Department of Environment,
Land, Water & Planning

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BY EMAIL ONLY

Dear Tony,

Public Consultation of the draft Craigieburn West Precinct Structure Plan (PSP) and draft amendment to the Hume Planning Scheme

Thank you for the opportunity to provide comment on the above draft PSP and planning scheme amendment. The Department of Environment, Land, Water and Planning (DELWP) has reviewed the documents associated with the amendment and provides the attached submission.

DELWP generally supports the draft documents subject to changes outlined in the submission.

DELWP's response includes specific and detailed comments on the draft Kangaroo Management Strategy. These include consolidated comments from DELWPs Arthur Rylah Institute and the Melbourne Strategic Assessment Team. DELWP's support of the draft documents is subject to these comments being addressed.

We look forward to continuing to work cooperatively with the Victorian Planning Authority and are available to discuss our submission.

If you have any questions, please contact James Walsh, Project Officer on (03) 8624 5721 or at james.walsh@delwp.vic.gov.au

Yours sincerely

Ben Nam
Manager, Melbourne Strategic Assessment

17 / 12 / 2020

Attachment 1 – DELWP response on exhibited Craigieburn West Precinct Structure Plan
Attachment 2 – DELWP comments on Draft Kangaroo Management Strategy Craigieburn West

Submission by the Department of Environment, Land, Water and Planning, Melbourne Strategic Assessment Team to the Draft Craigieburn West Precinct Structure Plan

Item	Comment	Model content
2.1 Vision	Please include a general reference to biodiversity conservation which recognises the value and contribution of Conservation Area 29 as identified in the Biodiversity Conservation Strategy (BCS).	Note, Section 3.1 of the BCS specifies overarching conservation outcomes that Conservation Area 29 is contributing towards. The general reference to biodiversity conservation outcomes should be in accordance with the relevant outcomes.
2.3 Objectives	Minor update to wording of O5	*"To facilitate the long-term conservation of significant flora and fauna species through the retention and protection of Conservation Area 29 and landscape features within Craigieburn West including scattered trees and waterways as key community assets that are integrated with the urban landscape."*
Plan 3/ 2.4 Land use budget	Update to specifically identify conservation area as BCS conservation area to distinguish from local conservation areas (present in PSPs other than Craigieburn West).	Update Plan 3 legend to specify '*BCS conservation area*.' Update Table 1, open space to specify '*BCS conservation reserve*.' Update accordingly on plans throughout the PSP for consistency: • Plan 2 (note, lists as GGF conservation – please remove) • Plan 4 • Plan 8 • Plan 10
3.3.2 Utilities	Update wording of R19 to DELWP's preferred wording	*"Utilities must be placed outside of Conservation Area 29"*

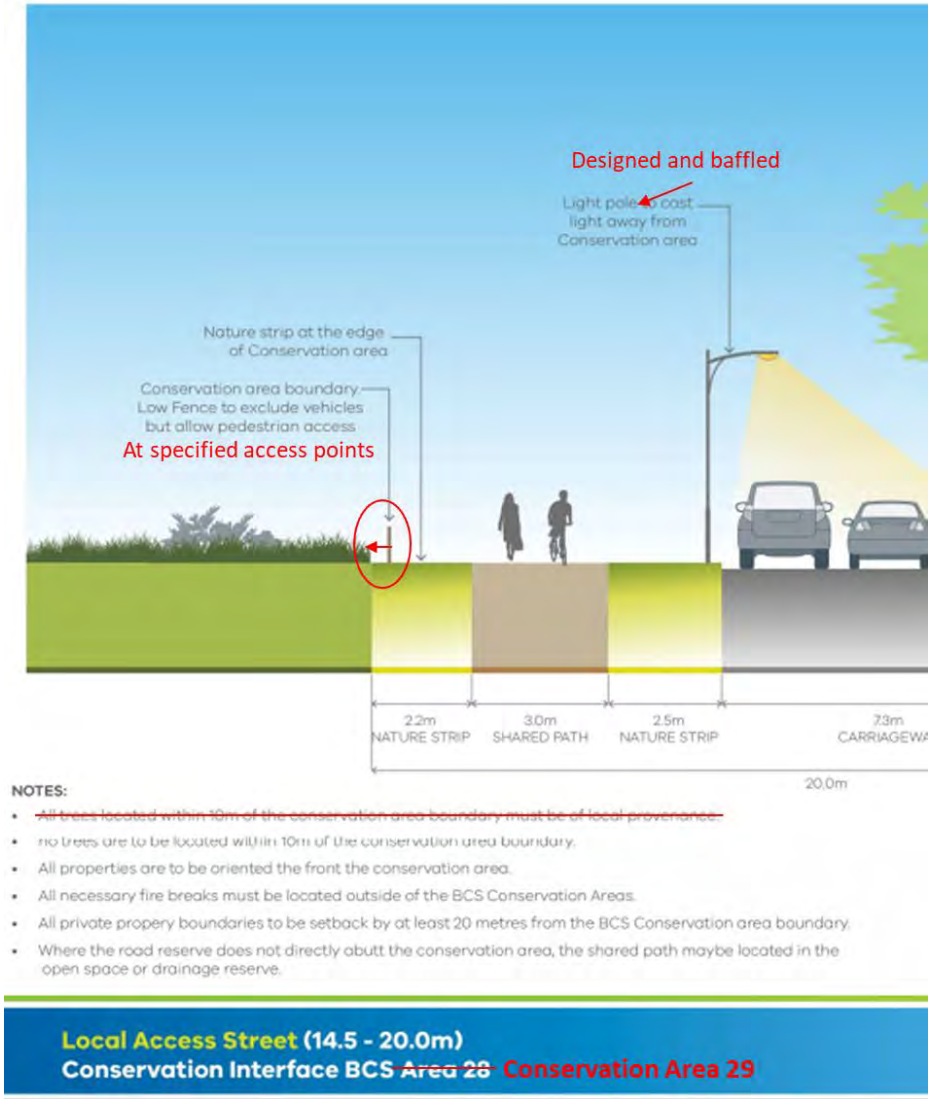
Item	Comment	Model content
3.3.3 Bushfire management & safety	**For Note:** Conservation Area 29 is currently classified as bushfire hazard area 2 with a grassland management class. Please confirm that this classification will remain accurate given the context of the conservation area being reserved for the protection of Grassy Eucalypt Woodland with some canopy restoration to occur (up to approximately 20% cover). Any fire buffer requirements must be met outside the conservation area. It is important that if additional setback may be required in the future, that there is no pressure for this to be within the conservation area.	
Plan 10 Biodiversity and vegetation plan	The extent of native vegetation shown here does not reflect the following MSA layers: - Timestamping native vegetation data layer - Scattered tree dataset No native vegetation is shown within Conservation Area 29 The title refers to 'vegetation' plan however should reference to 'native vegetation' to reflect the purpose of the plan.	Plan 10 needs to be updated to address the following: • reflect DELWPs timestamping data layer (for native vegetation patch) and scattered tree dataset; • ensure native vegetation within Conservation Area 29 is displayed • ensure the following information is shown: scattered trees to be retained, scattered trees to be removed, native vegetation patch to be removed and native vegetation patch to be retained. Title of Plan 10 should be changed to 'Biodiversity & Native Vegetation Plan'

Item	Comment	Model content
Biodiversity, vegetation & landscape character	Update requirement R29 to specify public road edge. Examples of private roads along the boundary of other conservation areas (e.g. for gated communities/retirement communities) has prevented the intent of a publicly managed buffer around the conservation area.	*"All proposed development adjacent to BCS Conservation Area 29 must provide a minimum 20m **public** edge road along all boundaries to the satisfaction of the Department of Environment, Land, Water and Planning."*
Biodiversity, vegetation & landscape character	Note, R31 states that paths must be located in accordance with the BCS Conservation Area Concept Plan. The PSP does not contain a Conservation Area Concept Plan and so this reference should be removed.	*"Paths located within the BCS Conservation Area 29 must be **located and** designed to avoid and minimise disturbance to native vegetation and habitat for matters of national environmental significance to the satisfaction of the Department of Environment, Land, Water and Planning."*

4.5 Street Cross Sections: Conservation Area Interface Plan (pg. 64)

Make the following amendments to the plan:

- Locate the vehicle exclusion fence on the boundary of the conservation area, not within the nature strip.
- First two dot points in the notes are contradictory. Remove first dot point.
- In the boundary fence note, specify it is to allow pedestrian access at specified access points.
- Plan caption currently reads as BCA Area 28. Update to *BCS Conservation Area 29*.
- Specify light pole to be designed and baffled to cast light away from the conservation area.



Item	Comment	Model content
Schedule to clause 52.17	Update the wording for the permit exemption in the table for schedule to Clause 52.17-1 to reflect proposed wording for an upcoming planning scheme amendment to update MSA planning conditions.	*"All native vegetation in the levy area within the meaning of the Melbourne Strategic Assessment (Environmental Mitigation Levy) Act 2020.* *This does not apply to native vegetation identified as to be retained in a precinct structure plan incorporated in this scheme."*
Schedule 6 to Clause 43.03 & Schedule 12 to Clause 37.07	DELWP MSA is currently in the process of updating standard biodiversity conditions for the program in consultation with the VPA. Once complete (expected end January 2020) DELWP MSA will provide these to the VPA for inclusion in the UGZ and IPO schedules for Shenstone Park. Remove the **Condition – Salvage and Translocation** from 43.03-3. No parcels are subject to salvage and translocation requirements within the Craigieburn West PSP area. Remove **Conditions Kangaroo Management Plan** from 43.03-3. Kangaroo management requirements suitably addressed through the Urban Growth Zone schedule.	
Kangaroo Management Strategy	Please address comments provided by DELWP's Melbourne Strategic Assessment Team and the Arthur Rylah Institute on the draft Kangaroo Management Strategy. Specific comments are provided seperately in the provided PDF copy of the strategy (Attachment 2). In particular the following should be addressed: It is DELWP's view that the following from the original RFQ and proposal have not been adequately addressed: **Management recommendations** Detail on the management actions that will be implemented to manage risks to animal welfare and human safety during development of the Craigieburn West Precinct including: • how it contributes to achieving the precinct wide strategy; • How the action relates to other actions and whether its effectiveness is dependent on other actions being implemented;	

Item	Comment	Model content

- Timing of the action relative to the precinct's development and other management actions
- Analysis on any constraints and what is needed to address them
- Estimate on the cost of the action

Responsibility & funding

- Who will coordinate implementation of the strategy?
- How will management actions be paid for and what measures will be implemented to ensure there is an equitable management burden across landowners.

Monitoring and review

- How monitoring of the strategy's effectiveness with respect to achieving risk management objectives will be done (including when and who)

DELWP also has the following general comments on the structure of the strategy:

General Structure/Content.

The content of Section 5 is currently difficult to follow in terms of detail on what the management action is, whether it is feasible, whether it is recommended and then how to implement the recommended actions. It is suggested that Section 5 be structured in three distinct sections:

- **Potential management options (5.1 and 5.2)**: Suggested that this section provide an overview of the potential management options that could be implemented. This could be in the form of a brief description of the management options and what the intended outcome of the management options would be. E.g. 'a culvert is a passage under a road etc. etc. A culvert allows kangaroos to safely crossroads etc. etc.' The current 5.1 and 5.2 largely achieve this, however, there appears to be an opportunity to condense this information, making it more concise, and shifting relevant parts about recommendations of management options to section 5.4 (see further below).
- **Feasibility assessment (5.3):** As per the current section 5.3 feasibility of each management option should be assessed. For management options that are deemed not to be feasible/have a low feasibility it should be identified in the assessment the key reasons why with reference to the context of the Craigieburn West PSP where relevant.
- **Management actions to be implemented (5.4):** This section should go into the detail of implementing the recommended management options. For example, detail on where, when and by who. Currently the appropriate level of detail in Section 5.4 is missing or is in Sections 5.1 and 5.2 where it is recommended to instead include the relevant information in 5.4.

Item	Comment	Model content
	Ultimately Section 5.4 would be the crucial part of the strategy as it should spell out which management options are recommended based on the feasibility assessment and how they will be implemented. Individual development level KMPs should be responding to the management recommendations in this section. **Addressing key risks.** DELWP believes the strategy does not adequately address two key future risks associated with development of the precinct including: • **Increased incidents of vehicle collisions**: the strategy seems to place heavy emphasis on virtual fencing to manage this risk. From DELWPs perspective there is currently a lack of scientific evidence that virtual fencing is effective and therefore DELWP does not believe it can be relied upon to address what is identified as a major risk. Construction of 'culvert/bridge underpasses' and 'overpasses' are identified as potential actions to reduce the numbers of individuals attempting to cross roads. DELWP believes the Strategy does not adequately investigating the feasibility of these actions and how they would be implemented. Key questions in this regard include: Where would they need to be located? How much land outside of road reserves would they likely encumber? Does the topography allow for them to be effectively constructed? Would there be issues with obtaining consent from landowners outside the precinct (ie. west of Mickleham Road)? What would they cost and who would pay for them? • **Risk of landlocking (southern population)**: there appears to be a particularly high risk of landlocking of kangaroos as a result of development in the southern section of the precinct. This includes landlocking within and outside the precinct. The strategy needs to outline specifically how the risk of landlocking in this area will be addressed.	
Proposed Conservation Area 29 Boundary Adjustment	It is noted that the PSP indicates that the boundary of Conservation Area 29 is subject to review. Hume City Council have applied to DELWP for the adjustment of the boundary of Conservation Area 29. The proposed boundary adjustment has been prepared in consultation with the relevant landowners and agencies. DELWP does not have any objections to the proposed boundary adjustment and is supportive of endorsing the adjustment application. This is on the grounds that the adjustment results in a net increase in the biodiversity values of the conservation area and will not impact on the future management of the conservation area. The final boundary adjustment requires approval from the Commonwealth Minister for Environment. With support from relevant stakeholders DELWP will submit a notice of boundary change and letter of endorsement to the Commonwealth Minister for Environment for approval.	

Draft Report

Eastern Grey Kangaroo Strategic Management Plan: Craigieburn West Precinct Structure Plan (PSP 1068), Craigieburn

Prepared for

Victorian Planning Authority (VPA)

October 2020

Ecology and Heritage Partners Pty Ltd

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DOCUMENT CONTROL

Assessment	Strategic Eastern Grey Kangaroo Assessment
Address	Craigieburn West Precinct Structure Plan, Victoria
Project number	14194
Project manager	Callum Luke (Consultant Zoologist)
Report reviewer	Aaron Organ (Director / Principal Ecologist)
Other EHP staff	Callum Luke (Consultant Zoologist), Sally Burgemeestre (Bushfire Consultant)
Mapping	Monique Elsley
File name	14194_EHP_KMS_CraigieburnWestPSP_ Draft_28102020
Client	Victorian Planning Authority (VPA)
Bioregion	Victorian Volcanic Plain
CMA	Port Phillip and Western Port Catchment Management Authority
Council	Hume City Council

Report versions	Comments by	Comments updated by	Date submitted
Draft	-	-	28/10/2020

Acknowledgements

We thank the following people for their contribution to the project:

- James Paull and Stephen Davis (Victorian Planning Authority) for project information, on-going discussions and comments on draft reports.
- James Walsh and Michael Ward (DELWP) for project information, on-going discussions and comments on draft reports.
- Amanda Dodd (Hume City Council) project information, on-going discussions and comments on draft reports.
- Digby Richardson (Melbourne Water)
- Ryan Harris (City of Casey)

CONTENTS

1 INTRODUCTION

1.1 Background

Ecology and Heritage Partners Pty was engaged by the Victorian Planning Authority (VPA) to develop a Kangaroo Management Strategy (KMS) that will allow for the coordinated management of Eastern Grey Kangaroo *Macropus giganteus* (referred to in this plan as 'EGKs') across the Craigieburn West Precinct Structure Plan (PSP) as development progresses (Figure 1).

The Craigieburn West PSP is located approximately 30km north-west of Melbourne's CBD along the western edge of Melbourne's Urban Growth Boundary (UGB). The precinct covers an area of approximately 564 hectares and is comprised primarily of agricultural farmland and rural living.

The Craigieburn West PSP is bound by the Lindum Vale Precinct Structure Plan to the north, the Craigieburn Precinct Structure Plan to the east, the Greenvale Precinct Structure Plan to the south, while the land to the west is primarily undeveloped and falls outside of the UGB.

Previous assessments have been undertaken to determine the population size, extent and movement directions of Eastern Grey Kangaroos residing within the PSP and identify the key risks posed to these populations.

1.2 Consultation

To ensure that accurate and implementable management practices are being proposed, Ecology and Heritage Partners undertook stakeholder consultation with the following stakeholders, including:

- Victorian Planning Authority;
- Department of Environmental, Land, Water and Planning (DELWP);
- Hume City Council;
- Melbourne Water; and,
- VicRoads.

The consultation was undertaken to ensure that the feasibility assessment in Section 5.3 included consideration to the management priorities of those stakeholders who are responsible for land neighbouring the PSP and for those who management

1.3 Objectives

The goal of this KMS is to identify best practice measures that can be implemented to manage the population of EGKs during the development of the Craigieburn West PSP. Management actions and recommendations are developed regarding animal and human safety throughout the life of the development. Once development within the PSP is complete it is not expected that an in-situ population of EGKs will remain in the area.

This strategy will form part of the PSP and focuses on providing developers and landowners with a clear and concise decision making framework allowing them to implement consistent management actions which will work to mitigate the risks to both human and EGK welfare while also providing a more coordinated approach across the PSP.

