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C2CD OFFSET PEST CONTROL PLAN

December 2021

DEPARTMENT OF TRANSPORT AND MAIN ROADS

Executive summary

The Department of Transport and Main Roads engaged Ecosure to develop a vertebrate pest control plan for 13 environmental offset areas within three clustered locations in the Gympie region: Curra, Victory Heights and Woondum. Pest control works will be undertaken in accordance with this plan over the next ten years to support the conservation of the matters of national environmental significance koala (*Phascolarctos cinereus*) and black-breasted button-quail (*Turnix melanogaster*). The overarching aim of the plan is to achieve a reduction in pest abundance in these environmental offset areas in order to contribute towards the ecological outcomes defined in the Cooroy to Curra Section D – Detailed Design Offset Management Plan.

Four pest species have been targeted in this control plan: wild dog (*Canis lupus familiaris*), red fox (*Vulpes vulpes*), feral cat (*Felis catus*), and feral pig (*Sus scrofa*). As outlined in the Cooroy to Curra Section D – Detailed Design Offset Management Plan, the target species for control within the koala offset areas (Curra, Victory Heights and Woondum) are wild dogs and foxes, while the target species for control within the black-breasted button-quail offset areas (Woondum) are wild dogs, foxes, feral cats, and feral pigs. While feral cats and pigs do not pose a direct threat to koalas, they have a detrimental impact on native species and the ecosystem in general. As such, all four species will be targeted in each offset cluster.

This control plan outlines:

- relevant legislative considerations in undertaking pest control activities in Queensland
- pest control options available for each target pest species
- a suitability matrix assessing the suitability and key considerations of each control option
- the planned best practice pest control activities to be undertaken within the 13 offset properties
- timing and logistics of pest management activities for the duration of the project
- the reporting and evaluation protocol for the control plan to ensure optimal pest control outcomes.

Acronyms and abbreviations

BBBQ	Black-breasted button-quail
C2CD	Cooroy to Curra Section D
CPE	Canid Pest Ejectors
DAWE	Department of Agriculture, Water, and the Environment
DNA	Deoxyribose nucleic acid
EDTA	Ethylenediaminetetraacetic acid
EPBC Act	*Environmental Protection and Biodiversity Conservation Act 1999*
FTA	Flinders Technology Associates
GBO	General biosecurity obligation
HSE	Health, Safety and Environment
MNES	Matters of national environmental significance
OMP	Cooroy to Curra Section D – Detailed Design Offset Management Plan
PAPP	Para-amino propiophenone
PHSP	Project Health and Safety Plan
QLD	Queensland
the Act	*Biosecurity Act 2014*
the plan	Pest control plan
the project	Cooroy to Curra Section D project
SOP	Standard Operation Procedure
TMR	Department of Transport and Main Roads
1080	Sodium fluroacetate

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1 Introduction

The Department of Transport and Main Roads (TMR) engaged Ecosure to develop a pest control plan for environmental offset areas associated with the Cooroy to Curra Section D (C2CD) project (the project) within the Gympie region. The offset areas comprise thirteen properties located in Curra, Victory Heights and Woondum (Figure 1) that were secured by TMR as part of the project's *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) approval. Pest control works will be undertaken within the offset areas over the next ten years (2021 to 2031) to support the conservation of the koala (*Phascolarctos cinereus*) and black-breasted button-quail (*Turnix melanogaster;* BBBQ), both matters of national environmental significance (MNES). The objective of the control plan is to achieve a reduction in pest abundance across each offset area to contribute to ecological outcomes defined in the project's Offset Management Plan (OMP; GHD 2020a) and EPBC Act approval conditions.

Baseline pest monitoring was conducted (February to April 2021) to gain an understanding of the pest abundance in each offset area. This monitoring will be repeated annually to determine the effectiveness of the pest management activities across the offset areas and to guide future management activities. Management in each offset property will target pest species known to threaten the koala and the BBBQ: red fox (*Vulpes vulpes*), wild dog (*Canis lupus familiaris*) feral pig (*Sus scrofa*), and feral cat (*Felis catus*).

The control plan outlines specific pest control activities to be undertaken for the four target species. The plan also includes a resourcing schedule with indicative timing for pest control works, logistic considerations, and a contingency plan for any works hindered by severe weather conditions or COVID-19 related travel restrictions. The control plan is dynamic and will be adapted in accordance with data collected over consecutive years to ensure the most effective control methods are being implemented, taking into account humane pest control techniques and the minimisation of non-target species capture.

This plan will be implemented in consultation with relevant stakeholders including Gympie Regional Council, surrounding landholders/tenants, and program synergies (e.g. aligned timing of control periods) will be considered where possible.

1.1 Offset pest control areas

Of the three offset areas, Curra is the largest (191.6 ha), followed by Woondum (77.86 ha) and Victory Heights (44.82 ha) (Table 1, Figure 1). Baseline monitoring revealed the presence of feral cats and foxes in all three offset clusters. Wild dogs were detected in Woondum and Curra, but not in Victory Heights. In addition, feral pigs were only detected in Curra. Due to the baseline monitoring survey being conducted over an eight-week period and the high movement potential of each of the target pest species, all four species will be targeted in each of the three offset clusters to ensure optimal pest control outcomes.

The Victory Heights offset property is Council-owned land managed by TMR under agreement

for use as an offset for the life of the OMP, and is surrounded by a large number of residential properties. Baseline monitoring data showed that tracks within the Victory Heights cluster were often utilised by local residents for recreational purposes, including dog walking and horse riding. This is a consideration that is taken into account in the plan and outlined pest management activities. The Curra and Woondum offset properties are on TMR-owned land and are much less populous than Victory Heights, however surrounding land is occupied and used by a few rental tenants.

Table 1 Offset site details

Cluster location/name	Lot/Plan	Offset focal species	Pest target species	Offset area (ha)	Total offset area (ha)
Curra TMR-owned land	1MPH23906	koala	Red fox, wild dog, feral pig, feral cat	9.96	190.6
	3MPH23906	koala	Red fox, wild dog, feral pig, feral cat	19.53	
	4MPH23906	koala	Red fox, wild dog, feral pig, feral cat	3.46	
	878MCH1061	koala	Red fox, wild dog, feral pig, feral cat	124.56	
	889CP864404	koala	Red fox, wild dog, feral pig, feral cat	33.09	
Victory Heights Council-owned land	19SP299683	koala	Red fox, wild dog, feral pig, feral cat	26.09	44.82
	1MPH23904	koala	Red fox, wild dog, feral pig, feral cat	5.86	
	1MPH5670	koala	Red fox, wild dog, feral pig, feral cat	2.02	
	2MPH14193	koala	Red fox, wild dog, feral pig, feral cat	7.27	
	763MCH5342	koala	Red fox, wild dog, feral pig, feral cat	3.58	
Woondum TMR-owned land	102SP297908	koala + BBBQ	Red fox, wild dog, feral pig, feral cat	12.38 + 11.22	77.86
	2SP302526	koala + BBBQ	Red fox, wild dog, feral pig, feral cat	11.43 + 13.63	
	3SP302524	koala + BBBQ	Red fox, wild dog, feral pig, feral cat	21.37 + 7.83	
Total					**313.28**

