

Have you noticed Miles near any other koalas? Please let us know who this little cutie is choosing to spend his time with.

Thelma BLE 11775.

Thelma is a gentle-natured [age] year-old senior female who weighed [weight] kg during her last vet visit on [recent release date], which is considered a little underweight for her age. Thelma enjoys variety in her life and can be seen in just about any species of gum tree.

Thelma previously called Minjerribah (North Stradbroke Island) her home, however she fell from a tree and injured her hip and had to be transported to the mainland for rehabilitation. She was released back into the wild at her new Mount Cotton home in in May 2021.

Thelma has an adventurous spirit and was initially frequently found alongside the busy West Mount Cotton Road with her joey, making everyone very nervous! More recently, she has made the more sensible decision to remain within the relative safety of extensive revegetation plantings that boast an exquisite array of cuisine choices.

Uka

Uka is a beautiful female koala who is [age] year-old and weighed [weight] kg during her last health check on [recent release date]. This is considered slightly underweight for her age. She loves living in the Melaleuca wetlands, hiding among the vines or enjoying her favourite Bluegum (*E. tereticornis*) trees.

Uka has been monitored since August 2020. During this time, she has been treated for conjunctivitis at Australia Zoo Wildlife Hospital. Since her release, her eyes have been carefully monitored for

any signs of discharge, redness, or a crusty appearance. Can you notice any of these symptoms around her eyes?

Uka is best described as an adorable, reclusive swamp-lover, and loves to hide out in the Melaleuca wetland areas of Tulloch Drive Park in Wellington Point. She does sometimes venture out of her swampy domain and has been sighted next to the Tulloch Drive Sun Smart playground and in Nelson Road Park.

Can you spot Uka's 2021/22 joey, Mistletoe, nearby?

Others

Squirrel (deceased)

Squirrel is [age] year-old male koala and a total cutie pie. He weighed [weight] during his last health check on [recent release date] which is slightly underweight for his size.

Squirrel was rescued as a joey and admitted to the Australia Zoo Wildlife Hospital, where he was treated for conjunctivitis. He was then taken into foster care until he was a young adult. He was released back into the wild on the 15th April 2021, and has been monitored since that day. Squirrel later developed mild dehydration, which was discovered during a health check on 9th September 2021. He received treatment and has since been carefully monitored for any signs of lethargy. Does Squirrel look alert and healthy? Can you see any signs of discharge, redness or a crusty appearance around his eyes?

It seems Squirrel has claimed the Hilliards Creek Park Wetlands in Wellington Point as his home base, however, keep a watchful eye out for him venturing further afield during breeding season (between August and December) while he's out and about searching for love.

Have you noticed Squirrel near any other koalas? Please let us know who this sweet boy is choosing to spend his time with.