1.4 Study Area

The study area is located within the northern growth corridor ~~of the Biodiversity Conservation Strategy (BCS)~~ and comprises the entire Craigieburn West PSP.

A Conservation Area (CA29) established under the BCS is located in the northern section of the study area (DELWP 2015a, table 1, page 8) (i.e. north of Craigieburn Road) and supports a resident population of the nationally significant Golden Sun Moth. According to DELWP's Native Vegetation Information Management (NVIM) Tool (DELWP 2020) the study area is located within the Victorian Volcanic Plain bioregion and is within the Hume City Council municipality.

The study area is bound by several main roads including Mickleham Road, Mt Ridley Road and Craigieburn Road which intersects the precinct. Mickleham Road abuts the entirety of the western boundary and it is considered a high risk, heavy traffic road. It is currently a two-lane road however, upgrades are currently underway to increase the width to a six-lane, duel carriage arterial. Mt Ridley Road abuts the northern boundary and is considered a moderate risk road. Craigieburn Road, which runs east to west through the middle of the study area, is also considered as a medium risk, heavy traffic road. It is currently a two-lane road, but upgrades have been planned to increase the width to four lanes (Major Road Projects 2019). Low risk roads such as Whites Lane and Olivers Road extend northward and westward respectively along the eastern boundary of the northern section, while Dunhelen Lane extends east of Mickleham Road allowing access into the conference centre.

1.4.1 Current EGK conditions

Two distinct populations of EGKs were identified during the previous site assessment consisting of approximately 130 individuals each (Figure 2). No north-south movement of EGKs was observed between these two populations. The first population (referred to as the 'northern population') was located north of Craigieburn Road and was distributed widely across the land south of Conservation Area 29. EGKs from this population were also observed to the east of the PSP within the currently undeveloped land of the Craigieburn R2 PSP.

The population of EGKs to the south (referred to as the 'southern population') were primarily clustered in the south-east corner of the PSP and the adjoining land to the south and east where large amounts of ptoective habitat, food and water resources were present.

1.4.2 Current EGK movement

There was no north-south movement of EGKs observed during the population surveys and very little exchange of individuals between the two populations is believed to occur. EGK movement out of the PSP is generally expected be westward across Mickleham Road as development progresses. Encroaching development to the south and east will not allow EGK movement in these directions.

1.4.3 Expected Lifetime of Development

Development within the Craigieburn West PSP is expected to commence in 2022 and is expected to take approximately 20-30 months to complete dependent on various factors.

1.4.4 Current Land Ownership Boundaries

The study area consists of 18 separate land holdings, varying from developers and religious centres to private landowners. A summary of the current land ownership boundaries is provided below (Table 1 and Figure 5).

Table 1. Eastern Grey Kangaroo Survey Results

Parcel #	Parcel SPI	Land Ownership	Parcel #	Parcel SPI	Land Ownership
1	1\TP423679	Mickleham Primary	21	1\LP55516	Private Landowner
2	1\TP951293	Mickleham Primary	22	2\LP55516	Private Landowner
3	3\PS301908	Community Centre	23	1\PS411432	Hawthorn Developments
4	2\PS736443	Stockland	24	2\PS411432	Pask
5	1\PS736443	Stockland	25	1\TP340316	Syrian Orthodox Church
6	2\PS301908	Stockland	26	1\TP957913	Stockland
7	1\LP97698	Deague Group	27	2\LP129504	Peet
8	1\PS445746	Deague Group	28	1\LP129504	Peet
9	2\LP37205	IRD Developments	29	3\LP129504	Peet
10	2\PS445746	Buddhist Temple	30	4\LP129504	Peet
11	3\LP97698	Pask	31	5\LP129504	Peet
12	1\TP950200	Private Landowner	32	1\TP828863	Porter Davis
13	1\TP341413	Private Landowner	33	2\TP828863	Porter Davis
14	1\LP212349	Deague Group	34	6\LP129504	AK (Aus) Pty Ltd
15	1\TP222329	Deague Group	35	7\LP129504	AK (Aus) Pty Ltd
16	1\TP558734	Deague Group	36	1\TP612993	Private Landowner
17	1\LP39373	Henley	37	8\LP129504	Private Landowner
18	1\LP53210	Pask	38	1\PS333257	Private Landowner
19	2\LP53210	Australian Islamic Association	39	1\PS333257	Aitken Conference Centre
20	3\LP53210	Private Landowner			

1.4.6 Eastern Grey Kangaroo Ecology

EGKs live in mobs of 10 or more with a home range extending up to five kilometres. Males grow larger than females typically weighing up to 66 kilograms, with a body length of up to 1.3 metres and a tail length up to one metre. Females can weigh up to 37 kilograms and have a body length of up to one metre and tail up to 0.84 metres. Male EGKs stand around 1.5 metres tall (Burrell 2015, DSE 2010) (Plate 1).

EGKs are found in a wide range of habitats from semi-arid Mallee scrub through to woodland, forest and farmland. EGKs are herbivorous, predominantly eating grasses, although they can also eat a range of other plants. They favour the protein rich young green grass shoots as dry grass is difficult for them to digest (Burrell 2015). A summary of EGK ecology is outlined below (Table 2).

Plate 1. Eastern Grey Kangaroo (Ecology and Heritage Partners Pty Ltd 2013)

Table 2. Summary of EGK Ecology

Feature	Description
Distribution	Wide distribution from North Queensland to Tasmania
Home Range	Sex-biased, smaller range for females
Sexual maturity	Males approximately 4 years old Females approximately 1.5 years old
Reproductive cycle	Seasonal breeding: Most young born in summer with pulse of emergent pouch young in spring. Oestrus cycle 46 days Gestation 36 days First pouch exit at 283 days (or 9 months) Permanent pouch exit at 319 days (or 10 months) Weaning typically 540 days (or 18 months – sub adult)
Mortality	Mortality is mainly due to lack of nutrition, predation (including human actions that reduce population numbers) and disease High mortality of young prior to breeding age, especially for males Few males more than 10 years old in wild
Fecundity	Data shows very high levels of fecundity even at high population densities and low *per capita* food availability

Source: Territory and Municipal Services (2010).

2 CURRENT SITE CONDITIONS

2.1 Pre-development Conditions

Previous site assessments have been undertaken within the study area (Ecology and Heritage Partners 2020) to determine the extent of the existing EGK population within the PSP and movement patterns (Figure 2) Habitat features includes protective habitat and water points have also been identified (Figure 3).

The below table summarising the results of the ecological features identified within the study area during the previous Kangaroo Assessment report.

Table 3. Summary of pre-development site conditions

Feature	Results
Population Density	A total of up to 285 kangaroos were recorded within the study area during one survey event and a total up to 823 individuals were recorded within the PSP. Two distinct populations of EGKs were observed within the study area, a northern population and a southern population split by Craigieburn Road. Both populations were roughly the same size consisting of approximately 130 individuals each.
Watering Points	38 water bodies and 4 drainage lines/creeks are located evenly across the study area including: • farm dams; • water troughs; and, • wetlands. Many of these are permanent and are likely to attract and/or maintain EGK populations in the study area year-round. A further 19 water bodies are located in the immediate area surrounding the PSP.
Grazing and Protective Habitat	The study area is largely comprised of suitable grazing habitat. Areas of protective habitat have been previously identified within the Craigieburn West PSP and include: • Conservation Area 29 (CA29) • Patches of River Red-gum along Craigieburn Road • Aitken Creek Corridor and associated wetlands; • Yuroke Creek and associated wetlands; • Greenvale Reservoir and surrounding paddocks; • Windrows; and, • Aitken Conference Centre There is suitable habitat to the west of Mickleham Road (outside the study area), that provides suitable foraging (grassland) and protective habitat for EGKs in the form of scattered trees, shrubs and numerous watering points.
Movement Patterns	• There are two populations of EGK within the PSP, the northern population located north of Craigieburn Road and the southern population located south of Craigieburn Road.

	• No movement or exchange of individuals between the two separate population was observed. • The Eastern Grey Kangaroo populations appear to be resident to the Craigieburn West PSP and maintains the ability to access surrounding properties to the north, west, and to a lesser extent, those to the east.

2.2 Future Conditions

As development progresses across the PSP the landscape will become more fragmented, reducing available resources and increases risk of land locking of EGKs. EGK movement will be encouraged westward out of the PSP across Mickleham Road as available resources are reduced.

2.2.1 Key changes

The key changes expected to occur across the PSP during the life of development include:

- Proposed 6 lane upgrade of Mickleham Road;
- Proposed 4 lane upgrade of Craigieburn Road;
- Increased urbanisation and fragmentation of existing EGK habitat;
- Removal of food, water and habitat resources for EGKs (Figure 3);
- Increases in the number of internal roads and increased traffic levels throughout the precinct;
- Increases in human activity across the PSP as development progresses;
- Increased interactions between EGKs, humans, vehicles and other animals (dogs) as the precinct becomes more inhabited.

A summary of the risk to both humans and EGKs as development across the PSP commences at provided below (Section 3).

3 SUMMARY OF RISKS

3.1 Risks to Human Safety

3.1.1 Increased vehicle collisions

Vehicle accidents due to near misses or collisions with EGKs are the one most common and serious kangaroo-related threat to people, while EGK-vehicle collisions are also one of the major contributors to population decline of kangaroos (Bunton *et al.* 2018). EGK-human interactions are shown to be more common when there is greater movement of EGKs (e.g. during autumn and winter when males are known to disperse) (Coulson *et al.* 2014)

These collisions can result in death or injury to vehicle occupants and EGKs. Mickleham Road presents the greatest hazards to the movement of EGKs westward out of the PSP. The development of the PSP will result in increased movement of EGKs across Mickleham Road as development continues through the PSP and encroaches into existing EGK habitat. The loss of habitat and food/water sources for EGKs, increased disturbance from development and movement of humans into EGK habitat will increase the pressure on these populations and encourage movement across major roads, therefore increasing the potential for vehicle-EGK collisions. Appropriate management strategies (i.e. crossing points, signage and virtual fencing) must therefore be implemented to ensure the risk to humans and EGKs is minimised.

3.1.2 Increased interactions with humans

While suitable habitat is present in the areas surrounding the study area, many of these areas abut existing residential developments. Development within the PSP may result in EGKs being forced to be move into these sub-optimal areas resulting in an increased number of adverse interactions between humans and EGKs.

These negative interactions may include:

- EGKs becoming aggressive towards people, usually when individual animals have regular contact with humans (DELWP 2020a); and,
- Increased attacks on EGKs by unrestrained dogs in areas of increased human activity such as along Aitken Creek linear park alignment or other areas of passive open space (Elton Consulting 2019; Bunton *et al.* 2018).

These interactions may occur in the Craigieburn West PSP project due to:

- Increases in human activity especially where larger observations of EGKs were made, and movement patterns were shown to occur on a broader scale between the PSP sections and the surrounding landscape; and,
- EGKs that have moved into the precinct from surrounding areas currently undergoing development which includes the areas found to the east of the northern half of the PSP (sections north of Craigieburn road), and the areas adjacent to the Aitken Conference Centre (Hilltop Parkland) and Greenvale Reservoir to the east and west.

3.2 Risks to Eastern Grey Kangaroos

3.2.1 Land-locking

There is a significantly high potential for land-locking of EGKs from both populations to occur based on the locations of EGK observations and existing residential development. If management is not considered correctly, several impacts to EGKs may arise such as diminishing health and welfare of isolated groups/individuals (i.e. stress from overcrowding and starvation), reduced mobility and reduced availability of palatable food and water resources (DELWP 2018). These isolated populations also diminish ecological values via overgrazing. If not managed correctly, isolated populations can starve, leading to high rates of mortality and/or population crashes. Furthermore, landlocking can increase human-EGK interactions via vehicular collisions, and the movement of EGKs into built up areas (which may result in injury by dogs and confrontation with humans) (DELWP 2018). The risk to EGKs becoming land locked varies largely on the sequence of development throughout the study area.

The highest risk of land locking to the northern population of EGKs is currently within the undeveloped land to the east within the Craigieburn R2 PSP if Land Parcel 14, 15 and 16 are developed prior to this land.

The southern population of EGKs is at risk of being land-locked in The Hills Reserve, directly east of the Aitken Conference Centre (Parcel 39) as development in the south of the PSP progresses.

3.2.2 Starvation, disease and malnutrition

Craigieburn West PSP provides a considerable amount of water and palatable resources throughout its extent, thereby allowing the area to support a large population of EGK. As a result of development, all watering points should be decommissioned and majority of the palatable resources removed, with the exception of lawns, open areas and Conservation Area 29. Resource removal is encouraged to begin prior to development to encourage EGK movement out of the area. When resource removal begins there will likely be an increase in grazing pressure on remaining areas which can result in an increase in competition between individual EGK and welfare issues. These changes, as a result of development and increase human population within the area, can lead to a range of potential impacts to the welfare of EGKs (Herbert 2004a; Coulson 2007), including:

- Starvation due to lack of food resources (i.e. removal of grassland habitats);
- Increase stress on EGK;
- Exposure to disease, including Phalaris poisoning;
- Malnutrition causing parasite infestations;
- Injury and mortality associated with fence and vehicle collisions; and,
- Increased interactions with humans (i.e. EGKs becoming dependent and possibly aggressive).

3.2.3 Over-grazing of Conservation Areas

High densities of EGKs have resulted from the removal of predation, increases in permanent watering points, protection from hunting and an increased availability of palatable resources. With development as a driving factor, these high kangaroo densities have the potential to impact conservation areas. While such areas are generally managed to maintain and promote biodiversity values, overgrazing as a result of high EGK densities,

has been shown to reduce vegetation cover, composition and diversity and it is important that these impacts do not compromise the management objectives for these areas. While overgrazing is a major impact of overabundance, EGKs can also trample and flatten the vegetation. Furthermore, damage to native understorey may also affect grassland species, such as Golden Sun Moth and may prevent tree regeneration thereby affecting regenerating communities such as Plains Grassy Woodland (DELWP 2015b).

3.3 Future Risks

As development within the precinct progresses the risks to EGKs and humans may change. Although it is difficult to determine the exact changes that may occur, several predictable future risks are outlined below.

3.3.1 Future conditions and hazards

Predicted future changes to conditions and hazards within the precinct include:

- Kangaroos may be present within the study area during development and may utilise habitat corridors and green spaces. However, once development is complete it is not expected that an in-situ population of EGKs will persist given the lack of suitable habitat that will remain.
- Increases in the number of internal roads and increased traffic levels throughout the precinct;
- Proposed 6 lane upgrade of Mickleham Road;
- Proposed 4 lane upgrade of Craigieburn Road;
- Land-locking of EGKs;
- Starvation as food sources are removed to make room for encroaching development; and,
- Increased interactions between EGKs, humans, vehicles and other animals (dogs) as the precinct becomes more inhabited.

3.3.2 Future changes to EGK population and movement

Although EGKs may exist within the development following completion, this is considered unlikely due to the extensive removal of food/water sources and the expected increase in human density. The removal of extensive areas of the palatable resources (i.e. open grassland) and watering points will most likely result in a reduction of EGKs population in the study area.

Upon completion of construction within the PSP it would be expected that there are no EGKs remaining in the study area. Movement of EGKs throughout the precinct will be drastically reduced due to a decrease in connectivity. Several new roads are also proposed to bisect the precinct further reducing EGK movement and increasing the risks of EGK-vehicle collisions. As the human population within the precinct increases EGKs are likely to be dissuaded from remaining due to increased survival pressures.

3.4 Risk Assessment

A risk-based assessment has been undertaken to identify the potential threat the planned future development of the PSP poses on the existing EGK population and associated habitats.

An assessment of impacts on key risks considered likely to occur within the PSP has been adopted in accordance with the principles of risk management described in AS/NZS 3100:2009 Risk management – principles and guidelines, and its companion documents HB 436:2013 Risk management guidelines companion to AS/NZS 3100:2009 and HB 203:2012 Managing environment-related risk. The adopted framework involved the following steps:

- Establish context. Set the context for the risk-based assessment through the identification and definition of values.
- Identify potential impacts and issues. Review potential effects and the identification of possible causes of changes to environmental values.
- Consequence analysis. Assess the consequences of identified effects assuming the effective implementation of risk reduction through elimination, mitigation and management. The criteria for determining the consequence of impacts are outlined below (Table 4). In some instances, the consequence criteria may produce inconsistent designations (i.e. an impact may be assessed as widespread but readily reversible). In these instances, the technical specialists used their professional judgement to determine the overall consequence on the ecological value.
- Frequency analysis. Estimate the frequency or likelihood of a change to environmental values occurring assuming the effective implementation of risk reduction. The criteria for determining the likelihood of impacts are outlined below (Table 4).
- Analyse residual risk. Analyse the risk of change to environmental values occurring using qualitative or quantitative techniques that define risk as follows: Risk = Consequence x Likelihood. The risk evaluation matrix is provided below.
- Risk reduction. Identify risk reduction controls and measures (avoidance, mitigation and management measures).

The results of the risk assessment are provided in below.

Table 4: Qualitative criteria for likelihood and consequence

Descriptor	Description
Likelihood	
1 - Almost Certain	A hazard, event and pathway exist, and harm has occurred in similar scenarios and is expected to occur more than once over the duration of the development within the PSP.
2 - Likely	A hazard, event and pathway exist, and harm has occurred in similar scenarios and is likely to occur at least once over the duration of the development within the PSP.
3 - Possible	A hazard, event and pathway exist, and harm has occurred in similar scenarios and may occur over the duration of the development within the PSP.