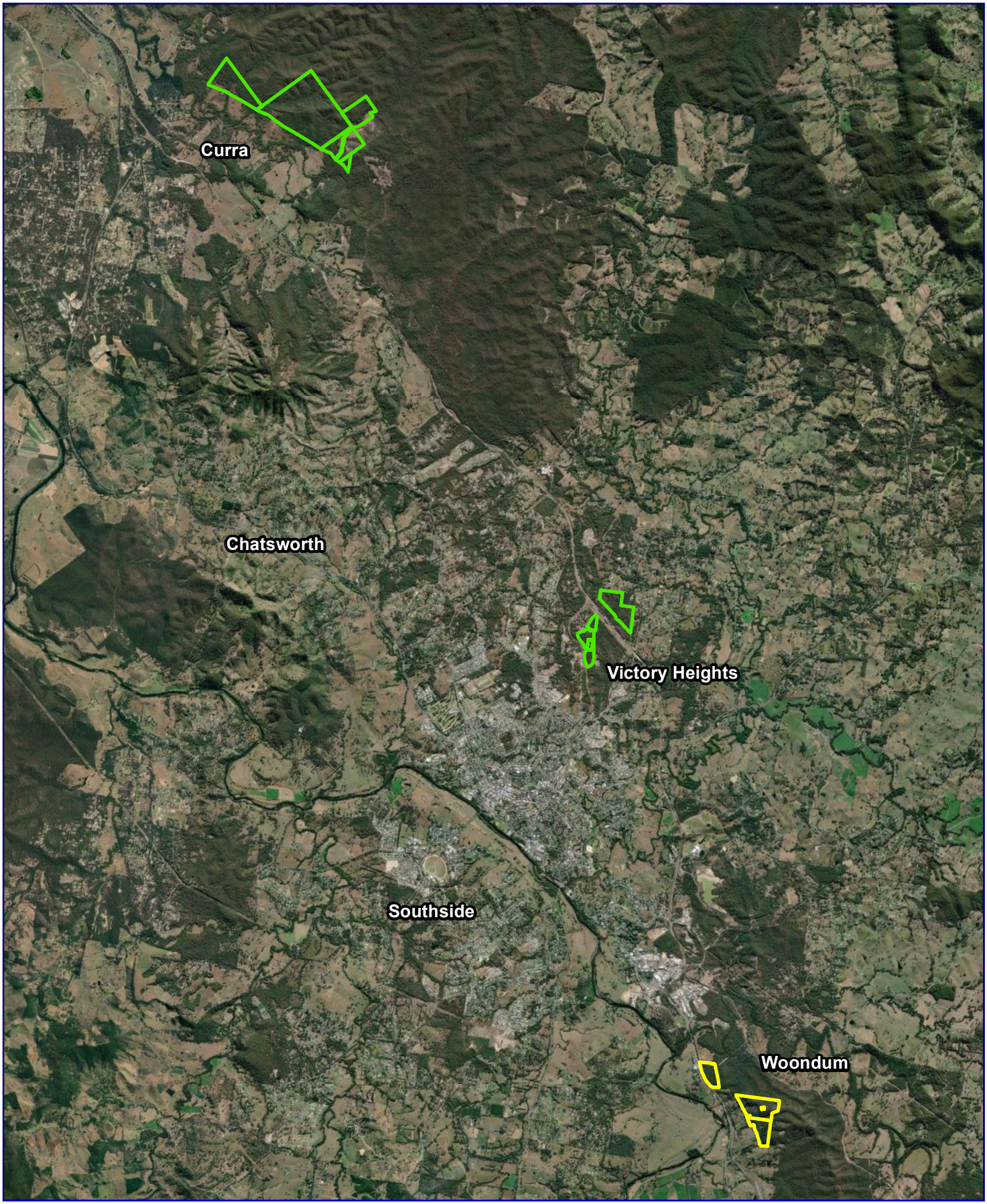

Figure 1: C2CD offset areas

Department of Transport and Main Roads

PR6714 C2CD Offset Pest Control Plan

Offset

- koala offset areas
- koala + black-breasted button-quail offset areas

ecosure

Job number: PR5620
Revision: 0
Author: EK
Date: 27/10/2021

0 0.5 1 2
Kilometers

GDA 1994 MGA Zone 56
Projection: Transverse Mercator
Datum: GDA 1994
Units: Meter

1.2 Legislation

The Queensland *Biosecurity Act 2014* (the Act) commenced in July 2016, replacing the *Lands Protection (Pest and Stock Route Management) Act 2002* as the overarching legislation guiding pest management in the state. The Act establishes a system to minimise biosecurity risks and facilitate a coordinated response to biosecurity events.

Pest control activities involving the use of toxins or fumigants are regulated by Queensland Health under the *Pest Management Act 2001* and *Medicines and Poisons Act 2019*. A Pest Management Technician Licence is required through Queensland Health under the *Pest Management Act 2001* to use fumigants for pest control.

Wild dogs, feral cats, feral pigs, dingoes (*Canis lupus dingo*), and foxes are categorised as restricted matter (former three are Category 3, 4 & 6 and latter two are Category 3, 4, 5 & 6) under the Act, which means they must not be moved, fed, given away, sold, kept (Category 5), or released into the environment without a permit. Dingoes are also defined as both 'wildlife' and 'native wildlife' under the *Nature Conservation Act 1992*, and as such are protected within protected areas (such as national parks), although not outside of these. Classification as restricted matter also means that all stakeholders including private landholders, local, state, and federal governments have a responsibility (general biosecurity obligation; GBO) under the *Biosecurity Act 2014* to take all reasonable and practical steps to prevent or minimise associated risks (e.g. health and safety, amenity, social, economic, and environmental risks).

The Queensland *Animal Care and Protection Act 2001* imposes a duty of care on persons in charge of animals to ensure animal welfare is upheld, and this legislation applies to controls implemented as part of this control plan.

Implementation of this Plan will also be in accordance with the *Weapons Act 1990* and best practice guidelines e.g. PestSmart Standard Operation Procedures (SOPs) for humane control of pest animal species.

2 Target pest species

As per the OMP, the target species for koala offset areas (Curra, Victory Heights and Woondum) are wild dogs and foxes, while the target species for BBBQ offset areas (Woondum) are wild dogs, foxes, feral cats, and feral pigs. However, baseline monitoring surveys conducted in early 2021 (Ecosure 2021) revealed the presence of a large feral pig group in Curra and feral cats in both Curra and Victory Heights. While feral cats and pigs do not pose a direct threat to koalas, they have a detrimental impact on native species and the ecosystem in general. As such, all four species will be targeted for control in each offset cluster.

2.1 Wild dogs

Wild dogs are a recognised key predator to both koalas and BBBQ (DAF 2016, Mathieson & Smith 2009, OEH 2019). They pose a significant threat to endangered wildlife, especially small and less agile species such as the koala and the BBBQ. In particular, they are known to pose a key threat to koala populations in peri-urban areas (Gentle et al. 2019). Wild dogs also predate on a range of native and pest animals such as kangaroos, wallabies, koalas, possums, rabbits, rodents, birds, and reptiles.

Wild dogs are social animals that often form packs to travel and hunt together and occupy territorial home ranges (DAF 2016). These home ranges tend to be large, can overlap with other territorial ranges, and are highly dependent on food availability (DAF 2016). Individual wild dogs that are not associated with a pack tend to have even larger ranges and are generally dispersing to find new territory or to leave their birth group. Wild dogs in eastern NSW have been recorded with an average home range of 40 km^2, though home ranges can vary between 4 km^2 and 1000 km^2 (DPI n.d.). They preferentially travel along roads and tracks and use these passages for territorial marking (Triggs 1996, Mitchell & Balogh 2007, Raiter et al. 2018). Wild dogs are nocturnally and diurnally active but are most active during the night and at dawn and dusk (McNeill et al. 2016, Verbeek & McLeod 2018).

Peak breeding season for wild dogs is typically Autumn to Winter (DAF 2016; 2016a) (Table 2). Wild dogs generally breed one to two times a year, rearing an average of five pups per litter (DAF 2016). Females reach sexual maturity at two years of age, while males reach sexual maturity at three years of age (DAF 2016). Wild dog activity generally peaks in spring and early summer when wild dogs are dispersing after the breeding season (McNeill et al. 2016, DAF 2016, North Coast Local Land Services 2019) (Table 2).