Descriptor	Description
4 - Unlikely	A hazard, event and pathway exist, and harm has occurred in similar scenarios but is unlikely to occur over the duration of the development within the PSP.
5 - Rare	A hazard, event and pathway are theoretically possible on this project and has occurred to a limited extent in similar scenarios but is not anticipated over the duration of the development within the PSP.
Consequence	
Negligible/Very Low	Where impacts from development will not result in any impacts to Humans, EGK or the environment. Negligible impacts are localised and temporary in nature, with no noticeable consequences
Minor	Where a risk from development will not adversely affect Humans, EGK or the environment, provided standard Kangaroo Management Plans are implemented. Minor impacts are noticeable but localised to the project footprint and short-term in nature. They can be effectively mitigated through standard Kangaroo Management Plan controls. Values affected by Minor impacts are generally recognised as being important at a local or regional level.
Moderate	Moderate impacts directly or indirectly affect EGK, Humans or the environment within the broader project locality and are short or moderate term in nature. Impacts can be ameliorated with specific Kangaroo Management Plan controls.
High	Occurs when proposed activities are likely to exacerbate threatening processes, result in landlocking of EGK and increase interactions with Humans. High impacts are substantial and significant changes that affect Humans, EGK or the environment within the project locality and are moderate to long-term in nature. Impacts are potentially irreversible and avoidance through appropriate design responses or the implementation of specific Kangaroo Management Plan controls is required.
Major	Arises when an impact will potentially cause irreversible or widespread harm to an EGK, Humans or the environment that is irreplaceable because of its uniqueness or rarity. Major impacts are significant or irreversible changes that affect the Humans, EGK or the environment.

Table 5: Risk Evaluation Matrix

		Increasing Likelihood				
		Rare	Unlikely	Possible	Likely	Almost Certain
Consequence	Negligible/Very Low	Very Low	Very Low	Very Low	Low	Moderate
	Minor	Very Low	Low	Low	Moderate	Moderate
	Moderate	Low	Low	Moderate	High	High
	High	Low	Moderate	High	Major	Major
	Major	Moderate	High	Major	Major	Major

Table 6: Risk Assessment Results

Risk	Potential Consequence(s)	Risk Assessment Matrix Score			Management Options to Minimise Risk
		Humans	Kangaroos	Environment	
Land-locking	• Starvation due to lack of resources • Disease from overcrowding • Increase in adverse human-EGK interactions • Increase in adverse human-dog interactions	Low	Major	Moderate	• Staged development • Exclusion fencing • Culvert or overpasses • Controlling development direction of the PSP • Culling • Translocation • Population monitoring
Increased interactions with humans	• EGKs becoming aggressive towards humans • Injury/death to humans	High	High	N/A	• Staged development • Exclusion fencing • Removal of food and water resources • Informative signage
Vehicle – EGK Collisions	• Death of human(s) • Death of EGK • Damage to property • Malnutrition	Major	Major	Very Low	• Staged development • Culverts and overpasses • Staged Development • Virtual fencing • Road signage
EGK – Dog Interaction	• Death or injury to dog • Death or injury to EGK	High	High	N/A	• Staged development • Exclusion fencing • Removal of food and water resources • Informative signage including dog on leash signs in areas close to grazing habitat
Starvation	• Increase road crossings • Increased encroachment into residential areas • Increase human – EGK interactions • Increased dog – EGK interactions • Increased impacts to potential biodiversity values	Moderate	High	Very Low	• Staged development • Exclusion fencing • Translocation • Culling
Overgrazing of conservation areas	• Adverse impacts biodiversity values	Very Low	Very Low	High	• Exclusion fencing • Translocation • Culling

Risk	Potential Consequence(s)	Risk Assessment Matrix Score			Management Options to Minimise Risk
		Humans	Kangaroos	Environment	
Road upgrades	• Increased vehicle – EGK collisions • Death or serious injury of human(s) • Increased death/serious injury of EGKs • Damage to property	High	Major	Very Low	• Culvert • Overpass • Signage • Virtual Fencing

4 PRE-DEVELOPMENT MANAGEMENT REQUIREMENTS

Prior to the commencement of development, an initial site survey must be undertaken to determine if EGKs are present on a property and/or in surrounding areas, or likely to use habitat resources on a site. Any current risks to EGKs (i.e. land locking) need to be identified during the initial site survey. If EGKs are identified to be within the land parcel or surrounding areas additional monitoring surveys will be required to determine the extent of EGKs, population size and health. Additional surveys may be required for land locked EGKs. The decision-making flow chart (Appendix 2) must be followed to determine potential risks to EGKs in addition to preparing a site specific a KMP.

4.1 Initial Site Assessment

An ecologist must be engaged to conduct an initial presence/absence survey to establish if there are kangaroos in the survey area, or if there is evidence that kangaroos have been in the survey area in the last 12 months. The population survey results from the previous assessment (Ecology and Heritage Partners 2020) should also be referred to as a starting point.

The survey area includes:

- the area for which the planning permit application is being made; and,
- land extending for 1 km in all directions beyond the boundary of the permit application area, including parks, reserves and conservation areas.

4.2 Population Survey

If the ecologist determines that kangaroos have used the survey area in the last 12 months, they must conduct a population survey to determine:

- the total number of kangaroos, or their estimated abundance (kangaroos per ha)
- the location of the kangaroos
- notable patterns of movement onto and across the permit application area
- any evident signs that any kangaroo is diseased or lame
- any other notable information.

4.3 Kangaroo Management Plan Preparation

A Kangaroo Management Plan (KMP) will be required for all developments within the PSP however, the type of KMP required will be determined by the Decision-Making Flowchart (Section 4.4).

Kangaroo Management Plans will be required for all land parcels at the at the individual development level of the PSP. The decision-making flow chart is used to determine the current level of risk to EGKs and provides

guidance around the management actions required. Kangaroo Management Plans must be submitted to DELWP for review and approval prior to the commencement of any construction. Appendix 4-6 outline the requirements for preparing site specific KMPs.

4.4 Decision Making Flowchart

The below flowchart will walk developers through a series of questions to determine the risks currently posed with EGKs as a result of their development and provide guidance around the necessary steps that must be undertaken to satisfy their planning permit requirements and effectively manage EGKs within their land and the surrounding area.

Refer to Appendix 2 for the decision-making flowchart.

5 MANAGEMENT ACTIONS

The following section outlines a number of management actions proposed to be implemented across the PSP to mitigate the risks to EGKs and humans. A feasibility and constraints assessment have been undertaken to determine the effectiveness of each proposed action.

5.1 General PSP Wide Management Recommendations

General PSP wide management recommendations are broad scale actions that can be implemented across the majority of the PSP to mitigate the risk to both humans and EGKs as development progresses. These management actions would need to be implemented by the responsible authority (i.e. local council and VicRoads in most instances) or in some cases the developer.

The following sections provide broad scale recommendations that if implemented would contribute to reducing the risks of adverse human-EGK interactions, in particular vehicle collisions as EGKs move eastward out of the PSP. For the most part, these recommendations are focused on Mickleham Road which presents the greatest risk to EGKs attempting to move out of the PSP. Consideration of the below listed management actions is strongly encouraged in order to mitigate these future risks.

5.1.1 Fauna Sensitive Road Design

5.1.1.1 Culvert and Bridge Underpasses

Culverts are man-made structures which aim to retain movement and habitat corridors within the landscape. They are designed to allow safe passage for the targeted species below the roads surface, thereby attempting to reduce the number of individuals attempting to cross the roads surface and ultimately reducing the amount of vehicle-kangaroo collisions. Culvert and bridge overpasses are the most common, with bridge overpasses considered the most effective as the traffic is elevated away from the landscape, and the provision of adequate natural lighting allows preferred substrates to grow.

To accommodate macropods, a bridge or culvert should provide a minimum clearance of eight metres in height and a minimum width of three metres. Culverts and bridges should be accompanied by the appropriate fencing to guide fauna to the correct location, and entry landscape to retain much of the natural character as possible.

Many studies have shown the validity of the use of culverts as effective tool for the management of Kangaroos, with one study recording as many as 3116 crossing events by individuals or groups of up to 21 individuals, within a 342-day monitoring period (Chachelle et al. 2016). However, this same study indicated that individuals displayed a preference for large underpasses (8 x 3 metres), with only two crossings recorded at the smaller culvert (0.9 metre diameter). The utilisation rate determined that underpass was used daily, with an average of nine crossing events per day.

Culverts should be focused on allowing EGK movement out of the PSP across Mickleham Road. It is recommended they are installed at points where EGKs will be able to easily reach and not be impeded by development. The points where Aitkin Creek intersects Mickleham Road and where Conservation Area 29 abuts Mickleham Road provide suitable locations as EGKs will be able to move through the landscape and access these points more easily as development progresses.

Plate 2. Underpass located at the intersection of Aitken Creek and Craigieburn Road, Craigieburn. This underpass facilitates the flow of the creek and movement of aquatic species (Ecology and Heritage Partners, 2020).

Plate 3. Underpass located at the intersection of Aitken Creek and Craigieburn Road, Craigieburn. Note the opening within the median strip to allow natural light to enter the underpass (Ecology and Heritage Partners, 2020.

5.1.1.2 Overpasses

Overpasses are man-made structures which, like culverts and bridges, aim to retain movement and habitat corridors within the landscape. Overpasses are designed to allow the safe passage of the targeted species above the roads surface, thereby attempting to reduce the number of individuals attempting to cross the roads surface and ultimately reducing the amount of vehicle-kangaroo collisions.

Overpasses are generally constructed with an hourglass or rectangular shape. They are generally accompanied by appropriate fencing used to funnel individuals onto the overpass and to prevent animals from falling off the sides. Design should consider the incorporation of soil and vegetation and enhanced with other complementary habitat features complementary to the EVC of the surrounding area. The minimum entry width should be no less than five metres, and a water body should be considered at one, or both, ends to encourage animals towards the entrance.

Overpasses are recommended in the same locations as culverts or bridge underpasses.

5.1.1.3 Road Signage

Local traffic management aims to reduce the speed limit and traffic volume and to raise driver awareness to the presence of wildlife (VicRoads 2012). These measures include:

- Flashing warning signage;
- Highly visual yellow kangaroo signs; and,
- Reducing speed limits by installing temporary or permanent signage.

While these traffic management options can be implemented individually, they are best implemented collectively alongside other forms of management (i.e. virtual fencing) and should be incorporated on all major roads within the PSP (i.e. Mickleham Road, Craigieburn Road and Mt Ridley Road. Plate 2 provides an examples of flashing warning signage that has been used by the city of Casey in high risk areas.

Plate 3. Example of flashing EGK warning signage (City of Casey, 2020)

Signage and temporarily reduced speed limits (between dusk and dawn) are suggested along all areas of Mickleham Road, Mt Ridley Road and Craigieburn Road for the length of the study area to attempt to reduce vehicle-EGK collisions. Along Mickleham Road, where EGK are expected over a certain distance, a warning sign should be included that specifies that kangaroos will be found within the next few kilometres (VicRoads 2012). All signs should have a fluorescent yellow background to make them more visible at dawn and dusk when EGKs are more active (VicRoads 2012).

A reduced speed limit of 60 kilometres is also recommended along these roads. A reduced limit of 40 kilometres is recommended within construction areas, outside of arterial roads. Where crossing points have been implemented it is suggested that signage, a reduced speed limits of 60 kilometres, rumble strips and/or speed humps and reduced intensity lighting be implemented.

5.1.1.4 Virtual Fencing

Virtual fencing is a new technology that uses bollards installed along roadsides. It is an active form of road-kill mitigation that is activated at night by approaching vehicles and emit a lashing lighting and sound to repel wildlife from the road. The virtual fences are solar powered units that produce a virtual fence along a roadway and can be set to work from dusk to dawn and aim to alert kangaroos present in the roadside to oncoming traffic. The internal light sensor on the units detects approaching vehicle headlights and produces an optical or auditory alert which aims to raise the attention of animals, and the lights aim to make animals move away from the road area.

Is it recommended that virtual fencing bollards are positioned in a zig zag pattern every 25 meters on alternating sides of the road at approximately 40 units per km. Installation is relatively straightforward and can be carried out by local councils without the requirement for specific equipment (WSS, 2018).

One trial in Tasmania noted a reduction in roadkill numbers by as much as 50% in smaller more commonly affected mammal species (Tasmania pademelon, Bennett's wallaby and brush-tailed possum) (Fox et al. 2018). An additional study conducted by Coulson and Bender (2019) observed a 93% reduction in roadkill where the technology was installed between 2003 and 2007, while the second survey observed a 77% reduction. Similar

trials are also currently being undertaken across Victoria on Phillip Island, City of Casey and Lysterfield where initial observations by local residents and wildlife carers has been overwhelmingly positive.

It is recommended that virtual fencing is installed along the length of Mickleham Road from Mt Ridley Road to Destination Drive as no defined crossing points across Mickleham Road currently exist. Virtual fencing should be installed in conjunction with road signage such as flashing warning signs to alert drivers of the increased risk of EGKs. Examples of installed virtual fencing bollards are provided in Plate 3 and 4 below.

Plate 4. Example of installed virtual fencing bollard (City of Casey).

Plate 5. Example of installed virtual fencing bollard (City of Casey).

5.1.2 Controlling Development Directions

Due to the size of the precinct and the large amount of available habitat both within, and surrounding, the study area, it is recommended that the study area is developed in a sequential manner where possible. While the assessment recognises the low feasibility of staged or preferential release of the development, the avoidance to land locking EGKs with minimal human intervention remains a primary goal. Staged development throughout the precinct would be the most effective method to ensure risks to EGKs are minimised and populations are able to easily disperse out of the study area. This method would enable EGKs to disperse via a logical, sequential manner through and beyond the study area and into suitable habitat to the west and the north of the study area, thereby reducing the potential for landlocking and adverse interactions between humans and kangaroos. This approach will also minimise any potential animal welfare issues (starvation, stress etc.) that may arise from land-locking, and herding of EGKs, which may be encountered in urban growth zone areas where construction occurs in a haphazard manner.

5.1.3 Resource Removal

Resource removal involves the removal or decommissioning of resources that are utilised by EGKs in order to encourage movement out of an area. Resource removal is focused on the removal of water points, food resources and protective habitat.

If a population of EGKs is identified to be land locked during pre-development surveys, resource removal should not occur as EGKs will not be able to disperse from the area and there will be an increased risk to both human safety and animal welfare if forced to move into more urbanised areas in search of resources.

Water Points

Water point removal involves the decommissioning, filling in, removal or fencing of water sources that may be used to EGKs including farm dams, ground tanks or troughs. Water points identified in the land features table (Appendix 1) should be removed/decommissioned prior to the commencement of development.

Although the effectiveness of EGK movement patterns to the closure of water points is inconclusive (LLS 2020) as EGKs may obtain their water needs from grasses (DELWP 2015b) this method is still encouraged as it is a straightforward and non-invasive method to discourage EGKs from an area.

Food Resources

Eastern Grey Kangaroo predominately feed on green annual grasses with moderate amounts of forb and shrub material (David *et al.* 2008; Pahl 2019). The majority of the study area consists of agricultural paddocks containing palatable grasses likely to be utilised by EGKs. When used in conjunction with removal of water points and protective habitat, the removal of palatable grasses and herbs may encourage EGKs to move on from the area and reduce the immediate risk of land locking. Removal of food resources should be undertaken by mowing, slashing or scraping the topsoil layer with heavy machinery before development starts.

Protective Habitat

Protective habitat are areas such as patches of trees, wind rows, gullies or valleys where EGKs can shelter, rest and are safe from human disturbances. If there is protective habitat within one kilometres EGKs are more likely to be found in that area (DELWP 2015b). Removal of protective habitat such as wind rows should be removed to encourage EGK movement out of the area.

Removal of protective habitat should be considered early on prior to development if possible and where permitted to encourage EGKs out of the area.

5.2 Site Specific Management Recommendations

Site specific management recommendations should be implemented at the individual development scale and in most cases will be required as part of a Kangaroo Management Plan.

5.2.1 Staged Development

Staging development allows for developers to set the order of a subdivision and can minimise the risk of landlocking EGKs at the individual development level. the planning of development. It is recommended that new development to abut existing development in neighbouring land and developers are encouraged to coordinate development directions to minimise risks of landlocking (DELWP 2015b). Staged development should also take into consideration EGK movement patterns and provide exit routes that allow EGK movement into adjoining land and not towards nearby roads or other hazards (DELWP 2015b).

A site-specific Kangaroo Management Plan will address specific staged development plans for each development within the PSP.

5.2.2 Exclusion Fencing

Exclusion fencing is recommended for all staged developments and to exclude EGKs from construction areas and encourage movement out of the area.

Fencing must be in accordance with the definition of fencing in DELWP's Guide to preparing a kangaroo management plan for Melbourne's growth corridors (2015, pp. 26 - 27).

The use of fencing with kangaroo proof features to exclude EGKs from crossing Mickleham Road and move them to low risk areas must:

- Be chain-link (cyclone) fencing or deer mesh (also known as K wire)
- Not be ring-lock-style fencing (which is an entanglement hazard)
- Be high-tensile, heavy galvanised wire
- Be at least 1.9 m high (deer mesh is produced in this size)
- Have no barbs
- Have no loose or open wires
- Be completely free of holes and gaps in, and under, the fence to stop the kangaroos trying to escape, and to stop them being injured.

It is not feasible to install exclusion fencing across large areas of the PSP as it is costly to install and maintain. It also poses risks to animal welfare as excluding populations that are over-abundant may lead to mass starvation (DELWP 2017). Approval from DELWP is required before installing exclusion fencing on any land parcel which will alter EGK behaviour or movement.