Table 2 Indicative reproductive calendar for wild dog (*Canis lupus familiaris)* (DAF 2016a). Note mating in the Gympie region has been observed as early as March, and whelping/dispersal can similarly occur earlier in some years (Gympie Regional Council, pers. obs.).

Summer			Autumn			Winter			Spring		
Dec	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**
					Mating						
					Breeding						
						Whelping					
Dispersal											

During baseline monitoring surveys, packs of four wild dogs and two wild dogs were present in the Curra and Woondum offset properties, respectively (see Ecosure 2021 for further detail). No wild dogs were detected in Victory Heights during baseline monitoring, however have been recorded and controlled proximal to this site by Council officers over time and it is likely they will pass through the area from time to time (Gympie Regional Council, pers. comm.). Based on their colouration and physical features, it is possible that some individuals may have high dingo purity. Wild dog activity was distributed relatively evenly across the Curra offset properties, while the wild dogs in Woondum were only observed in the northern portion of the eastern offset cluster.

Common methods used to control wild dog populations in Australia include trapping and shooting (padded-jaw traps, cage traps, soft net traps), ground shooting, ground and aerial baiting using sodium fluroacetate (1080) and para-amino propiophenone (PAPP), and other non-lethal methods such as exclusion fencing and guardian animals for livestock protection (Sharp 2012a).

2.1.1 Wild dog DNA sampling

A ‘pure’ dingo refers to the genetic variety of dingo prior to European settlement in Australia. The introduction of domestic dogs has since lead to hybridisation between the species, causing a significant decrease in pure dingo populations (and increase in hybrid populations) across Australia (McAllister 2011). Hybridisation is a primary threat to the survival of the dingo in Australia, thus emphasising the need to protect populations with known purity (Stephens et al. 2015, Allen et al. 2017).

There are various physical characteristics that distinguish pure dingoes from hybrids and domestics dogs. Pure dingoes can exhibit a range of coat colours including ginger, tan, black, white or a combination of these. They also often have white colouration on their toes, feet, tail tip and chest, though the proportion of white can very among individuals. Alternatively, hybrid and domestic dogs often have patch, sable, or brindle coat colouration. Despite the physical differences between the two, confirmation of dingo purity requires DNA testing. A recent study investigating the purity of dingoes across Australia has revealed, through microsatellite DNA testing, that 99% of wild dog/dingo samples tested (5029 samples) had dominant dingo purity (i.e. > 50%) (Figure 1). Figure 1 suggests the Gympie region contains dingoes with purity ranging from 65% - 75% and >75%.

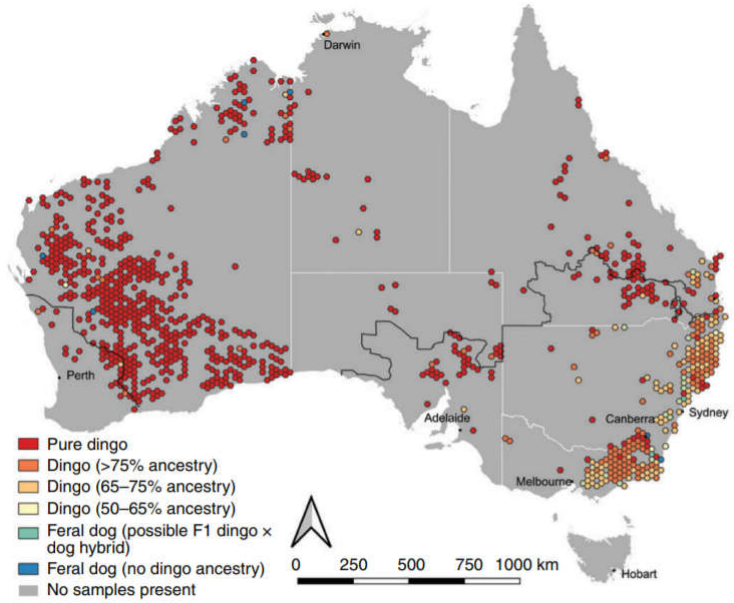

Figure 2 Spatial patterns of dingo ancestry across Australia based on microsatellite DNA testing conducted by Cairns et al. (2021).

In Australia, some studies have shown that dingoes can play an important ecological role as the apex predator by maintaining trophic balance and contributing to the suppression of detrimental mesopredators such as feral cats and red foxes, either through direct predation or behaviour changes (Mitchell & Banks 2005, Johnson & VanDerWal 2009, Brook et al. 2012, Gordon et al. 2015). Dingoes also play a role in controlling feral goats, rabbits, and overabundant macropods (Smith et al. 2018).

In recognition of the cultural and ecological significance of dingoes, and the importance of protecting populations with high dingo purity, genetic samples will be collected from live wild dogs/dingoes for genetic study prior to on-ground control where possible. Fur samples will be collected with roll boards or from scats and sent to laboratory facilities to be analysed. If high-purity dingoes are identified, Ecosure will consult with TMR and engage with stakeholders to discuss control options and implications.

Under the *Biosecurity Act 2014*, if a wild dog is trapped, it cannot be released into the environment and must therefore be euthanased. Thus, if a wild dog is trapped and their purity is unknown, it will be euthanased. In this case, fur, tissue, blood (in EDTA [ethylenediaminetetraacetic acid] or on FTA [Flinders Technology Associates] cards) or buccal swab samples will be taken from deceased animals and sent for genetic testing. This will allow us to accurately profile the genetic integrity of the wild dog/dingo population in the Gympie region, which can be used to inform ongoing pest control. It is acknowledged that both wild dogs and dingoes can be a cause of significant koala mortality (Gentle et al. 2019), and careful monitoring (camera and dietary analysis, see Section 2.1.2) is required if dingoes are to be conserved.

2.1.2 Dietary analysis

Dietary analysis of wild dog/dingo scats may be conducted to identify recent prey items, specifically koala and/or BBBQ. Scats will be collected opportunistically in the field, and

targeted searches may be undertaken by field personnel. This analysis will provide some insight into the predatory tendencies of wild dogs/dingoes on koala and/or BBBQ, which may inform management decisions if wild dogs are genetically proven to be of high dingo purity. Robust scat survey methods including adequate survey effort will be required to rely on dietary analysis as evidence koalas and BBBQ are not being impacted if dogs with high dingo purity are to be conserved.

Dietary analysis of scats of fox (Section 2.2), cat (if scats observed) (Section 2.3) and feral pig (Section 2.4) may also be incorporated into the monitoring program to provide additional data on impacts.

2.2 Red foxes

Red foxes are a recognised key predator to both koalas and BBBQ (DAF 2020b, Mathieson & Smith 2009, OEH 2019). They are known to predate on BBBQ and small koalas (i.e., juveniles and sub-adults; Ramsay 1999), albeit to a lesser extent than wild dogs. Foxes are generally solitary hunters, though can also live in a small group consisting of a breeding pair, cubs, and sometimes sub-ordinate females (DAF 2016b). In urban areas, foxes can generally be found in remnant bushlands or parks and feed on a variety of food types including small birds, small mammals, worms, insects, and fruit (DAF 2016b).

Fox home ranges can vary depending on sex (i.e. males have a larger home range than females), habitat type/landscape (e.g. temperate agricultural, coastal, arid/semi-arid, urban, semi-urban) (Carter et al. 2011), food availability, and fox density (Verbeek & McLeod 2018). In general, home ranges vary between two and five km^2 (Verbeek & McLeod 2018). Similar to wild dogs, they are primarily active at night, dusk and dawn, and rest during the day (DAF 2016b).

Female foxes breed once a year, with breeding occurring in winter and cubs being born in spring (DAF 2016b) (Table 3). Litter sizes typically range between four to ten cubs (DAF 2016b). Fox densities have been shown to peak in summer (Coman et al. 1991), with cubs emerging from dens in late spring and dispersing from family territory in late summer to early winter (Gentle 2006, DSEWPC 2010). Dens are generally used during early spring to summer and are otherwise vacant (Gentle 2006).