5.2.3 In-situ Population Management

Three areas which may provide habitat for EGKs is Conservation Area 29, the land directly south of the Aitkin Hill Conference Centre within the Greenvale North R1 PSP and Hilltop Parkland directly to the east of the conference centre.

Although EGKs have been known to persist in pockets of vegetation within urbanised environments (Coulson *et al*. 2014) DELWP discourages in situ management of EGKs in nature conservation areas (i.e. in Conservation Area 29) due to conflict with the overarching management objectives of these areas (DELWP 2015b). High densities of EGKs persisting in areas may lead to overgrazing, which has been shown to adversely impact biodiversity and result in a reduction of Golden Sun Moth numbers (EPSDD 2017; TMS, 2010).

Conservation Area 29 is a designated nature conservation reserve with the focus on protection of Grassy Eucalypt Woodland and Golden Sun Moth populations. An in-situ population of EGKs persisting in this area may lead to overgrazing, which has been shown to adversely impact biodiversity and result in a reduction of Golden Sun Moth numbers (EPSDD 2017; TMS, 2010).

Consultation with Melbourne Water has determined that the land directly south of the Conference Centre will be managed as service open space and will be fenced with kangaroo proof fencing once it is shown that no EGKs persist in the area. ~~Further discussion between DELWP and Melbourne Water could determine the feasibility of allowing an in-situ population of EGKs to persist in this area~~.

Hilltop Parkland to the east of the PSP may also provide suitable habitat for EGKs to persist, however this population would become land-locked and the risk to EGK welfare (e.g. lack of resources, particularly during low rainfall years) would be significantly high.

An in-situ population of EGKs remaining within the PSP or open space directly adjacent in the south would likely result in increased EGK-Human interactions. As development proceeds in these areas the likelihood of adverse impacts to both human safety and animal welfare will increase. In this instance, in-situ population management of EGKs is not considered feasible.

5.2.4 Population Control

The Office of Conservation Regulator, DELWP, issues Authorities to Control Wildlife (ATCWs) under section 28A of the *Wildlife Act 1975* for the control of kangaroos where they are demonstrated to be damaging pasture, crops or other property or impacting on biodiversity values (DELWP 2020a). Any landowner/developer wishing to control wildlife, including kangaroos, on their property is required to apply for an ATCW.

The management techniques for controlling kangaroo populations include translocation, culling and reproductive management. These techniques vary in effectiveness depending on the situation and size of the population being managed. ~~Wherever possible, DELWP advocates for the non-lethal management of kangaroos.~~ Where non-lethal techniques are ineffective or impractical, lethal control may be necessary. The type of population management action implemented will be heavily influenced by detailed population monitoring surveys to determine the size, health and site-specific conditions in consultation with DELWP.

5.2.4.1 Translocation / relocation

Translocation or relocation is a method that is widely used as a conservation and management strategy for many species and involves the intentional movement of a species by humans from one location to another. While widely used this management option can lead to a significant risk of injury and death of individuals as a direct result of capture, handling and transfer. Furthermore, translocation is generally considered inappropriate for the management of abundant species, such as EGKs, due to the high associated cost, the need to include experts and the requirement of an appropriate release site (Descovich *et al.* 2016). If the EGK survive the process, they may attempt to return to their initial home range where translocated individuals often observed seen wandering or moving long distances away from the translocation site thereby exposing them to a range of hazards including collisions with vehicles and attacks by dogs. As such, translocation is largely inappropriate for the management of EGKs within the Craigieburn West PSP and should only be considered in exception circumstances where individual or very small populations of EGKs have become land locked

5.2.4.2 Culling

Shooting is considered the most effective method to control kangaroos because the animals die quickly, and it reduces the numbers rapidly. Specifically, night shooting has welfare outcomes superior to many other wildlife killing techniques and is considered the most humane approach to culling kangaroos (Hampton & Forsyth 2016).

The lethal control of kangaroos by shooting is done in accordance with the National Code of Practice for the Humane Shooting of Kangaroos and Wallabies (DELWP 2017).

Despite culling being an effective method of EGK control, it should only be undertaken as a last resort when all other management actions have been exhausted.

Community views on culling of EGKs vary. One study determined that kangaroo culling was supported when it is was undertaken for animal welfare or conservation reasons (Descovich *et al.* 2016). Other studies have found that the community is often opposed to EGK culling, particularly when it's in response to EGK-human interactions and risks to people.

5.2.4.3 Reproductive Management

Reproductive control is an alternative to lethal control and can be implemented when the abundance of EGKs in an area is considered too high (Descovich *et al.* 2016). This method involves the contraception or sterilisation of EGKs and be used in both sexes (Herbert *et al.* 2004b; 2004c, Woodward *et al.* 2006).

In general, fertility control is too expensive and not effective for large-scale EGK management (Olsen and Low 2006) however implementation may be successful in small, isolated populations that have become land locked during development across the PSP. A study by Tribe *et al.* (2014) suggests that fertility control treatment of female EGKs alone is sufficient to produce a reduction in overall population. However, this method would only be effective in isolated populations and ~~repeat treatments~~ repeat treatments every two years would be required.

Reproductive control should only be considered for controlling populations of EGKs that are not in immediate danger of encroaching development and where adequate resources exist for a temporary population of EGKs to persist. On-going monitoring of EGKs would be necessary to determine the effectiveness of reproductive management actions.

Reproductive control is a more humane method of EGK control and should be prioritised over culling or translocation if considered feasible. Implementation of this type of management action would need to be undertaken in consultation with DELWP.

5.3 Feasibility Assessment of Management Actions

A feasibility assessment has been undertaken to identify the most implementable management practices within the PSP. The assessment looks at the acceptability (i.e. Is the management method supported by the wider community, is it ethical and is it supported by science) ~~and endorsement by DELWP (i.e. have DELWP reviewed the management method and endorsed it for application in EGK management).~~

The below table rates each management option based on their effectiveness, strengths and weaknesses to provide a feasibility score (i.e. high, medium or low).

Table 7. Feasibility assessment

Management Action		Risks Mitigated	Effectiveness	Strengths	Weaknesses	Acceptability	Action Approved by DELWP for EGK Management		Feasibility
Fauna Sensitive Road Design	Culverts and Bridges	• Landlocking • Human/EGK Interactions • Vehicle/EGK Collisions	Several studies have indicated that large species, such as kangaroos, include a fauna underpass as part of their home range. A study ~~a study~~ conducted by Chachelle *et al.* 2016 observed 3116 crossing events of individuals or groups of up to 40 individuals of Western Grey Kangaroo across a 342-day period, and summarised that culverts are likely to be used by kangaroos and provide the creates reduction in risk to kangaroos and motorists.	• Reduce the numbers of EGK attempting to cross the road surface; • Limits the interaction between motorists and EGK; • Reduces the potential for land locking EGKs • Minimal human interference • Does not restrict home range of EGK.	• Cost prohibitive. • Needs to be located within a fauna movement corridor. • Requires targeted landscaping and fencing. • Limited by topography of land • May be difficult to establish vegetation under some structures.	Community			Moderate
						Ethically			
						Scientifically			
	Overpasses	• Landlocking • Human/EGK Interactions • Vehicle/EGK Collisions		• Reduce the numbers of EGK attempting to cross the road surface; • Limits the interaction between motorists and EGK; • Reduces the potential for land locking EGKs • Minimal human interference • Does not restrict home range of EGK.	• Very high cost – typically more expensive than culverts • High cost for ongoing landscaping and management. • May not be utilised once development within PSP is complete.	Community			Low
						Ethically			
						Scientifically			

Management Action	Risks Mitigated	Effectiveness	Strengths	Weaknesses	Acceptability	Action Approved by DELWP for EGK Management		Feasibility
Virtual Fencing	• Human/EGK Interactions • Vehicle/EGK Collisions	Little scientific evidence has been published at this stage however initial indications are that this is an effective method (anecdotal evidence from wildlife carers, Tasmania study on smaller mammals)	• Comparatively much cheaper than installing culverts or overpasses. • Have the potential to dramatically reduce EGK collisions. Demonstrated that it can be established • Existing examples of successful implementation by other councils (i.e. City of Casey). • Insurance claims from EGK-vehicle collisions may be costing more than the cost to install virtual fencing.	• Can be costly to maintain if damaged (i.e. vehicle collisions with bollards). • New technology with little scientific evidence on effectiveness at this stage.	Community			High
					Ethically			
					Scientifically			
Signage	• Human/EGK Interactions • Vehicle/EGK Collisions	On ground evidence from the City of Casey has indicated that placing signage (flashing) in high risk areas that aim to alert motorists to the presence of kangaroos encourage drivers to slow down and increase vigilance, especially during the hours between dusk and dawn.	• Existing examples of successful implementation by other councils (i.e. City of Casey).	• Can be costly to maintain if damaged (i.e. vehicle collisions with signs) • Does not deter EGK from crossing roads.	Community			High
					Ethically			
					Scientifically			

Management Action	Risks Mitigated	Effectiveness	Strengths	Weaknesses	Acceptability	Action Approved by DELWP for EGK Management		Feasibility
Controlling Development Directions of the PSP	• Land locking • EGK-Human Interactions • EGK-Vehicle collisions • Starvation	Staging has been shown to be highly successful at mitigating potential impacts (i.e. land-locking) to kangaroos at the individual development level.	• Very controlled, cost-effective method for proactively managing risks to EGKs. • Would require little on ground implementation.	• Responsible authority has little to no power to control timing or direction of development across the PSP.	Community			Low
					Ethically			
					Scientifically			
Removing Resources	• Land Locking • EGK-Human Interactions	Highly effective at the individual development scale when implemented alongside exclusion fencing.	• Cost effective • Proven and effective management action. • Minimal human intervention.	• Can increase risk to EGK welfare if too many resources are removed and EGKs are forced to compete for resources or move into sub-optimal habitat. • Used in conjunction within other management options such as fencing • Regrowth needs to be closely monitored as young shoots may attract EGKs • Slashing ineffective, complete removal advised. • Removal of any native vegetation needs to be in line with the Victorian Governments Biodiversity Conservation Strategy.	Community			High
					Ethically			
					Scientifically			

Management Action	Risks Mitigated	Effectiveness	Strengths	Weaknesses	Acceptability	Action Approved by DELWP for EGK Management		Feasibility
Exclusion Fencing	• Land Locking • EGK-Human Interactions • EGK-Vehicle Interactions • EGK-Dog Interactions • Starvation • Overgrazing of conservation areas	Highly effective at the individual development scale.	• Expensive to establish and maintain across large areas.	• Effective way to exclude EGKs for specific areas and control/restrict movement into high risk areas; • When done incorrectly can landlock kangaroos.	Community			Moderate
					Ethically			
					Scientifically			
In-situ Population Management	• Starvation • Overgrazing of conservation areas	Can be effective when accompanied by a monitoring and management program	• Ecosystem services provided by EGKs remaining in an area. • Positive community views of co-existing with native wildlife. • May be a better environmental outcome.	• Requires frequent monitoring of EGK populations. • Additional management actions may be required to control population. • Increased risk of EGK-human interactions • Can be costly to manage and monitor in-situ population in perpetuity.	Community			Low
					Ethically			
					Scientifically			
Staged Development	• Land Locking • EGK-Human Interactions • EGK-Vehicle Interactions • EGK-Dog Interactions • Starvation	Highly effective at the individual development phase.	• Minimal human intervention	• Needs to be implemented within other management options (resource removal, exclusion fencing etc.)	Community			High
					Ethically			
					Scientifically			

Management Action	Risks Mitigated	Effectiveness	Strengths	Weaknesses	Acceptability	Action Approved by DELWP for EGK Management		Feasibility
Translocation / relocation	• Land locking • Starvation	Can result in high mortality rates of individuals due to darting and the stress. Has a many associated animal welfare and biodiversity concerns. Only a viable method when the necessary criteria are met (Appendix 4).	• Non-lethal • Community approved	• Kangaroo Myopathy; • Misplaced or wandering individuals; • High associated cost; • Expertise required; • Labour intensive; • Requirement of release sites; • If the recipient site is close to the original site, it could need to be fenced, to stop kangaroos moving back to the original site.	Community			Low
					Ethically			
					Scientifically			
Culling	• Land Locking • EGK-Human Interactions • EGK-Vehicle Interactions • EGK-Dog Interactions • Starvation	Effective when following the guidelines established by DELWP and the associated animal welfare principles (Appendix 4).	• Removes the populations completely from the study area.	• Expertise/professionals required • Carcass disposal required • Public consultation may be required as part of the process; • Community contention around culling where there is a lack of understanding.	Community	*		High
					Ethically	*		
					Scientifically			
Reproductive Management		Effective where in-situ population is maintained, however, treatment may	• More socially acceptable method of population control.	• More resource intensive than other management options.	Community			Low

Management Action	Risks Mitigated	Effectiveness	Strengths	Weaknesses	Acceptability	Action Approved by DELWP for EGK Management		Feasibility
	Management of population numbers.	not be 100% effective as new individuals may move into area		• Can only be implemented if EGKs immediately threatened by encroaching development. • High associated cost • Expertise required • Labour intensive • Repeat treatments may be required every 2 years.	Ethically			
					Scientifically			
Population Monitoring	Used to evaluate the success of current management actions and inform any subsequent management actions	N/A	N/A	N/A	Community			High
					Ethically			
					Scientifically			

* - accepted if done correctly (i.e. culling is ethically accepted if conducted by trained professionals)

5.4 Summary of the Key Management Actions

The below table provides a summary of the key management actions that are implementable across the PSP, their timing and who the responsible authority for implementing each action will be.

Table 8. Summary of key management actions

Management Action	Description	Timing	Responsible Authority
Culvert	Fauna underpass designed to allow EGKs to safely disperse below transport and other infrastructure	Implemented during upgrade of Mickleham Road	VicRoads
Speed limit reduction	Reduces vehicle speed on roads with high EGK numbers to mitigate collision risk	Pre-development Phase	Council
Resource Removal	Removal/ fencing off all water points, food and protective habitat	Pre-development Phase	Developer/Landowner
Virtual Fencing	Roadside bollards using automatic sensor light and sound to repel wildlife and mitigate collision risk when vehicles approach	Implemented during upgrade of Mickleham Road	Council
Exclusion Fencing	Adopting fence designs that minimise wildlife injury can improve animal welfare and in turn reduce ongoing infrastructure damage.	Pre-development Phase	Developer/Landowner
Staged Development	The planning and construction of each stage of the potential subdivision in a particular order in an attempt to avoid land locking EGKs.	Pre-development/Development Phase	Developer/Landowner
Culling	The culling of landlocked kangaroos when all other management actions are exhausted.	Development/Post-development	Developer
Population Monitoring	Monitoring of the sizer, structure, health and location of the EGK populations within the PSP to ensure that the chosen management actions are not adversely affecting the populations and resulting in unforeseen impacts/interactions. Allows for adaptive management.	Development Phase	Council/developer/landowner

REFERENCES

Allan, C. and Stankey, G. 2009. Adaptive Environmental Management: A Practitioner's Guide. Pp. 368. Springer and CSIRO Publishing: Dordrecht, Netherlands and Collingwood, Australia.

Brunton A, Srivastava A and Burnett S, 2018. Spatial ecology of an urban eastern grey kangaroo (*Macropus giganteus*) population: local decline driven by kangaroo–vehicle collisions. CSIRO Publishing, Wildlife Research, 2018, 45, 685-695.

Burrell, S. 2015. *Eastern Grey Kangaroo*, Australian Museum. [www Document]. URL: http://australianmuseum.net.au/eastern-grey-kangaroo

Coulson, G. 2007. Exploding Kangaroos: assessing problems and setting targets in Pest or guest: the zoology of overabundance. Ed. Lunney, D., Eby, P., Hutchings, P. and Burgin, S. Royal zoological society of New South Wales, New South Wales.

Coulson G, Cripps JK, Wilson ME. Hopping Down the Main Street: Eastern Grey Kangaroos at Home in an Urban Matrix. Animals (Basel). 2014 May 27;4(2):272-91. doi: 10.3390/ani4020272. PMID: 26480041; PMCID: PMC4494371.

David, N, Coulson, G, Forsyth, D 2008. Diets of native and introduced mammalian herbivores in shrub-encroached grassy woodland, south-eastern Australia. CSIRO Publishing, Wildlife Research, 2008, 35, 684–694.

Descovich, K, Tribe, A, McDonald, I.J., Phillips C.J.C 2016. The eastern grey kangaroo: current management and future directions. CSIRO Publishing, Wildlife Research, 2016, 43, 576 – 589.

DPCD 2010. Delivering Melbourne's Newest Sustainable Communities. East Melbourne, Victoria: Department of Planning and Community Development.

DSE 2010. Our Wildlife Factsheet. No. 6. Eastern Grey Kangaroo. East Melbourne, Victoria: Department of Sustainability and Environment.

DELWP 2015a. Guidance note: Implementing the Biodiversity Conservation Strategy for Melbourne's Growth Corridors. Working document – February 2015. Melbourne Strategic Assessment.

DELWP 2015b. Guide to preparing a kangaroo management plan for Melbourne's growth corridors. Victorian Department of Environment, Land, Water and Planning.

DELWP 2017. Kangaroo population management. Public land kangaroo control in 2017. Victorian Department of Environment, Land, Water and Planning.

DELWP 2018. Translocation policy for isolated wild Eastern Grey Kangaroo populations in Victoria. Victorian Department for Environment, Land, Water and Planning.