Table 3 Indicative reproductive calendar for red fox (*Vulpes vulpes)* (Gentle 2006, DSEWPC 2010). Fox breeding, whelping and dispersal can often run later (into October/November; Gympie Regional Council, pers. obs.).

Summer			Autumn			Winter			Spring		
Dec	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**
							Breeding				
								Whelping			
		Dispersal									
											Cubs emerge from dens

During baseline monitoring surveys (Ecosure 2021), foxes were detected in each offset cluster, with the highest activity (i.e. expected number of detections / camera station / day) detected in Victory Heights, followed by Woondum and Curra. Foxes were the most common pest animal detected in each offset cluster and overall, with approximately 58% of the total independent pest observations being foxes.

Common methods used to control fox populations in Australia include trapping and shooting (padded-jaw traps, cage traps, soft net traps), ground shooting, ground and aerial baiting using sodium fluroacetate (1080) and para-amino propiophenone (PAPP), den fumigation using carbon monoxide, and other non-lethal methods such as exclusion fencing and guardian animals for livestock protection (Sharp 2012b).

2.3 Feral cats

Feral cats are a recognised key predator to BBBQ (Mathieson & Smith 2009, OEH 2019). Feral cats are opportunistic feeders, feeding on small mammals, birds, reptiles, amphibians and sometimes fish (DAF 2020c). Rabbits may comprise up to 40% of a feral cats' diet, though this is highly dependent on rabbit availability (DAF 2020c). During times where rabbit density is much lower, there is a significantly higher number of native animals predated upon (DAF 2020c). In addition to direct predation, feral cats also negatively affect other native animals that compete for these food sources, such as quolls, raptors, and reptiles (DAF 2020c). Many feral cats thrive in urban environments and rely on supplementing their diet by scavenging rubbish scraps (DAF 2020c). True feral cats, however, do not rely on humans at all, and obtain all of their food and shelter from the natural environment (DAF 2020c).

Feral cats are predominantly nocturnal but are also active at dawn/dusk (Mitchell & Balogh 2007). They are often thought of as solitary animals, though studies show that this is generally only limited to hunting (DAF 2020c). Cats will often live in social groups comprising several related females and an adult male. Their home ranges can vary depending on resource availability (including food and den sites) and sex, with males having a larger home range of up to 10 km^2 (Mitchell & Balogh 2007). The dominant males' range generally extends across the range of other groups of females (DAF 2020c, Mitchell & Balogh 2007).

Female feral cats generally have two litters per year in spring and late summer/early Autumn, comprised of two to seven kittens. However, the 'breeding season' is less well-defined than wild dogs and foxes as breeding is generally dictated by environmental conditions and resource availability (Mitchell & Balogh 2007). As such, they do not have a particular peak activity season/month and are renowned for being highly elusive and difficult to monitor. Young males raised in their natal group generally disperse or are driven from the group once their reach sexual maturity.

During baseline monitoring surveys (Ecosure 2021), cats (both feral and suspected domestic) were detected in each offset cluster, with the highest activity detected in Curra, followed by Victory Heights and Woondum. The cat detected in Woondum was confirmed as domestic and cats in Victory Heights may potentially be domestic given the proximity to residential properties.

Common methods used to control feral cat populations in Australia include trapping and shooting (padded-jaw traps, cage traps, soft net traps), ground shooting, and baiting using sodium fluroacetate (1080) and para-amino propiophenone (PAPP) (Sharp 2012c).

2.4 Feral pigs

Feral pigs pose a threat to BBBQ populations primarily through habitat degradation, e.g. destruction of sheltering sites and introduction of exotic weeds (Mathieson & Smith 2009, OEH 2019). Due to their varied omnivorous diet (e.g. grain, sugarcane, fruit, tubers, worms, soil invertebrates etc.), feral pigs can have a significant impact on agricultural crops though uprooting, trampling and feeding. They can also be responsible for transporting weeds, damaging fences, dam walls and dirtying water tanks and bore drains (DAF 2020d). Feral pigs can degrade habitat and water quality for small terrestrial and aquatic animals, and examination of their faeces have shown remains of marsupials, reptiles, insects as well as ground nesting birds and their eggs (DAF 2020d).

Feral pigs occupy roughly 40% of Australia across all different habitat types, though they are limited to moist areas where there are adequate water supplies and adequate shelter to protect against extreme temperatures (DAF 2020d). The highest densities of feral pigs are found around larger drainage basin and swamp areas (DAF 2020d). Female (sows) and juvenile pigs generally persist in small family groups while adult males are typically solitary. Feral pig home ranges can vary between 10 and 50 km^2 for males and 5 and 20 km^2 for sows, though if food availability is high this home range can be restricted to within 5 km of an adequate food source (Agriculture Victoria 2020). Home ranges of sows and piglets can be even more restricted to around 0.16 km^2 (Agriculture Victoria 2020).

Similar to feral cats, feral pigs do not have a defined breeding period and can breed throughout the year when conditions are optimal. Breeding tends to peak following rapid growth of green vegetation after heavy rain. Sows make nests of available vegetation within 2 km of a water source. Piglets remain in the nest for one to five days with the sow staying close by (DAF 2020d). Piglets are weaned by the age of two to three months, and sexual maturity is reached at around six months of age (DAF 2020d).

During baseline monitoring surveys (Ecosure 2021), feral pigs were only detected in Curra offset properties. Group sizes were highly variable, ranging from 1 - 15 across the 50 independent observations made throughout the monitoring period.

Common methods used to control feral pig populations in Australia include trapping and shooting (large cage traps), aerial and ground shooting (including the use of Judas pigs), baiting using sodium fluroacetate (1080) and sodium nitrite (HogGone®), and the use of Judas pigs (Sharp 2012d). The Judas pig technique describes a method of locating unidentified groups of pigs by exploiting the gregarious nature of feral pigs. Once a pig group is identified, a ‘Judas’ pig is radio-collared and allowed to escape during on-ground control (e.g. shooting), leaving it to seek another pig group. Once it has inevitably found another group, that group is euthanased and the process is repeated. This is a seeking technique that may be coupled with control if improved efficacy is required during implementation of the program.

3 Pest control strategy

A summary of control options that may be utilised in the pest control plan is provided in Section 3.1. An adaptive management approach is critical to the success of any control program, and as such there will be some flexibility around the selection of control options. Control methods will follow best practice to ensure animal welfare is upheld, and to avoid ineffective control resulting in pest animals becoming warier and harder to manage.

3.1 Control options

3.1.1 Trapping

Trapping using padded-jaw traps, cage traps, and soft net traps can be used to capture wild dogs, foxes, and feral cats. Padded-jaw traps are more commonly used and consist of small metal traps which are buried slightly below the ground. The aim of this technique is to trap the animals' paw as it steps onto the trap and hold it there until a vertebrate pest management specialist can attend to the location and humanely euthanase the animal. Cage traps, as the name suggests, are fully enclosed cage wire traps that are usually baited to attract pest animals. Once an animal enters the trap, it triggers a weight sensor, and the door closes behind them, thus trapping them until a specialist can attend the location. Soft net traps provide an alternative trapping method for animals that won't enter the enclosed space of a cage. A soft net is released over an animal, entangling it in the net. This method is rarely used by industry professionals and will not be used in this control plan.

All traps have the potential to cause injury and distress, though welfare impacts can be minimised by:

- ensuring adequate cover
- checking traps at least once per day (early in the morning)
- approaching traps calmly and quietly
- using sensor-hub traps that alert specialists when an animal has been trapped, allowing for a rapid response (within two hours)
- avoiding periods when dependent young are likely to be in dens or at foot
- placing traps away from fences to prevent captured animals from incurring lacerations or broken limbs from the fence while trying to escape.

There is also a risk of non-target animals becoming trapped. This risk can be minimised by:

- strategically placing traps to target pest animals (e.g. track junctions)
- avoiding areas of likely non-target activity (e.g. the base of trees, under fences, macropod tracks)
- pre-control monitoring so areas of high non-target activity can be avoided.

Using species-specific lures to attract wild dogs, foxes, and feral cats. We acknowledge there is the potential (albeit low) of a koala becoming trapped in a padded-jaw trap, given the koala densities in each offset cluster; 0.016 koala/ha in Curra, 0.045 koala/ha in Victory Heights, and 0.155 koala/ha in Woondum (GHD 2020b). While we consider the risk to be low, extensive efforts will be made to reduce the risk further. Species-specific lures will be used to decrease the attractiveness of trap locations to koalas. In addition, traps will be placed strategically to avoid areas of high koala movement e.g. the base of trees, areas where trees have koala scratch marks, and areas with koala scats. When placing traps, field personnel will do a 5-minute cursory search for koala scats in the immediate area (within 5 meters of trap) and traps will only be placed if no scats are located. With these mitigation measures in place, the residual risk of capturing a koala is very low. If risk is considered greater than very low in some areas, methods will be adjusted accordingly (for example, trapping replaced by target-specific baiting).

Feral pigs can be trapped using large cage traps. Pig-specific traps should be used to optimise the success of the trapping program and decrease the risk of capturing non-target native animals. An example is a trap with a V-shaped door that opens in the centre when pushed. This design is preferred as feral pigs are known to exhibit a 'pushing' behaviour, while other native animals (e.g. macropods) are highly unlikely to enter such a trap. A period of free feeding with pig-specific bait (e.g. fermented grain) will be undertaken prior to setting the trap. After multiple days of free feeding, the trap will be placed in free feeding locations, but not set to trigger. Free feeding will continue for at least one week, or until the number of pigs visiting the site reaches a plateau, to habituate pigs entering the trap and encourage other pigs to locate the trap site using cues deposited by habituated pigs already feeding there. A camera will be placed near the trap to monitor activity in and around the trap. Once pigs have been observed regularly entering the trap, it will be set to trigger and checked each morning. If native animals are observed entering the trap at any stage throughout pre-monitoring, adjustments will be made to the trap design to prevent access, or the trap may be moved. Trapped feral pigs will be humanely euthanased by shooting.

Trapping will only be undertaken by personnel that have extensive training and experience in humane trapping and euthanasia programs.

3.1.2 Baiting

Baiting programs can be used to target wild dogs, foxes, and feral cats (1080 and PAPP), and feral pigs (1080 and HogGone®). Baiting will be done as set under legislation (Section 1.2) and the Queensland Health Departmental Standard – Dealing with restricted S7 poisons for invasive animal control.

1080 occurs naturally in a number of native plant species including *Acacia georginae* and members of the *Gastrolobium* and *Oxylobium* genera. As a result, native fauna species have a level of tolerance to the toxin, which reduces the risk of non-target poisoning. Potential impact to non-target species can be further reduced through:

- the use of species-specific bait types, size, and dose rates
- burying baits to reduce visibility and access to non-target species

- tying bait to stakes (or similar) to avoid native animals (such as birds) taking / moving the bait, or foxes caching baits where it may be more likely consumed by a native animal
- using targeted bait delivery devices such as Canid Pest Ejectors (CPE) and HogHopper™ to reduce the risk of baits being exposed and available for non-target animals including domestic pets
- free-feeding with non-toxic baits prior to laying toxic baits and monitoring for non-target activity – areas of high non-target activity can then be avoided.

PAPP is a relatively new bait that is considered more humane than 1080 as the active toxin (para-amino propiophenone) acts faster (RSPCA 2020) and with a different mode of action (hypoxia resulting from methaemoglobinemia [APVMA 2015] compared with nervous system involvement with 1080 [DPIRD 2018]), causing a quicker and less distressing death to target animals. PAPP also has an antidote that can be administered by a veterinarian if a non-target animal is known to consume it. This is particularly important in urban/residential areas where there is increased risk of domestic dogs and cats consuming baits (e.g. Victory Heights). Unlike 1080 baits, native animals do not have a natural tolerance to PAPP and consumption of the bait can cause serious illness and possibly death in varanid lizards (goannas), marsupial carnivores, bandicoots, and some bird species. Specific measures must therefore be taken to reduce the risk of native wildlife consumption if PAPP baiting is adopted.

HogGone® is considered the most humane baiting method for wide-scale feral pig control. The active toxin (sodium nitrite) acts quickly to cause death in feral pigs, which occurs within 2 hours of bait consumption, compared to 6-8 hours for 1080 baits. Non-target animals are unlikely to be attracted to HogGone® baits, though targeted delivery devices can be used to target feral pigs and decrease the risk of non-target consumption.

If baiting is undertaken, a risk/benefit analysis will be done to determine the best baiting product to use for each pest species.

3.1.3 Shooting

Wild dogs, foxes, feral cats, and pigs can be targeted through ground and aerial shooting programs (the latter only for feral pigs). Ground shooting can be effective if carried out by experienced, licenced marksmen, especially in combination with other control methods, for example integrated with trapping to target trap-shy individuals. During ground shooting, two experienced personnel will traverse relevant roads and tracks in a vehicle or on foot, locating target animals with a thermal imaging scope or spotlight. If it is assessed to be safe and appropriate to use firearms in that location, the animal will be humanely euthanased.

Feral pig locations can also be identified through the use of Judas pigs (as discussed in 2.4). Aerial shooting is sometimes used for wide-scale feral pig management, though given the size of the offset properties and limited number of pigs, ground shooting is preferred for this program.

Shooting is a humane method of control provided it is performed by experienced, skilled

marksmen using a species-appropriate firearm, ammunition and shot placement. Shooting will be undertaken in strict accordance with legislation, SOPs and the Project Health and Safety Plan (PHSP). Shooting will be avoided during periods when dependent young are likely to be present. If lactating females are inadvertently shot, efforts will be made to find dependent young to be humanely euthanased. Shooting will also be avoided in peri-urban and urban sites (e.g. Victory Heights) during school holidays and public holidays.

3.1.4 Den fumigation

Fox den fumigation is a technique that is most effectively used in combination with other control techniques (e.g. trapping or baiting) to manage fox populations. This method involves fumigating breeding or natal dens with carbon monoxide which causes oxygen depletion and subsequent death of den occupants. It is a humane technique if implemented correctly, as it acts rapidly to cause unconsciousness and death without pain and discomfort. Den fumigation is generally undertaken around August - October when dens are active and fox cubs are older than four weeks of age. Younger cubs can be relatively resistant to hypoxia, meaning it may take longer for them to become unconscious and die, thus reducing the humaneness of the technique.

Den fumigation is very target-specific as only active fox dens are fumigated. Active fox dens are identified by signs of fox occupation such as tracks, remains, and fox odour. Old fox dens can be re-occupied by native animals, so any den without active fox signs will not be fumigated.

Carbon monoxide is also toxic in humans, so only trained, experienced personnel holding a Queensland Pest Management Technician Licence for the fumigation of dens and burrows under the *Pest Management Act 2001* are able to undertake den fumigation. Before undertaking fieldwork involving fumigation, personnel will complete pre-operational safety checks to ensure all necessary equipment is included in the field kit (e.g. DEN-CO-FUME® cartridge, fire extinguisher, lighter, shovel). Once a fox natal den has been identified as active, a comprehensive, onsite-specific risk assessment will be conducted to ensure fumigation activities are safe to conduct in the area. Once deemed safe, personnel will commence the fumigation process, including:

1. clearing flammable material from around the den entrance
2. taking DEN-CO-FUME cartridge and perforate around fuse, as per manufacturer's instructions
3. holding cartridge at den entrance and lighting fuse facing into den entrance
4. pushing cartridge into den with shovel handle
5. sealing den entrance with soil ensuring no smoke can escape from other entrances
6. waiting at least five minutes to ensure cartridge has burnt out.