DELWP 2020a. Our Wildlife – Kangaroos. Population Management. [www Document]. URL: https://www.wildlife.vic.gov.au/our-wildlife/kangaroos. Victorian Department of Environment, Land, Water and Planning, Melbourne, Victoria.

DELWP 2020. Native Vegetation Information Management system [www Document]. URL: https://nvim.delwp.vic.gov.au/. Victorian Department of Environment, Land, Water and Planning, Melbourne, Victoria.

Descovich, K, Tribe, A, McDonald, I, Phillips, C 2016. The eastern grey kangaroo: current management and future directions. Wildlife Research, CSIRO Publishing, 2016, **43**, 576-589.

Ecology and Heritage Partners 2019. Proposed Boundary Adjustment of Biodiversity Conservation Strategy Conservation Area 29 – Northern Growth Corridor: Mickleham Road, Mickleham – DRAFT.

Elton Consulting 2019. Craigieburn West PSP Co-design Workshop – Outcomes report. Prepared for Victorian Planning Authority. November 2019.

EPSDD 2017. Golden Sun Moth Synemon Plana Action Plan. Environment, Planning and Sustainable Development Directorate. ACT Government.

Fox, S, Potts, J, Pemberton, D, Crosswell, D 2018. Roadkill mitigation: trialing virtual fence devices on the west coast of Tasmania. Australian Mammalogy 41, 205-211.

Hayes & Goldingay 2009. *Use of fauna road-crossing structures in north eastern New South Wales*. Australian Mammalogy, CSIRO Publishing, 2009, **31**, pp. 89 – 95.

Herbert, C. A. 2004a. Long-acting contraceptives: A new tool to manage overabundant kangaroo populations in nature reserves and urban areas. Australian Mammalogy 26: 67-74.

Herbert, C, Trigg, T, Cooper W 2004b. Effect of deslorelin implants on follicular development, parturition and post-partum oestrus in the tammar wallaby (Macropus eugenii). Reproduction (Cambridge, England) 127, 265–273. doi:10.1530/rep.1.00094

Herbert, C, Trigg, T, Renfree, M, Shaw, G 2004c. Effects of a gonadotropin-releasing hormone agonist implant on reproduction in a male marsupial, Macropus eugenii. Biology of Reproduction 70, 1836–1842. doi:10.1095/biolreprod.103.02 5122

Kerle, A 2019. The Eastern Grey Kangaroo: A Modern Conservation Dilemma. Australian Zoologist: 2019, Vol. 40, No. 1, pp. 102-117.

LLS 2020. Options for integrated kangaroo management in the Western region. A practical guide for active management. Kangaroo Management Taskforce, Local Land Services. New South Wales Government.

Major Road Projects 2019. Craigieburn Road Upgrade Community Update. Major Roads Projects Victoria. November 2019.

Olsen, P. and Low, T 2006. Update on Situation Analysis Report: Current state of scientific knowledge on Kangaroos in the environment, including ecological and economic impact and effect of culling. Prepared for the Kangaroo Advisory Panel. March 2006.

Pahl, L 2019. Macropods, feral goats, sheep and cattle. 2. Equivalency in what and where they eat. The Rangeland Journal 41, 519–533.

Pople, A., and Grigg, C. G. 1999. Commercial harvesting of Kangaroos in Australia. Environment Australia, August 1999. Department of Zoology, University of Queensland.

Queensland Government 2019. *Fauna Sensitive Road Design Volume 2*. Department of Transport and Main Roads, Queensland. [www Document]. URL: https://www.tmr.qld.gov.au/business-industry/Technical-standards-publications/Fauna-Sensitive-Road-Design-Volume-2

RSPCA 2014. Policies. RSPCA Australia: Deakin West ACT.

Territory and Municipal Services 2010. ACT Kangaroo Management Plan. Pp. 194. Parks, Conservation and Lands, Territory and Municipal Services: Canberra, Australia.

TMS 2010. ACT Kangaroo Management Plan, Territory and Municipal Services, Australian Capital Territory, Canberra. [www Document]. URL: http://www.tams.act.gov.au/__data/assets/pdf_file/0012/394698/Kangaroo_Management_Plan_complete_for_web.pdf.

Treetec 2019. Craigieburn West PSP 1068 Arboricultural Assessment Report. Prepared for Victorian Planning Authority. Melbourne, Victoria.

Tribe ,A, Hanger, J, McDonald, I, Loader, J Nottidge, B, McKee, J and Phillips CJC 2014. A reproductive management program for an urban population of eastern grey kangaroos (Macropus giganteus). Animals 4: 562-582

Spiire 2019. Craigieburn West Landscape Character Assessment February 2019. Prepared for Victorian Planning Authority. February 2019

VPA 2019. Craigieburn West Precinct Structure Plan. Plan – Ownership DRAFT. Victorian Planning Authority 2019.

VicRoads 2012. Fauna Sensitive Road Design Guidelines. VicRoads, Victoria, August 2010.

Woodward, R, Herberstein, M, Herbert, C 2006. Fertility control in female eastern grey kangaroos using the GnRH agonist deslorelin. 2. Effects on behaviour. Wildlife Research 33, 47–55. doi:10.1071/WR04114

WSS 2018. Virtual Fencing, Installation and Maintenance Manual: V1 July 2018. Wildlife Safety Solutions.

FIGURES

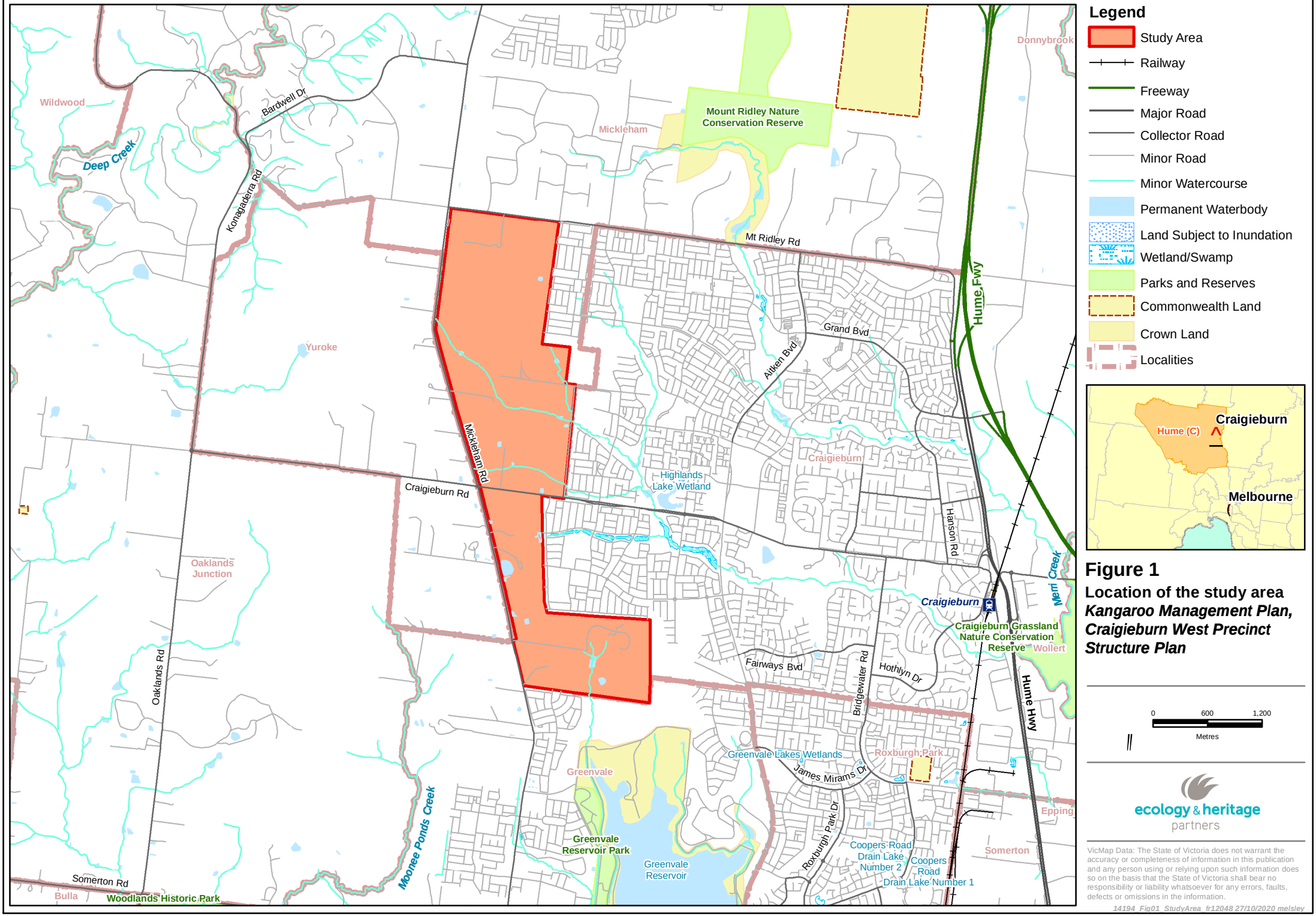

Figure 1

Location of the study area *Kangaroo Management Plan, Craigieburn West Precinct Structure Plan*

ecology & heritage partners

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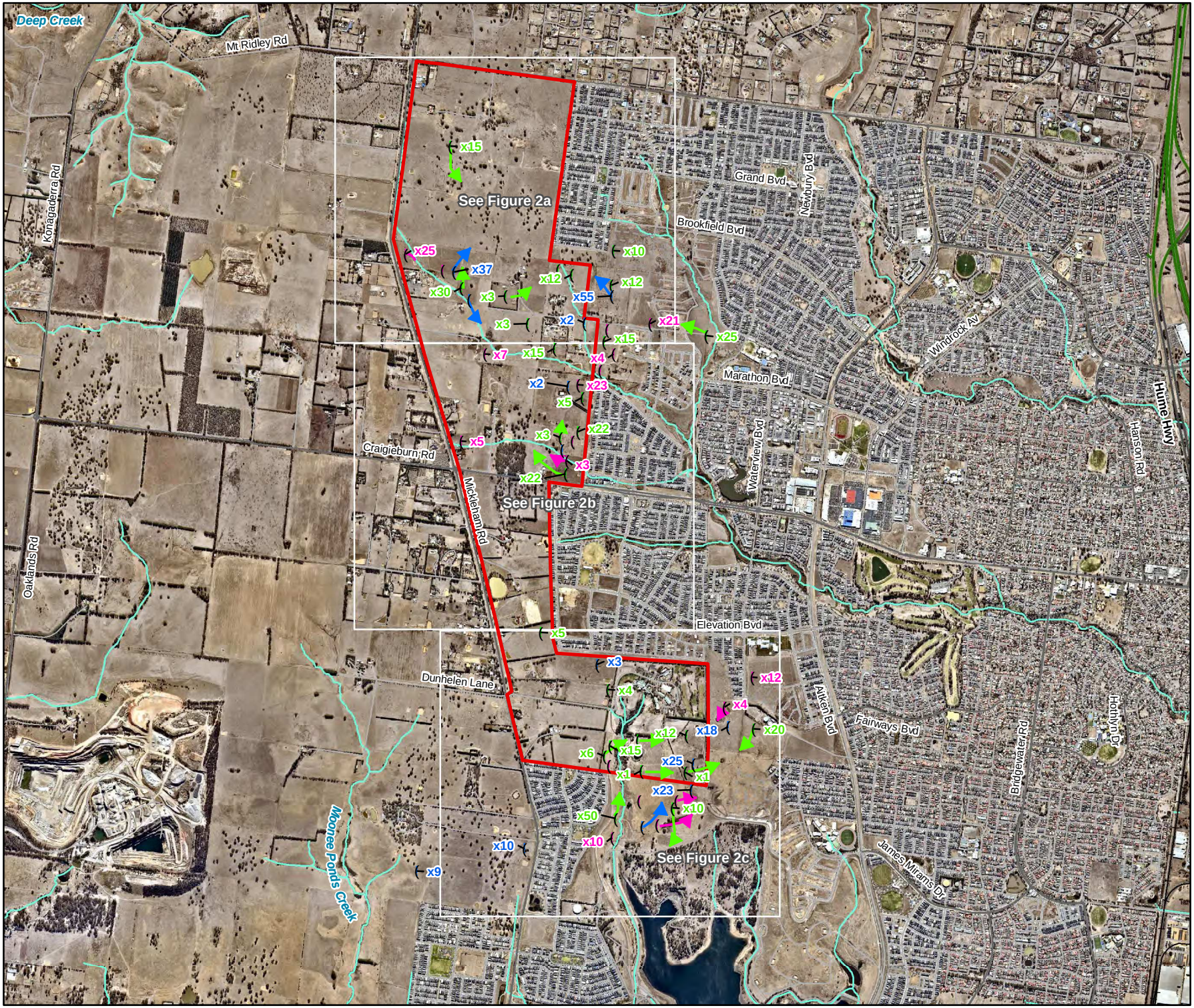

Legend

Study Area

Survey date:

- Survey date: 04/06/2019
- Survey date: 05/06/2019
- Survey date: 06/06/2019

Survey date:

- Survey date: 04/06/2019
- Survey date: 05/06/2019
- Survey date: 06/06/2019

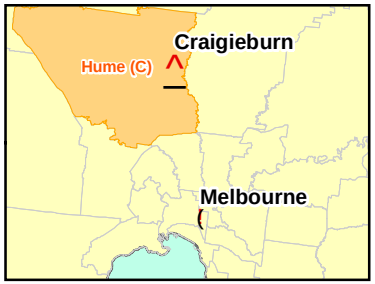

Figure 2 Overview

Kangaroo observations

Kangaroo Management Plan, Craigieburn West Precinct Structure Plan

0 500 1,000

Metres

ecology & heritage partners

14194_Fig02_KangObs_MB 27/10/2020 melsley

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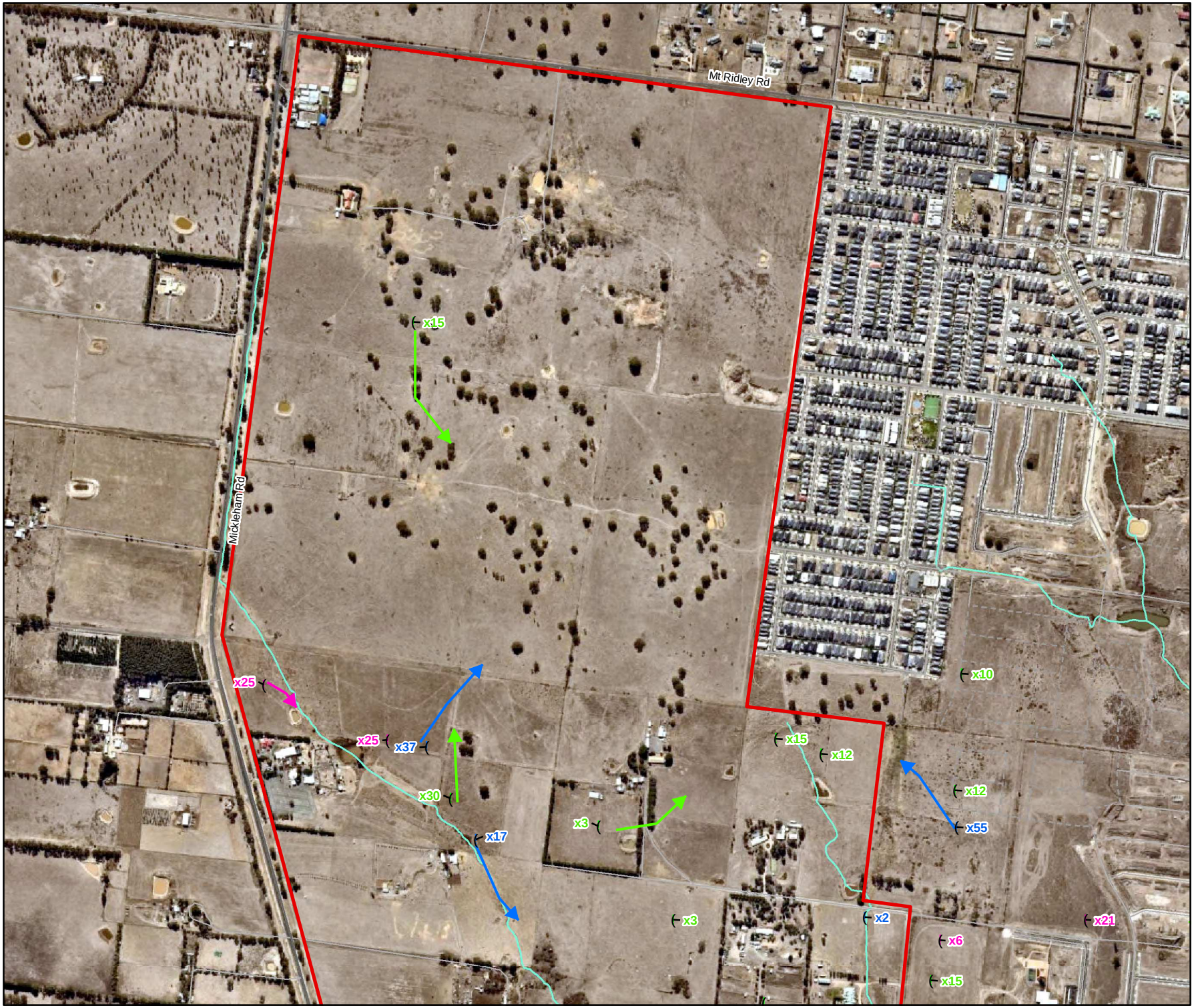

Legend

Study Area

Survey date:

- Survey date: 04/06/2019
- Survey date: 05/06/2019
- Survey date: 06/06/2019

Survey date:

- Survey date: 04/06/2019
- Survey date: 05/06/2019
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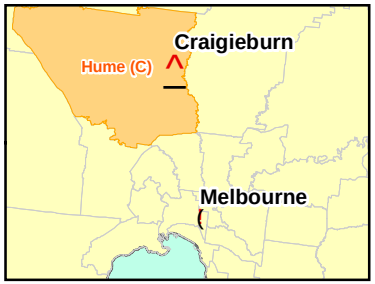

Figure 2a

Kangaroo observations

Kangaroo Management Plan, Craigieburn West Precinct Structure Plan

0 150 300

Metres

ecology & heritage partners

14194_Fig02_KangObs_MB 27/10/2020 melsley

Aerial source: Nearmap 2019

Legend

Study Area

Survey date:

Survey date: 04/06/2019

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Survey date: 04/06/2019

Survey date: 06/06/2019

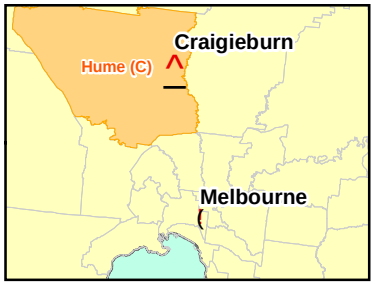


Figure 2b

Kangaroo observations *Kangaroo Management Plan, Craigieburn West Precinct Structure Plan*

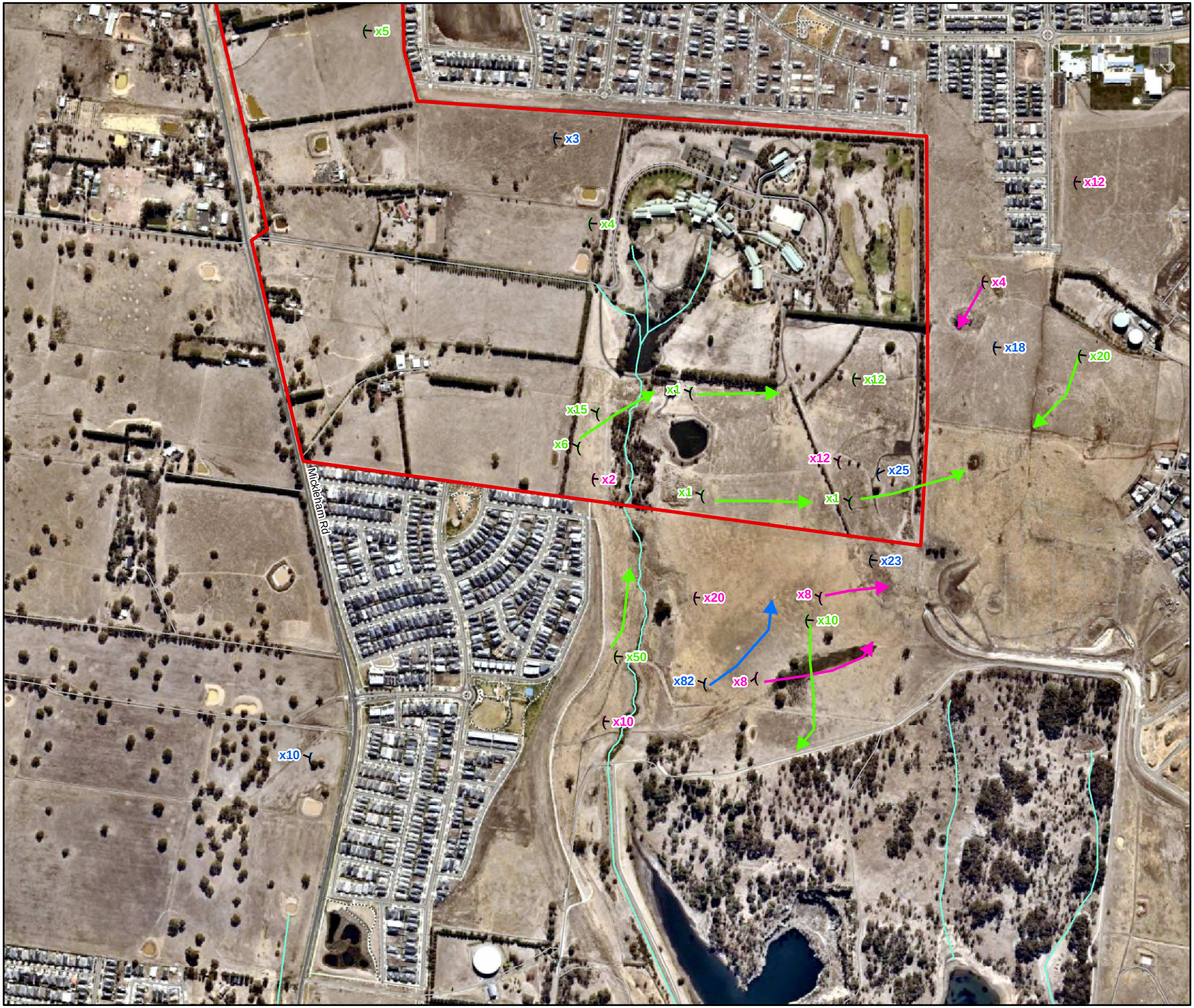
0 150 300

Metres

ecology & heritage partners

14194_Fig02_KangObs_MB 27/10/2020 melsley

Aerial source: Nearmap 2019



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Study Area

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Survey date: 04/06/2019

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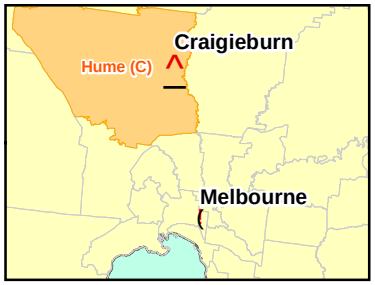


Figure 2c

Kangaroo observations

Kangaroo Management Plan, Craigieburn West Precinct Structure Plan

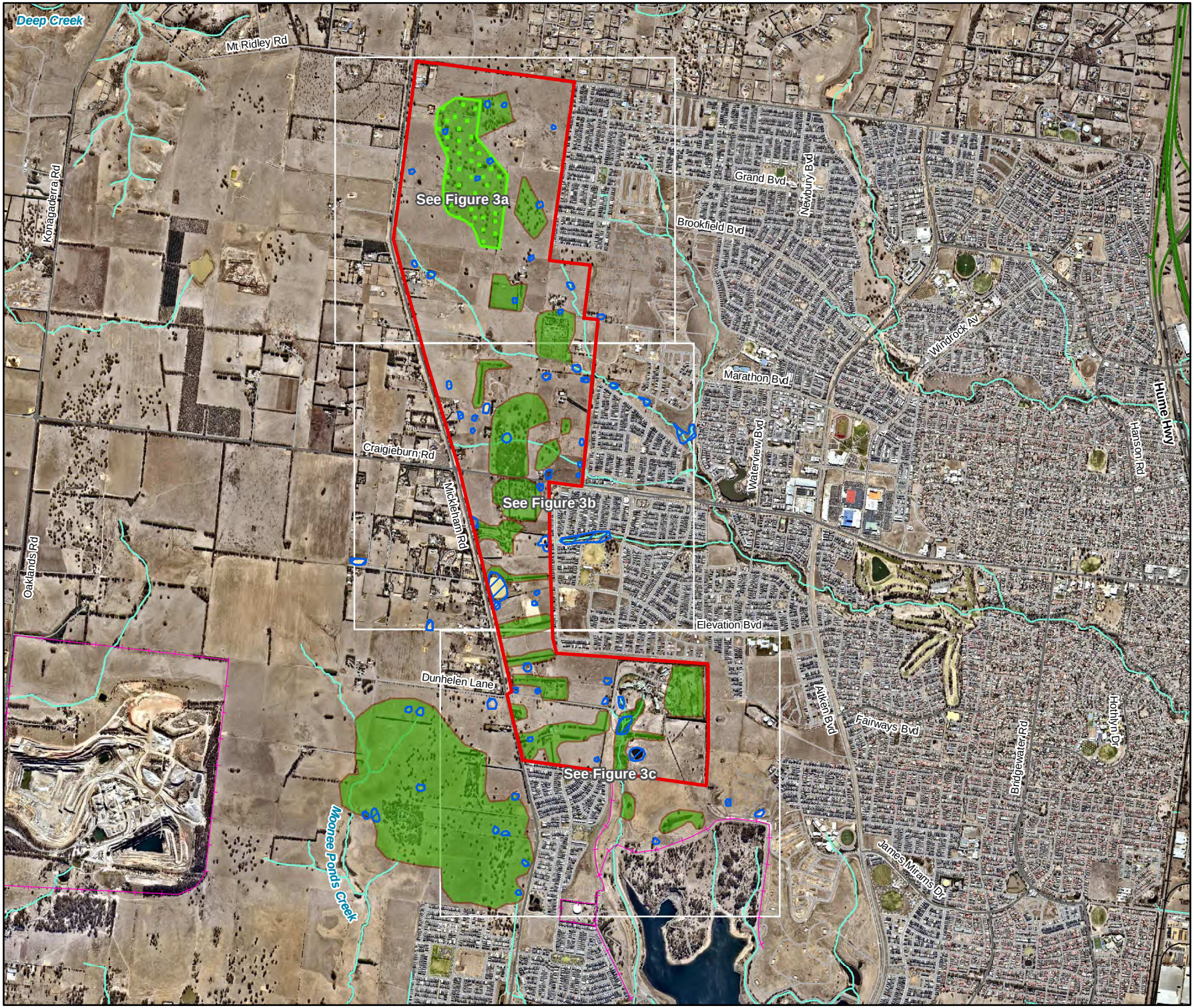
0 150 300

Metres

ecology & heritage partners

14194_Fig02_KangObs_MB 27/10/2020 melsley

Aerial source: Nearmap 2019



Legend

- Study Area
- BCS Conservation Area
- Protective habitat
- Water points
- Protective fencing

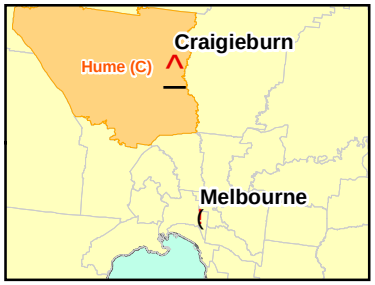


Figure 3 Overview

Habitat features

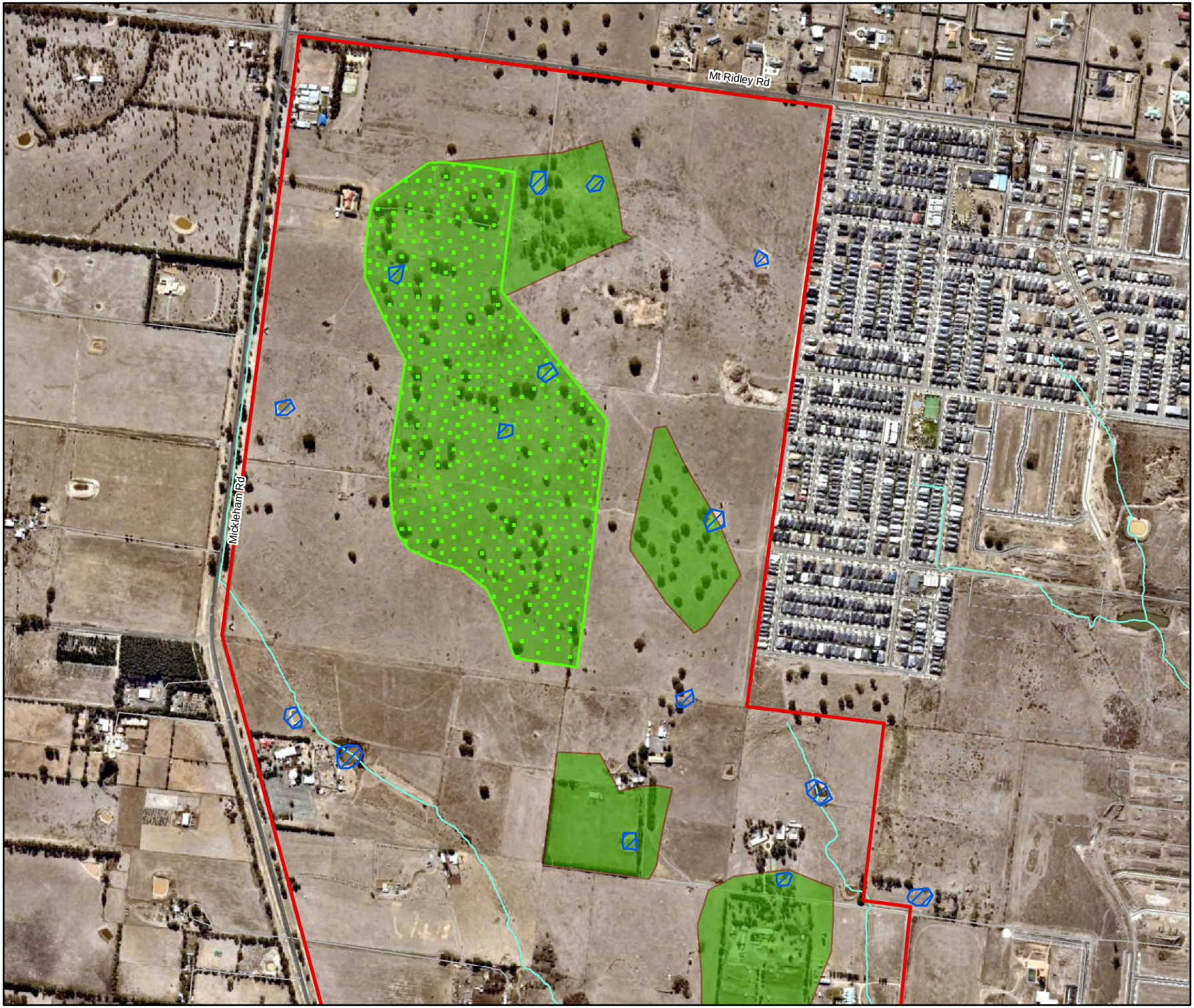
Kangaroo Management Plan, Craigieburn West Precinct Structure Plan