Fox dens are generally located/identified by trained detection dogs or on-ground personnel searches. Desktop mapping of soil type, vegetation, resources and topography can be used to narrow down areas where fox dens are likely to occur, leading to a more targeted search

area. Dens observed opportunistically either during on-ground pest control works, or by Ecosure's Ecological Restoration team undertaking habitat restoration works, will be recorded into a cloud-based data management system, and may be fumigated by the pest control team. On-ground personnel searches can be effective across very small areas (e.g. Victory Heights), though detection dogs are more effective, particularly over larger areas (e.g. Curra). Detection dogs are able to search areas yet to be surveyed and enable their handlers to rapidly obtain and record evidence of the target species. In many instances, den sites can remain undetected without the special benefits afforded by a detection dog. Dogs are able to locate discrete dens (and other signs of activity) that provide limited access to human handlers and thus provide a distinct advantage over other methods of den detection.

3.1.5 Exclusion fencing

Exclusion fencing can be used to exclude wild dogs, foxes, and cats from protected areas. Netting and electric fencing can be effective in preventing access, though this technique is very labour intensive and requires a high level of maintenance to ensure efficacy. In addition, fences must be designed in a way to account for pest animal behaviour such as digging, climbing, and jumping, resulting in the most effective designs being expensive and relatively complex. Fencing can also hinder wildlife movement and create isolate populations which are susceptible to inbreeding.

Exclusion fencing is not considered appropriate or feasible for this project.

3.2 Suitability of control options

Control options were assessed against key considerations for any pest control plan: animal welfare, human safety, feasibility, cost, and community perception. Options were ranked as 'low', 'medium', or 'high' for each consideration, based on the descriptions in Table 4.

Table 4 Descriptions of the low, moderate, and high categories.

Key considerations	High - appropriate (H)	Moderate - may be appropriate in some situations (M)	Low - never appropriate (L)*
Animal welfare	animals not subjected to unnecessary stress	may pose some issues to animal welfare but can be managed through appropriate mitigation measures	likely to have adverse impacts on animal welfare or considered unethical
Impact to non-target animals	non-target animals not impacted by control method	may impact non-target animals but risk can be decreased through appropriate mitigation measures	likely to have adverse impacts on non-target animals
Human safety	minimises human safety risks	may pose some human safety risks but can be managed through appropriate mitigation measures	does not effectively or appropriately manage risks to human safety

Key considerations	High - appropriate (H)	Moderate - may be appropriate in some situations (M)	Low - never appropriate (L)*
Feasibility	practical to implement with available resources	practical to implement but requires a high level of resources	presents challenges to implement within the control area
Cost	benefits outweigh cost in all situations	benefits outweigh cost in some situations	benefits do not outweigh cost
Community perception	community likely to view favourably	will cause concern to some members of the community	likely to result in community complaints or dissatisfaction
Efficacy	technique is highly effective in controlling pest animals	can be effective if timed appropriately	not generally an effective method of pest control

Table 5 Offset area-specific assessment of potential control options against key considerations. Grey-shaded options will not be used in this control plan.

Method and target pest species	Key considerations							Overall suitability	Rationale for Overall suitability
	Animal welfare	Impact to non-target animals	Human safety	Feasibility	Cost	Community perception	Efficacy		
Trapping *Wild dog and fox: soft-jaw trap* *Feral cat: soft-jaw and/or cage trap* *Feral pig: large cage trap*	M*	M	H	H	M	H	H	**H**	High scores in four categories. Animal welfare and impact to non-target species will be managed through techniques described in Section 3.1.1.
Baiting *Wild dog, fox, feral cat: 1080/PAPP* *Feral pig: 1080/HogGone®*	M	M	H	H	M	M	H	**M**	Moderate scores in most categories. Impact to non-target animals will be managed through techniques described in Section 3.1.2. May be used in the control plan if trapping alone is proving ineffective. Feasibility in Victory Heights may be lower (M).
Ground shooting *Wild dog, fox, feral cat, feral pig*	H	H	M**	M	M	M	M	**M**	Suitable in some areas and can be done safely in appropriate areas (i.e. H for 'human safety' in locations). Particularly useful for 'mop-up control'.
Den fumigation *Fox*	M	H	H	H	H	H	M	**H**	High scores in five of the categories. When timed appropriately, this technique is highly effective.
Aerial shooting *Feral pig*	M	H	M	L	L#	L	M	**L**	Option scores low in three categories and is not currently suitable for offset properties.
Exclusion fencing *Wild dog, fox, feral cat*	H	M	H	L	L	H	H	**M**	Excluding pest animals to protect koala and BBBQ is a safe and high-welfare management measure, though is costly and unfeasible for the offset areas.

*sufficient space, shelter, food and water is to be provided to limit stress to trapped animals, and personnel must respond in a timely response (ideally less than four hours and no more than 12 hours); **ground-shooting, with appropriate controls, can be done safely but is ranked Moderate as it is not appropriate in all areas (e.g. around smaller residential lots); #cost ranked low as benefit would not outweigh cost with low numbers currently in Curra.

3.3 Planned control approach

3.3.1 Trapping program

Wild dogs, foxes, and feral cats will be managed primarily through regular padded-jaw trapping in each offset cluster. Trapping will occur over four two-week periods each year, to account for temporal variation in breeding and movement patterns. Traps will be set in areas of high activity as determined during baseline monitoring (Appendix 1) in the first year of control, and annual monitoring in subsequent years. Annual monitoring will be undertaken in accordance with the Baseline Pest Animal Monitoring Report (Ecosure 2021), ensuring consistency and comparability between years.

Additional monitoring may be undertaken over the course of the program to further inform trap placement, including potentially the use of trained detection dogs. Passive infrared (PIR) cameras and monitoring of animal signs (e.g. tracks & scats) will be used throughout the year to assist in identifying species presence and to inform control timing and effort. Species-specific lures will be used to target wild dogs, foxes, and feral cats. Each trap will be fitted with remote monitoring sensors to allow for rapid response times, and traps will be checked at least once a day. Captured animals will be promptly euthanased and appropriate carcass disposal will occur at waste transfer stations or designated dumping sites.

Feral pigs will be primarily managed through a trapping program, though pig traps will be deployed for periods beyond the dog/fox/cat two-week trapping periods to maximise habitual visitation and trap success. In the first year, the trap will be set in the eastern section of the Curra offset cluster to target the large group of pigs observed during baseline monitoring (Appendix 1). The placement thereafter will be determined by trap success in this first round and ongoing pest monitoring.

3.3.2 Ground shooting and baiting

Ground shooting and ground baiting may be used as secondary pest control to supplement the trapping program. If used, ground shooting and/or baiting will target outlying individuals that are unable to be successfully trapped (e.g. trap shy individuals). This may occur at any time of the year.

3.3.3 Den fumigation

Fox dens will be located and fumigated in August - October each year, either through opportunistic findings, on-ground searches, and/or the use of trained detection dogs, depending on resource and cost requirements/availability.

3.3.4 Timing

Table 6 provides an outline of timing for control works in the first year of the control plan. Control works in subsequent years may be shifted or increased depending on the plan's success in this first year, in which case an updated schedule will be provided to TMR.

Table 6 Timing of pest control works for the first year of the plan. Subsequent years may be altered based on monitoring and control results. Solid colours represent planned works, while hashed lines represent tentative works that may be undertaken if required and if time and resources permit.

	Oct				Nov				Dec				Jan				Feb				Mar			
	w1	w2	w3	w4	w1	w2	w3	w4	w1	w2	w3	w4	w1	w2	w3	w4	w1	w2	w3	w4	w1	w2	w3	w4
Den fumigation																								
Fox/dog/cat trapping	*																							
Pig trapping																								
Ground baiting																								
Ground shooting																								
Annual pest monitoring																								

Table 6 cont.

	Apr				May				Jun				Jul				Aug				Sep			
	w1	w2	w3	w4	w1	w2	w3	w4	w1	w2	w3	w4	w1	w2	w3	w4	w1	w2	w3	w4	w1	w2	w3	w4
Den fumigation																								
Fox/dog/cat trapping			**																		*			
Pig trapping																								
Ground baiting																								
Ground shooting																								
Annual pest monitoring																								

* trapping will be undertaken for a two-week period between September and November depending on highest priority target species as informed by monitoring, and to align with Council's annual wild dog baiting program (generally scheduled April/May and September) where possible (Council also undertakes wild dog control in response to activity, and some routine trapping/shooting generally August-March).

** shifted one week later than the usual 3-month interval to avoid coinciding with annual pest monitoring.

3.3.5 Logistics and landholder notifications

Landholders and rental property tenants within close proximity to the offset properties will be notified of planned works. A mail out for residents with adjoining (at a minimum) properties will be done annually at least two weeks in advance of trapping. If baiting will be incorporated into the program, landholders will be notified prior to each baiting period as required under legislation.

The letter will include:

- contact details of Ecosure pest control field lead
- type of pest control being undertaken
- period of control works
- key considerations and messages for residents during control works (e.g. to ensure domestic pets are confined during the trapping/baiting period, the need to adhere to signage).

Signs will also be erected at every entrance to each offset cluster two weeks prior to control works to ensure anyone entering offset properties is aware of current pest control works.

During trapping works, any dog or cat suspected of being a domestic stray will be impounded (via liaison with Council) to minimise any unintentional euthanasia of domestic pets. Field personnel will be equipped with a microchip scanner for rapid determination of domestic/feral status in the field.

Local Police will also be notified about when the program is likely to use firearms.

3.4 Project Health and Safety Plan (PHSP)

A site-specific PHSP will be prepared prior to site mobilisation that complies with relevant occupational health and safety legislation and details how the safety of staff and other personnel will be managed throughout on-ground monitoring and management. The PHSP will include:

- Health, Safety, and Environment (HSE) roles, responsibilities, and targets
- field team qualifications, inductions and permits required to conduct works
- vehicle and field equipment used on site and maintenance schedules, including daily vehicle and equipment inspections
- survey schedule that details time and location of all field activities
- job HSE analysis that assesses all potential hazards/risks associated with the field surveys, describes control measures required to manage those risks and assesses residual risks with controls in place
- safe work method statements for key hazards, including work in remote locations and working at night

- communications plan that documents:
    - communication equipment to be carried by the field team (e.g. vehicle and handheld UHF radio, military radio if required, satellite phone, mobile phone)
    - project personnel and emergency contacts
    - daily safety check-in procedures
- emergency preparedness and response plan (including reporting of all incidents and near incidents to TMR)
- injury management plan
- vehicle journey management plan.

3.5 Contingency plan

In the event of a COVID-19 lockdown, pest control works will continue and will be led by Ecosure field personnel based in the Gympie region. In the event of extreme or prolonged adverse weather/events that may affect the behaviour of pest animals (i.e. less likely to be trapped) or cause unsafe conditions for field personnel, works will be postponed until conditions are more optimal.

3.6 Reporting and program evaluation

Reporting following each day/night of control will be completed. This will include:

- date and time of control activities
- general environmental and weather conditions
- locations visited
- number and species of pest animals observed at each location
- number of rounds of ammunition fired
- number, age class and sex of each pest animal culled
- any issues, incidents or injuries encountered
- other comments.

A brief report summarising this information will be provided to TMR following each period of control works.

The primary goal of this program is to demonstrate a consecutive annual reduction in pest abundance. The control plan will be evaluated following annual pest monitoring in February – April each year, which will be undertaken in accordance with methodology used in the Baseline Pest Animal Monitoring Report (Ecosure 2021). This program involves an eight-week camera monitoring survey targeting wild dogs, foxes, feral cats, and feral pigs. Camera data will be analysed using statistical methods detailed in the Baseline Pest Animal Monitoring Report (Ecosure 2021). Activity indices derived for each pest animal in each offset cluster will be

compared to baseline results to determine the change in pest animal ‘abundance’ (represented by activity indices). The number of pest animals removed by control operations will also be compared with any changes in activity indices to assess whether the control intensity is sufficient to produce an observable decline (as in Bengsen et al. 2011).

If an overall reduction in pest activity is not achieved, the pest control plan will be reviewed and adapted as required, to ensure that it is being effective, is resourced appropriately, and that risks continue to be effectively mitigated.

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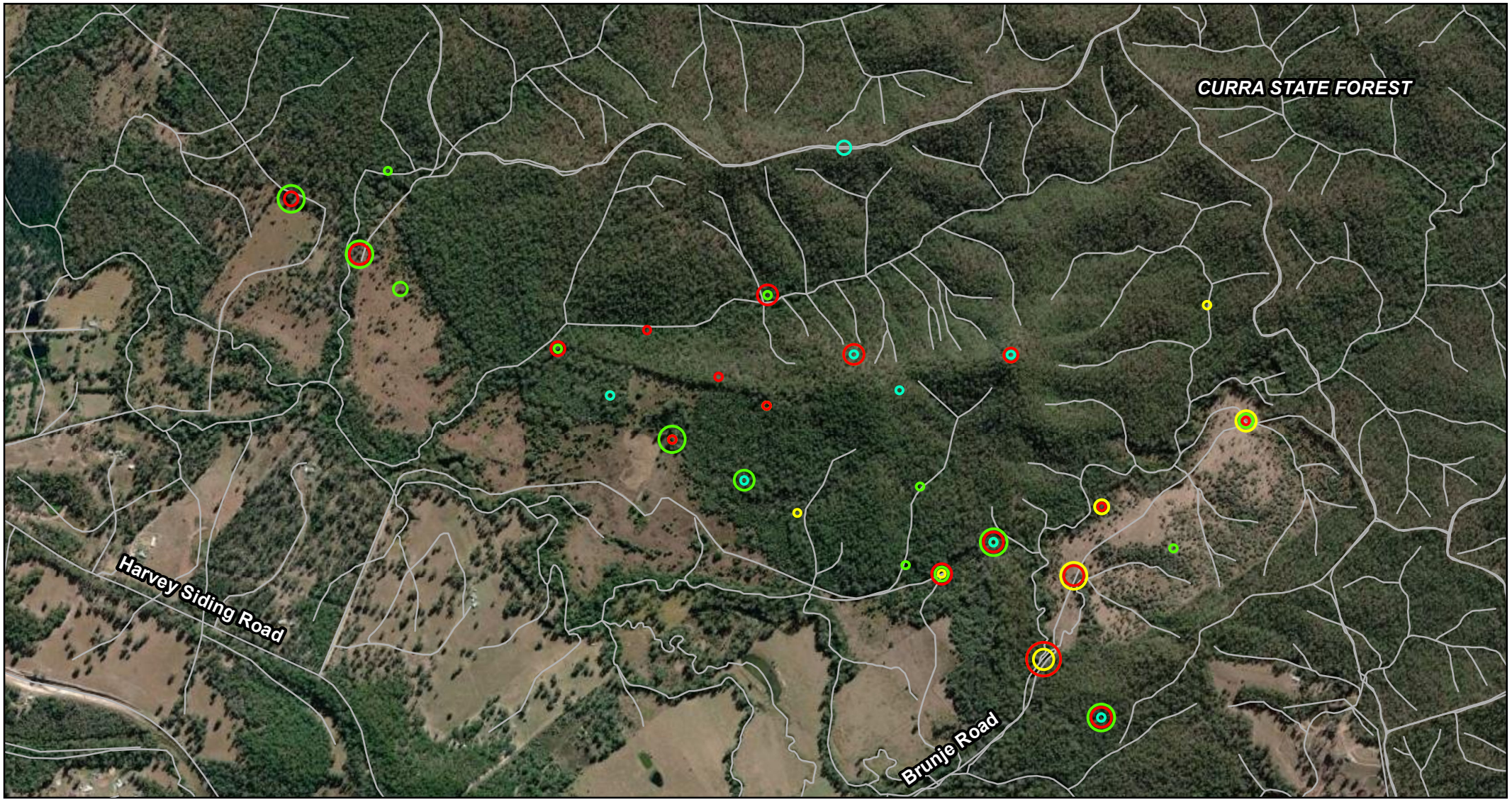
Appendix 1 Baseline pest animal observations