0 500 1,000
Metres

ecology & heritage partners

14194_Fig03_HabFeat_MB 27/10/2020 melsley

Aerial source: Nearmap 2019



Legend

- Study Area
- BCS Conservation Area
- Protective habitat
- Water points

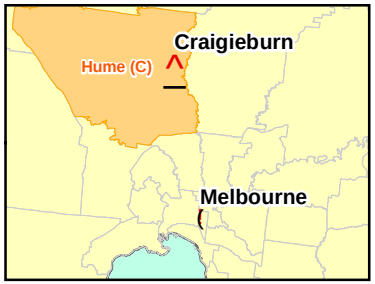


Figure 3a

Habitat features

Kangaroo Management Plan, Craigieburn West Precinct Structure Plan

0 150 300

Metres

ecology & heritage partners

14194_Fig03_HabFeat_MB 27/10/2020 melsley

Aerial source: Nearmap 2019

Legend

- Study Area
- Protective habitat
- Water points

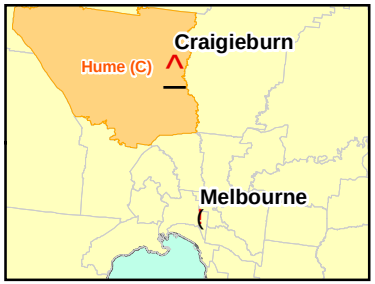


Figure 3b

Habitat features

Kangaroo Management Plan, Craigieburn West Precinct Structure Plan

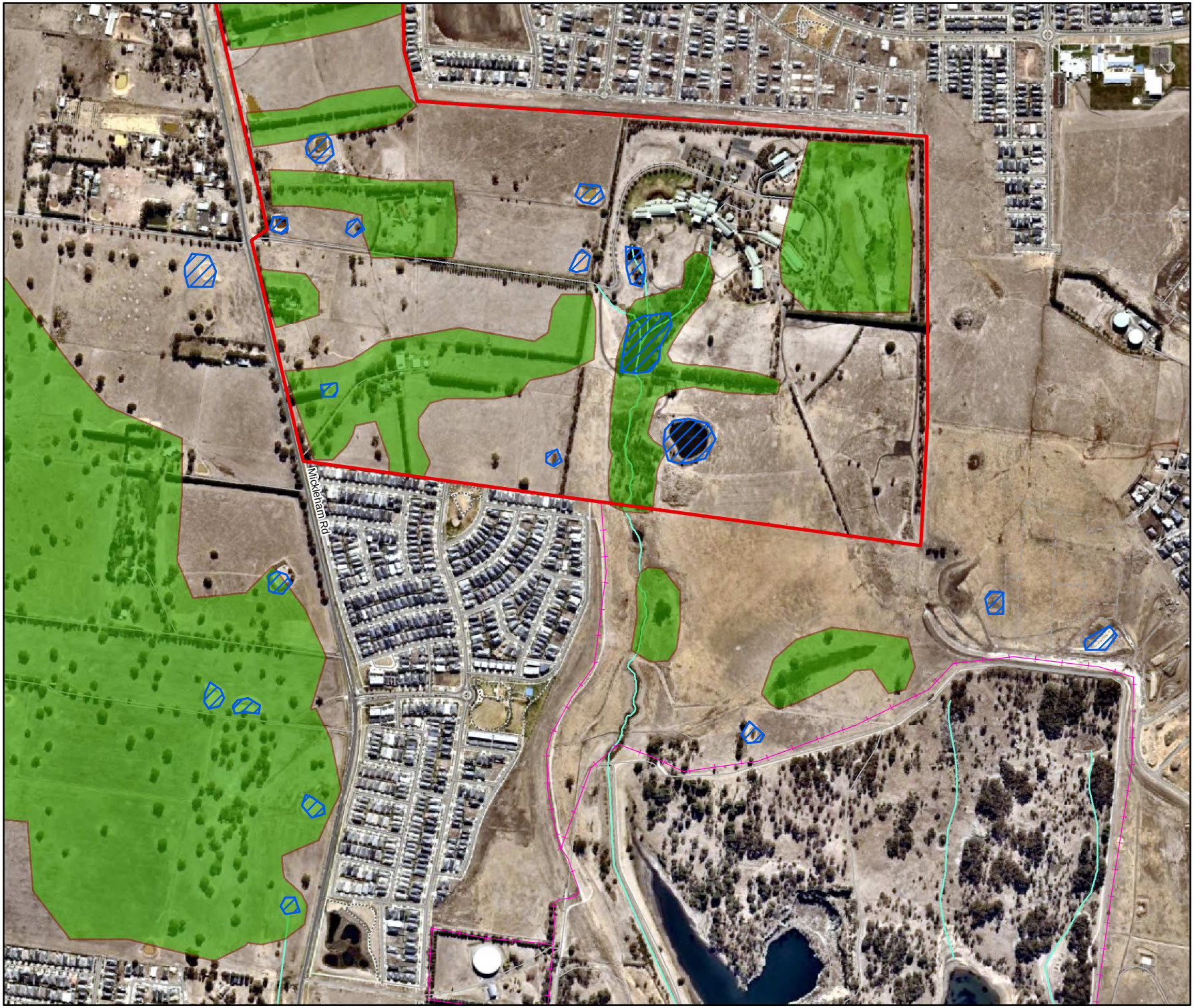
0 150 300

Metres

ecology & heritage partners

14194_Fig03_HabFeat_MB 27/10/2020 melsley

Aerial source: Nearmap 2019



Legend

- Study Area
- Protective habitat
- Water points
- Protective fencing

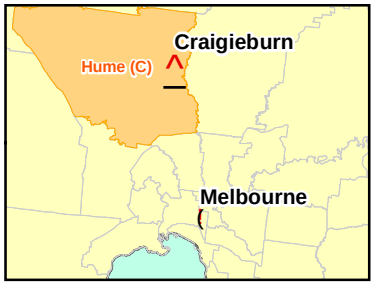


Figure 3c

Habitat features

Kangaroo Management Plan, Craigieburn West Precinct Structure Plan

0 150 300

Metres

ecology & heritage partners

14194_Fig03_HabFeat_MB 27/10/2020 melsley

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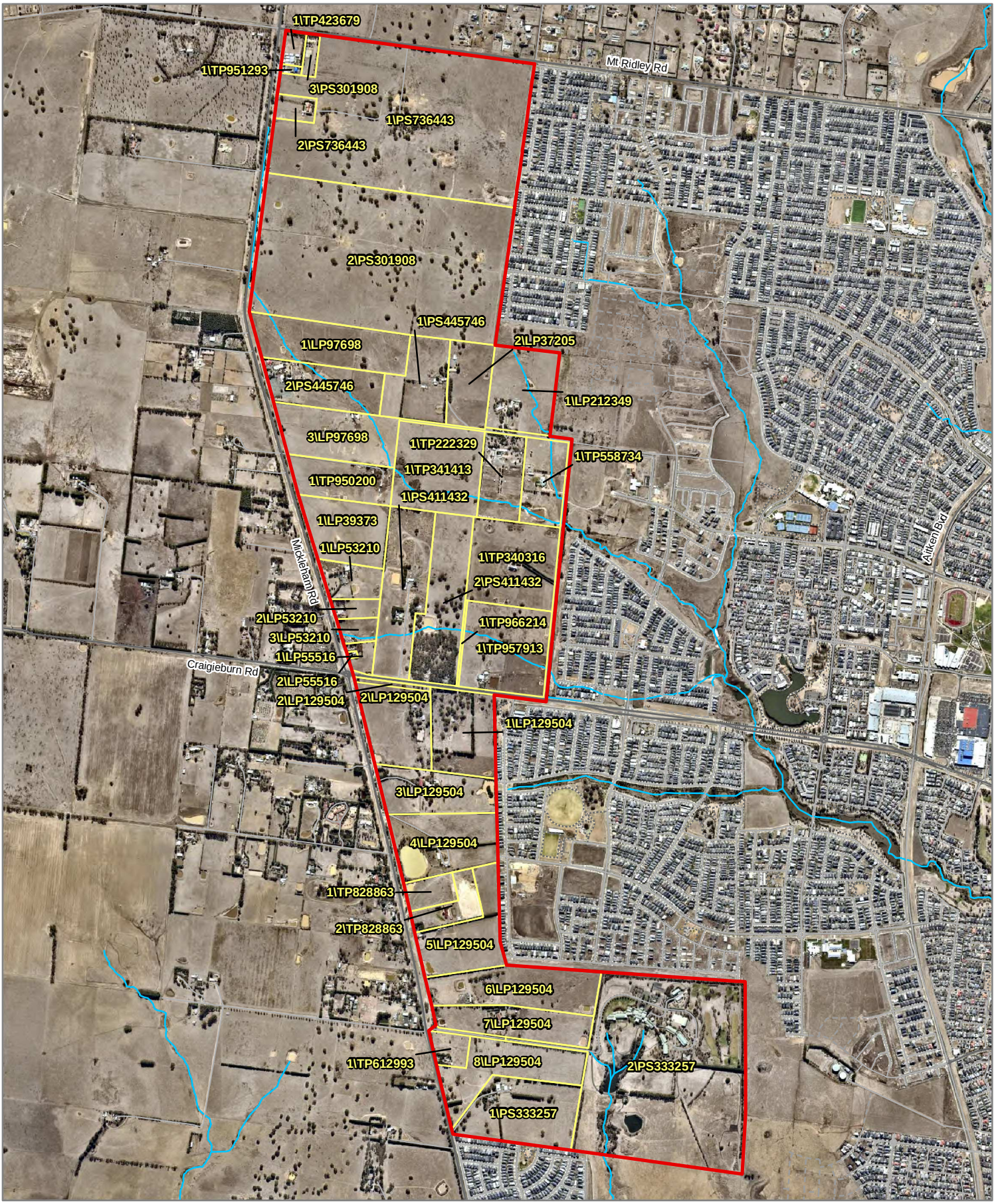


Figure 4

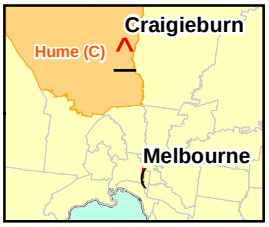
Properties within the study area

Kangaroo Management Plan, Craigieburn West Precinct Structure Plan

Legend

Study Area

Property boundary (with SPI)



0 200 400

Metres

ecology & heritage partners

14194_Fig04_Properties_P 27/10/2020 melsley

Aerial source: Nearmap 2019

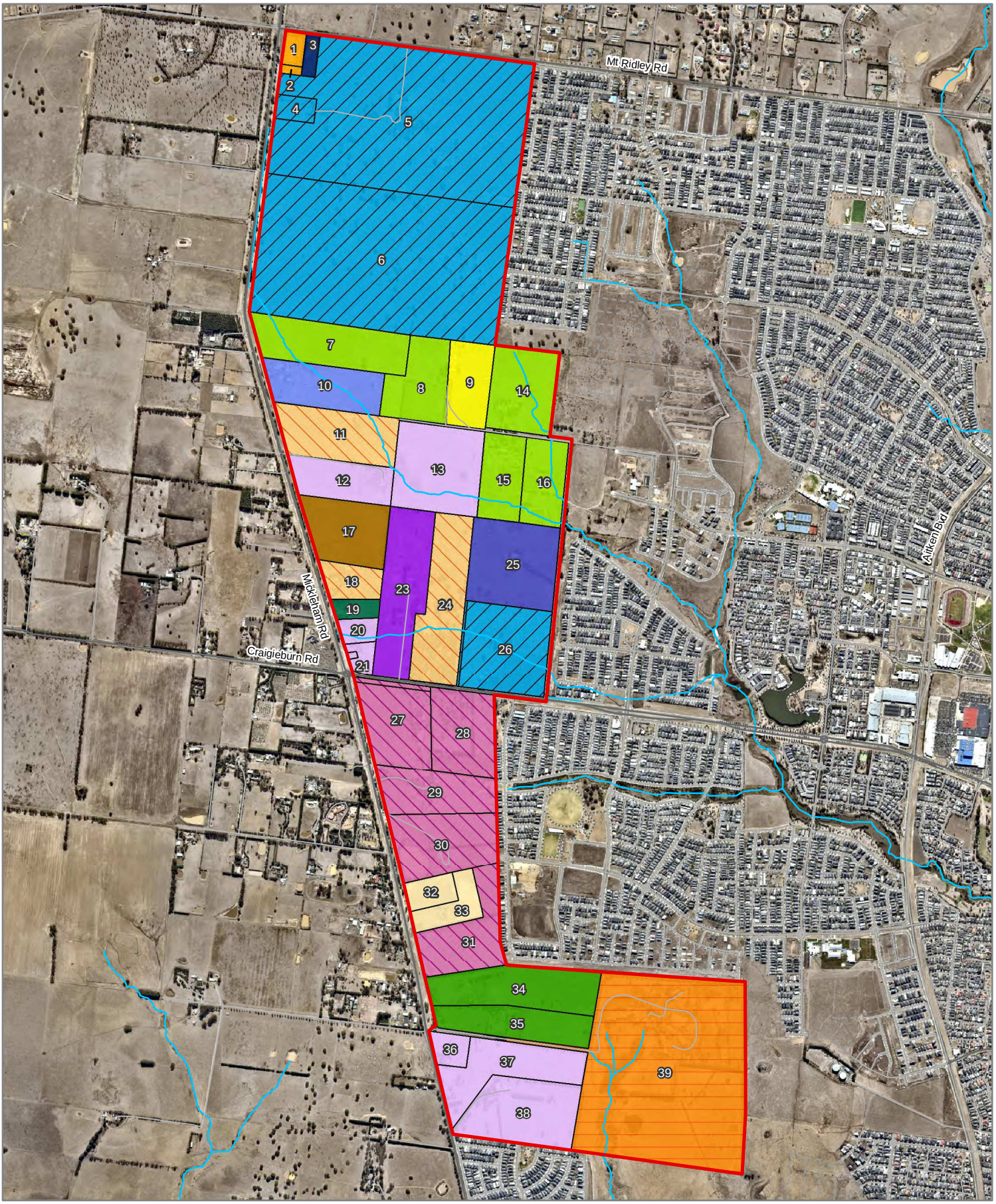


Figure 5

Land ownership boundaries

Kangaroo Management Plan, Craigieburn West Precinct Structure Plan

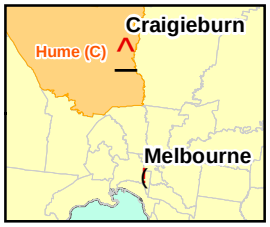
ecology & heritage partners

Legend

- Study Area

Property owner (VPA 2019)

- AK (Aus) Pty Ltd
- Aitken Conference Centre
- Australian Islamic Association
- Buddhist Temple
- Community Centre / Tennis Courts
- Deague Group
- Hawthorn Developments
- Henley
- IRD Developments
- Mickleham Primary
- Pask
- Peet
- Porter Davis
- Private landowner
- Stockland
- Syrian Orthodox Church



0 200 400
Metres

14194_Fig05_LandOwnership_P 27/10/2020 melsley

Aerial source: Nearmap 2019

APPENDIX 1 – EXISTING CONDITIONS TABLE

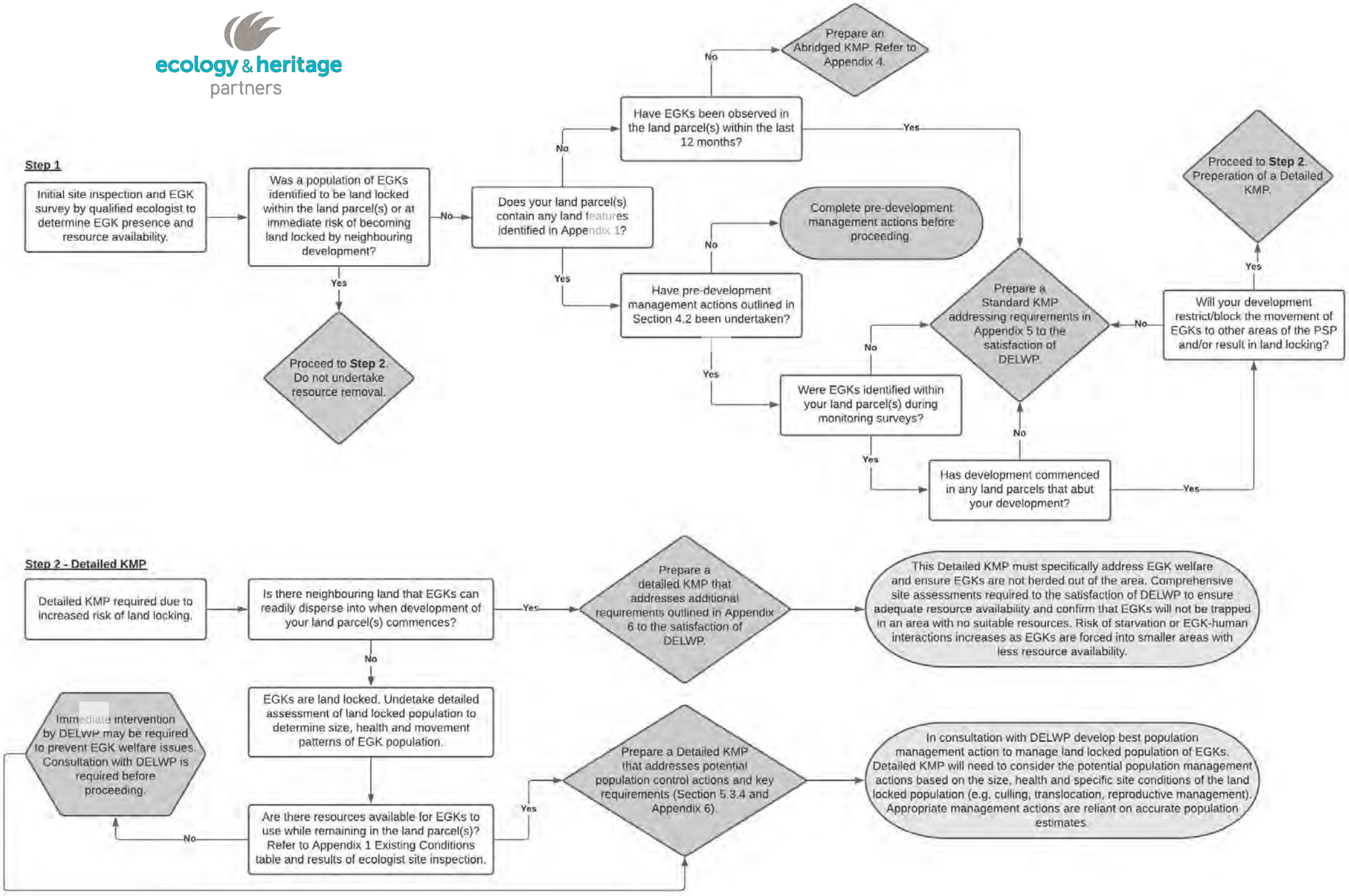
Parcel #	Parcel SPI	Land Ownership	Land Features	Primary Risks
1	1\TP423679	Mickleham Primary	-	-
2	1\TP951293	Mickleham Primary	-	-
3	3\PS301908	Community Centre	-	-
4	2\PS736443	Stockland	Conservation Area Protective habitat	Increased EGK-Vehicle Collisions Increased grazing pressure on CA
5	1\PS736443	Stockland	Conservation Area Water points Grazing habitat Protective habitat	Increased EGK-Vehicle Collisions Increased grazing pressure on CA
6	2\PS301908	Stockland	Conservation Area Water points Grazing habitat Protective habitat	Increased EGK-Vehicle Collisions Increased grazing pressure on CA
7	1\LP97698	Deague Group	Water points Grazing habitat Protective habitat	Increased EGK-Vehicle Collisions
8	1\PS445746	Deague Group	Water points Grazing habitat Protective habitat	Land locking of EGKs Increased EGK-Human interactions
9	2\LP37205	IRD Developments	Water points Grazing habitat Protective habitat	Land locking of EGKs Increased EGK-Human interactions
10	2\PS445746	Buddhist Temple	Water points Grazing habitat Protective habitat	Increased EGK-Vehicle Collisions
11	3\LP97698	Pask	Grazing habitat Protective habitat	Increased EGK-Vehicle Collisions
12	1\TP950200	Private Landowner	Water points Grazing habitat Protective habitat	Increased EGK-Vehicle Collisions
13	1\TP341413	Private Landowner	Water points Grazing habitat Protective habitat	Increased EGK-Vehicle Collisions
14	1\LP212349	Deague Group	Water points Grazing habitat Protective habitat	Land locking of EGKs Increased EGK-Human interactions