Pest animal observations in Curra offset properties

Offset Pest Animal Monitoring - Baseline Report

Offset cluster
Movement corridors

feral cat
feral pig
red fox
wild dog

No. of independent observations x count per observation

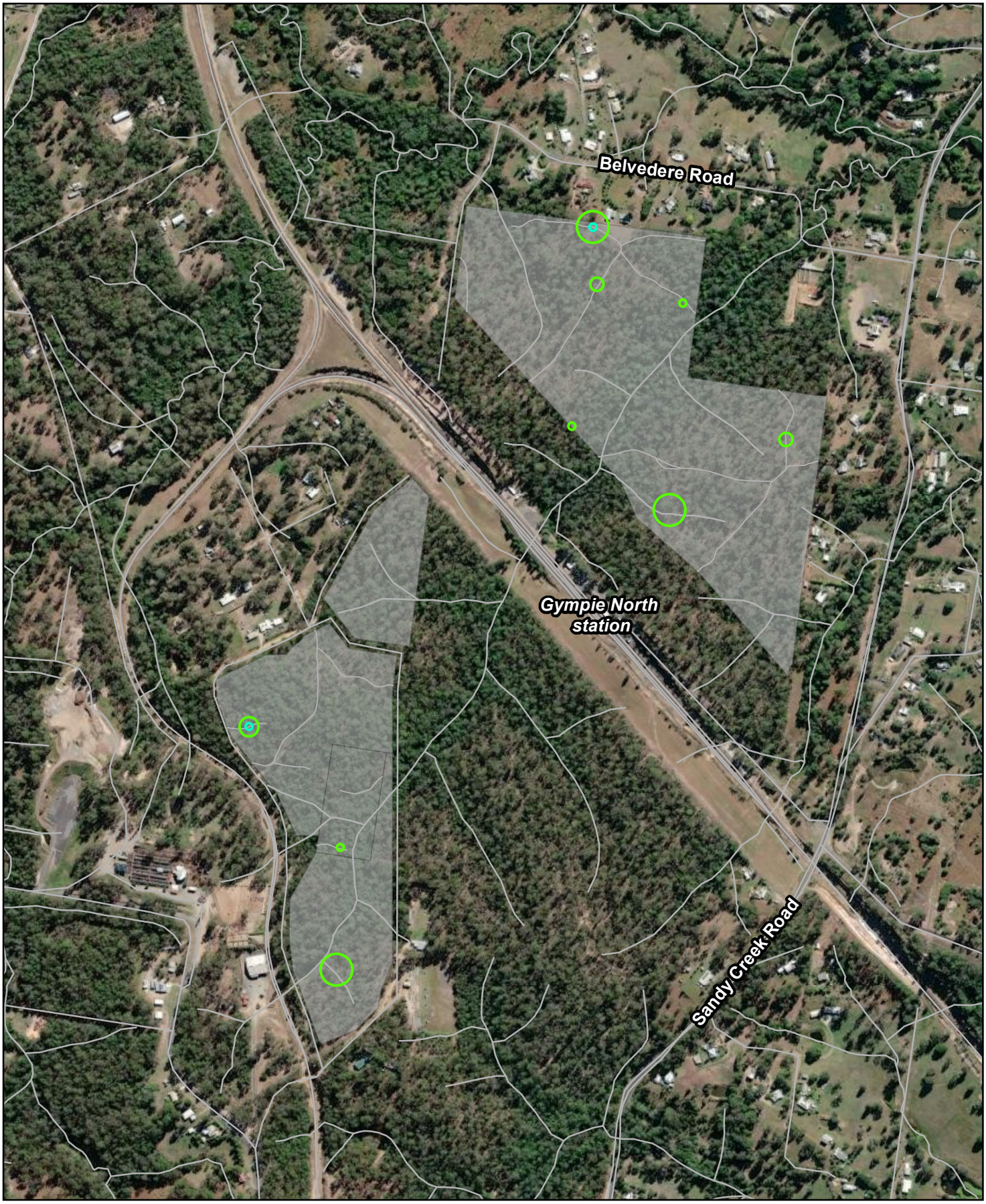
1 - 2
3 - 6
7 - 11
12 - 16
17 - 21

ecosure

Job number: PR5853
Revision: 0
Author: EK
Date: 27/10/2021

0 175 350 700
Metres

GDA 1994 MGA Zone 56
Projection: Transverse Mercator
Datum: GDA 1994
Units: Meter



Pest animal observations in Victory Heights offset cluster

Offset Pest Animal Monitoring - Baseline Report

Offset cluster
Movement corridors
feral cat
red fox

No. of independent observations x count per observation

1 - 2
3 - 6
7 - 11
12 - 16
17 - 21

ecosure

Job number: PR5853
Revision: 0
Author: EK
Date: 27/10/2021

0 40 80 160
Meters

GDA 1994 MGA Zone 56
Projection: Transverse Mercator
Datum: GDA 1994
Units: Meter

PR5853_MPX_PestActivity_VictoryHeights
A4

Pest animal observations in Woondum offset properties

Offset Pest Animal Monitoring - Baseline Report

Offset cluster
Movement corridors
domestic cat
red fox
wild dog

No. of independent observations x count per observation

1 - 2
3 - 6
7 - 11
12 - 16
17 - 21

ecosure

Job number: PR5853
Revision: 0
Author: EK
Date: 27/10/2021

0 40 80 160
Meters

GDA 1994 MGA Zone 56
Projection: Transverse Mercator
Datum: GDA 1994
Units: Meter

PR5853_MPX_PestActivity_Woondum
A4

Revision History

Revision No.	Revision date	Details	Prepared by	Reviewed by	Approved by
00	8/10/2021	C2CD Offset Pest Control Plan DRAFT	Ellie Kirke, Wildlife Biologist Tegan Dinsdale, Graduate Wildlife Ecologist	James Davis, Pest Management Consultant, Padfoot Animal Management	Jess Bracks, Principal Wildlife Biologist
01	27/10/2021	C2CD Offset Pest Control Plan DRAFT R1	Ellie Kirke, Wildlife Biologist	Justin Sanderson, Senior Environmental Officer (Cooroy to Curra D), TMR	Jess Bracks, Principal Wildlife Biologist
02	08/11/2021	C2CD Offset Pest Control Plan DRAFT R2	Ellie Kirke, Wildlife Biologist	Andrew Bengsen, Principal Vertebrate Pest Ecologist, Biosphere Environmental Consultants	Jess Bracks, Principal Wildlife Biologist
03	08/12/2021	C2CD Offset Pest Control Plan FINAL		Jess Bracks, Principal Wildlife Biologist	

Distribution List

Copy #	Date	Type	Issued to	Name
1	8/12/2021	Electronic	Department of Transport and Main Roads	Justin Sanderson
2	8/12/2021	Electronic	Ecosure	Administration

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