Parcel #	Parcel SPI	Land Ownership	Land Features	Primary Risks
15	1\TP222329	Deague Group	Water points Grazing habitat Protective habitat	Land locking of EGKs Increased EGK-Human interactions
16	1\TP558734	Deague Group	Water points Grazing habitat Protective habitat	Land locking of EGKs Increased EGK-Human interactions
17	1\LP39373	Henley	Water points Grazing habitat Protective habitat	Increased EGK-Vehicle Collisions
18	1\LP53210	Pask	Water points Grazing habitat Protective habitat	Increased EGK-Vehicle Collisions
19	2\LP53210	Australian Islamic Association	Water points Grazing habitat Protective habitat	Increased EGK-Vehicle Collisions
20	3\LP53210	Private Landowner	Water points Potential grazing habitat, looks cropped though Protective habitat	Increased EGK-Vehicle Collisions
21	1\LP55516	Private Landowner	Water points Potential grazing habitat, looks cropped though Protective habitat	Increased EGK-Vehicle Collisions
22	2\LP55516	Private Landowner	-	Increased EGK-Vehicle Collisions
23	1\PS411432	Hawthorn Developments	Water points Grazing habitat Protective habitat	Land locking of EGKs Increased EGK-Human interactions
24	2\PS411432	Pask	Water points Grazing habitat Protective habitat	Land locking of EGKs Increased EGK-Human interactions
25	1\TP340316	Syrian Orthodox Church	Water points Grazing habitat Protective habitat	Land locking of EGKs Increased EGK-Human interactions
26	1\TP957913	Stockland	Water points Grazing habitat Protective habitat	Land locking of EGKs Increased EGK-Human interactions
27	2\LP129504	Peet	Water points Grazing habitat Protective habitat	Increased EGK-Vehicle Collisions
28	1\LP129504	Peet	Water points Grazing habitat Protective habitat	Land locking of EGKs Increased EGK-Human interactions

Parcel #	Parcel SPI	Land Ownership	Land Features	Primary Risks
29	3\LP129504	Peet	Water points Grazing habitat Protective habitat	Increased EGK-Vehicle Collisions
30	4\LP129504	Peet	Water points Grazing habitat Protective habitat	Increased EGK-Vehicle Collisions
31	5\LP129504	Peet	Water points Grazing habitat Protective habitat	Increased EGK-Vehicle Collisions
32	1\TP828863	Porter Davis	Water points Grazing habitat	Increased EGK-Vehicle Collisions
33	2\TP828863	Porter Davis	Water points Grazing habitat Protective habitat	Increased EGK-Vehicle Collisions
34	6\LP129504	AK (Aus) Pty Ltd	Water points Grazing habitat Protective habitat	Increased EGK-Vehicle Collisions
35	7\LP129504	AK (Aus) Pty Ltd	Water points Grazing habitat Protective habitat	Increased EGK-Vehicle Collisions
36	1\TP612993	Private Landowner	Grazing habitat Protective habitat	Increased EGK-Vehicle Collisions
37	8\LP129504	Private Landowner	Water points Grazing habitat Protective habitat	Increased EGK-Vehicle Collisions
38	1\PS333257	Private Landowner	Water points Grazing habitat Protective habitat	Increased EGK-Vehicle Collisions
39	1\PS333257	Aitken Conference Centre	Water points Grazing habitat Protective habitat	Land locking of EGKs Increased EGK-Human interactions

APPENDIX 2 – DECISION MAKING MATRIX

ecology & heritage partners



Definitions of terms used in flow chart

Term	Definition
Development commencing	The date in which development begins in a given land parcel.
DELWP	Department of Environment, Land, Water and Planning
EGK	Eastern Grey Kangaroo
Herded out	The non-lethal, human induced movement of EGKs out of the area.
Land locking	Where kangaroos are 'shut in' completely or almost completely by surrounding development with no way out.
Monitoring surveys	Surveys undertaken to monitor the health, location and size of identified populations within the area to inform any necessary contingency management.
Neighbouring land	Land immediately adjoining the land parcel in question
Population Survey	Conducted if EGKs are identified within the study area over the last 12 months and used to determine the number, location, movement patterns, health and other notable information of the identified EGKs. Refer to Section 4.2 for more information.
Resource	Edible grasses or herbs and water points
Restrict movement	Where individuals cannot freely move out of the area.
Staged development	Staged development is the planning of the order of each stage of a subdivision to avoid landlocking kangaroos.
Starvation	The lack of resources resulting in the starvation and eventual death of EGKs.
Site inspection	An initial presence/absence survey to establish if there are kangaroos in the survey area, or if there is evidence that kangaroos have been in the survey area in the last 12 months, Refer to section 4.1 for more information.

APPENDIX 3 – INFORMATION SHEET: KANGAROOS IN ACTIVE CONSTRUCTION SITES

If you see a kangaroo in the construction area...

- Let the kangaroo leave of its own accord.
- Don't herd the kangaroo: it is an offence under the *Wildlife Act 1975*. Herding can stress and confuse a kangaroo, and make it behave erratically. This can result in the kangaroo, and people, being injured.
- Try to identify where the kangaroo entered the construction area. Temporarily widening the entry point might encourage the kangaroo to leave through it. If the kangaroo leaves, securely close off the entry point as soon as possible.
- Report seeing the kangaroo to the ecologist (who might need to reassess the kangaroo management plan, and increase monitoring).
- If there are things attracting kangaroos (such as food, shade, water and habitat) in the construction area, contact the ecologist immediately about amending the site's kangaroo management plan to possibly remove the attractants.
- If the kangaroo is injured, or will not leave by itself, contact one of these agencies for advice:
    - Help for Wildlife (0417 380 687)
    - Wildlife Victoria (1300 094 535)
    - BADGAR emergency 24-hour wildlife rescue centre (1300 223 427).
- If a kangaroo is injured or killed in a construction area covered by a kangaroo management plan, and the Department of Environment, Land, Water and Planning must be notified as soon as possible on 136 186.
- All people must obey standard construction area speed limits.

APPENDIX 4 - AUTHORITY TO CONTROL WILDLIFE

Authority to Control Wildlife Application Form

Due to the impacts of COVID-19, you are encouraged to submit your application via email (see page 4 for details). Application forms returned via post or fax may be subject to delays greater than 6 weeks.

1. Applicant's personal details

Title | First Name | Other Given Names | Family Name

Date of Birth | Gender | DELWP Customer Number (if known)

2. Applicant's residential address

Property Name *(Name of house, farm or building if applicable).* | Flat/Unit No. | House/Lot No.

Street Name | City/Suburb/Town | Postcode

3. Applicant's postal address *(if same as above, please write "as above")*

Property Name *(Name of house, farm or building if applicable).* | Flat/Unit No. | House/Lot No.

Street Name | City/Suburb/Town | Postcode

4. Applicant's contact details *(Please circle your preferred contact)*

Telephone – Mobile | Telephone – Private | Telephone – Business | Email address

5. Applicant's relationship to the land with the wildlife problem: (*Tick ONE box which best describes this)*

☐ Land owner ☐ Land manager ☐ Lessee ☐ Business Owner/Director ☐ Employee *(Specify position)*

……

6. Business name *(ONLY complete if the land is owned under the name of a business)*

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7. Description and location of land where you plan to control wildlife

(Crown Allotment Number(s) must be supplied – see your Rates Notice or Shire Office). Include CFA Map Book Map No., Square No. & House No, if applicable.

Road Location (*e.g. No. 2010 Plenty Rd, 2km west of intersection with Centre Rd*)

Postcode

Municipality *(e.g. Southern Grampians Shire*)

Land where wildlife is to be controlled is either: *(Tick applicable box)*

☐ **Private land** ☐ **Crown land**

Approximate area in hectares

Land Use Zone

Current land use (*e.g. Cropping wheat, cattle grazing, apple orchard, etc)*

8. Species and total number of wildlife causing property damage or health and safety risks

Please provide a count or your best estimate of the number of animals that are the source of the problem.
Attach a separate sheet if applying to control more than four species.

	Species	**Number causing damage**
1		
2		
3		
4		

9. Description of damage or health and safety risks resulting from wildlife

The description should outline the type and extent of damage to property including buildings, fences, pasture, crops or livestock. Any issues related to human health and safety should also be included (for example, hazards to aircraft safety, fouling of produce or property or aggressive behaviour). Attach a separate sheet if required.

CONSERVATION REGULATOR VICTORIA

10.What non-lethal control methods are you currently taking to manage the issues identified in section 9?

Include any measures you have taken with regards to fencing or restricting wildlife access to property or crops. Attach a separate sheet if required.

11.What methods are you proposing to undertake to manage the wildlife problem?

For example: scaring, shooting, trapping and shooting, trapping and release, destroying eggs and nests.

12. Acknowledgment by applicant

I, *(name of applicant)* ……..…… being the applicant for this Authority to Control Wildlife, acknowledge that it is an offence under Section 58B of the *Wildlife Act 1975* to provide false or misleading information in, or in connection with, the application for an Authority to Control Wildlife and I state that the information that I have provided is true, correct and complete.

SIGNATURE of Applicant …….. DATE signed ……..

Collection, use and disclosure of personal information - *Privacy and Data Protection Act 2014*

The Department of Environment, Land, Water and Planning (DELWP) is committed to protecting personal information provided by you in accordance with the principles set out in the Victorian privacy laws. This privacy statement applies to the collection and use of personal information, voluntarily provided by you, in relation to administration of licences and authorisations administered under the *Wildlife Act 1975*.

The information you provide will be used to assess your application, administer any relevant licences or authorisations and carry out compliance relating to those licences or authorisations.

DELWP or its contracted service providers under confidentiality agreements may survey you about your experience with DELWP.

You may apply for access to your personal information at any time to confirm that it is accurate and up to date, upon payment of a prescribed fee (if any). Enquires should be directed to the DELWP Customer Service Centre on 136 186.

An authorisation may not be issued if the information required is not provided.

Submitting your application

Once your application for an Authority to Control Wildlife has been **completed** and **signed,** please submit it to your local DELWP Office. **Due to the impacts of COVID-19, you are encouraged to submit your application via email.** Application forms returned via post or fax may be subject to delays greater than 6 weeks.

Port Phillip region
atcw.portphillipregion@delwp.vic.gov.au

or
Permissions Lead
DELWP
Private Bag 15
Ferntree Gully Delivery Centre VIC 3156
Fax: 9210 9230

Gippsland region
gippsland.environmentalcompliance@delwp.vic.gov.au

or
Permissions Lead
DELWP
574 Main Street
Bairnsdale VIC 3875
Fax: 5152 6865

Hume region
atcw.hume@delwp.vic.gov.au

or
Permissions Lead
DELWP
1683 Healesville – Kinglake Road
Toolangi VIC 3777
Fax: 5962 9354

Grampians region
grampians.compliance@delwp.vic.gov.au

or
Permissions Lead
DELWP
402 Mair St
Ballarat VIC 3350

Barwon South West region
bsw.environmentalcompliance@delwp.vic.gov.au

or
Permissions Lead
DELWP
PO Box 115
Colac VIC 3250
Fax: 5233 5500

Loddon Mallee region
atcw.lmr@delwp.vic.gov.au

or
Permissions Lead
DELWP
PO Box 3100
Bendigo Delivery Centre
Bendigo VIC 3551
Fax: 5448 4982

Guide to applying for an Authority to Control Wildlife

Victoria is home to a diverse range of wildlife, including a number of species not found anywhere else in the world. Native wildlife in Victoria, including all birds, mammals, reptiles and amphibians, is protected under the *Wildlife Act 1975.* It is illegal to wilfully disturb protected wildlife or to destroy protected wildlife without approval. You may apply to DELWP for an ATCW to scare, disperse, trap or destroy wildlife if it is:

- damaging buildings, pasture, crops or other property
- posing a risk to human health and safety, or
- impacting on biodiversity.

Applying for an ATCW

You are encouraged to return your application via email. Application forms returned via post or fax may be subject to delays greater than 4 weeks.

If you require an ATCW, you should complete an ATCW application form and submit it to DELWP. Please complete all sections of the application form to avoid delays.

Your ATCW application will be assessed by a DELWP officer who may inspect your property to confirm the damage being caused by wildlife. Under the requirements of the *Wildlife Act 1975* and DELWP policy, an ATCW will only be issued if the DELWP officer is satisfied that it is necessary to manage the problem and that all practical non-lethal control methods have been exhausted.

If you are seeking to control wildlife on Crown land you must have the permission of the Crown land manager.

Non-lethal control

All practical non-lethal control methods must be exhausted before you apply for an ATCW for lethal control.
There are a number of long-term solutions available to manage wildlife damage that do not require an ATCW. For example, fencing or netting to exclude animals, planting different types of crops, or planting at different times. While lethal control may seem like the immediate answer, it is time-consuming and often must be repeated to be effective.

An ATCW is required by law to disturb wildlife through scaring, harassing, dispersing, trapping or translocating. For example, a landholder using a gas gun to frighten birds from their orchard would require an ATCW, while a landholder using netting and a scarecrow would not.

If you would like more information about non-lethal control methods that do not require an ATCW please refer to the fact sheets on DELWP's wildlife website: https://www.wildlife.vic.gov.au/managing-wildlife/wildlife-management-and-control-authorisations or call the DELWP Customer Service Centre on 136 186.

Lethal control

If you have explored other methods for managing wildlife and consider that lethal control is your last resort, you must apply for an ATCW.

If you have been issued with an ATCW you may arrange for someone else to control wildlife on your behalf. This person is known as your agent. Although you are no longer required to list agents on your ATCW application you still may be legally responsible for their actions. It is recommended that you specifically discuss the conditions of the ATCW with your agent. You must give a copy of the ATCW to any agents because anyone controlling wildlife is required by law to carry a copy of the ATCW.

Anyone shooting wildlife must also comply with the *Firearms Act 1996*. Shooters are required by law to hold an appropriate firearms licence. Depending on the location, you may be required by law to obtain a 'Public Place Permit' from Victoria Police before shooting wildlife. Penalties apply for non-compliance. For more information about matters regarding firearms please visit www.police.vic.gov.au/firearms or call 1300 651 645.

Engaging licensed Wildlife Controllers

You may engage a licenced Wildlife Controller to manage wildlife on your behalf. Wildlife Controllers may control unprotected wildlife (except deer) and native reptiles under their licence even if you don't have an ATCW. However, for all other wildlife, you must be issued with an ATCW before the Wildlife Controller can control wildlife on your behalf.

Common wombats – revocation of the Order in Council

Common wombats (*Vombatus ursinus)* are now protected wildlife everywhere in Victoria. It is illegal to disturb or to destroy protected wildlife without an Authority to Control Wildlife (ATCW) from the Conservation Regulator.

Acting on your ATCW

All ATCWs include strict conditions to ensure that animals are controlled humanely. You, and anyone acting on your behalf, are required by law to comply with the ATCW conditions. If you don't comply, your authorisation may be suspended or cancelled and you may be taken to court and fined.

DELWP recommends that you and/or your agent undertake firearm competency training prior to shooting wildlife.

DELWP also recommends that you read the *National Code of Practice for the Humane Shooting of Kangaroos and Wallabies for Non-Commercial Purposes* before shooting kangaroos. For a copy of the code visit the Commonwealth Department of Environment website: http://www.environment.gov.au/biodiversity/wildlife-trade/publications/national-codes-practice-humane-shooting-kangaroos-and-wallabies.

APPENDIX 5 - ABRIDGED KANAGROO MANAGEMENT PLAN

An Abridged Kangaroo Management Plan will only be required for small land parcels where EGKs have not previously been detected or where there are few habitat and food resources. The guideline to preparing kangaroo management plan for Melbourne's growth corridors (DELWP 2015b) provides further clarification around the requirements for an Abridged KMP. An Abridged KMP will address the following:

- Introduction;
- Kangaroo management rationale;
- Site description;
- Survey methodology;
- Plan goals;
- Staged development plan;
- Preventative actions; and,
- Assessment of other preventative options.

All Kangaroo Management Plans must be submitted to DELWP for review and approval before development can commence.

APPENDIX 6 - STANDARD KANGAROO MANAGEMENT PLAN

A Standard Kangaroo Management Plan will be required in most instances across the PSP where EGKs are not at risk of becoming land locked. The guideline to preparing kangaroo management plan for Melbourne's growth corridors (DELWP 2015b) provides further clarification around the requirements for a standard KMP. A Standard KMP will address the following:

- Introduction;
- Kangaroo management rationale;
- Site description;
- Survey methodology;
- Population survey results;
- Plan goals;
- Staged development plan;
- Management actions;
- Assessment of other management options;
- Monitoring; and,
- Contingency planning.

All Kangaroo Management Plans must be submitted to DELWP for review and approval before development can commence.

APPENDIX 7 - DETAILED KANGAROO MANAGEMENT PLAN

A Detailed KMP is required when the decision-making flow chart has identified a risk of land locking to EGKs. A Detailed KMP must address the requirements of a Standard KMP as well as addressing the following conditions to the satisfaction of the responsible authority:

- A description of the proposed development in context to EGKs observed in the area;
- Feasibility of developing alternative staging plan that may allow EGKs to disperse to neighbouring land or reduce likelihood of EGK-human interactions;
- Description of the potential impacts and risks presented to EGKs and humans;
- Detailed site and population surveys undertaken by a suitably qualified ecologist to determine:
    - Extent of available EGK resources within areas of high land locking risk;
    - Number of EGKs land-locked or at risk of becoming land locked;
    - Health of land locked EGKs;
    - Population structure of land-locked EGKs (e.g. Number of males, females and juveniles); and,
    - EGK movement patterns and any potential corridors out of high-risk areas.
- Mapping showing locations of EGKs, resources and areas where EGKs are land locked;
- Evidence of consultation with neighbouring landowners to determine risks to EGKs and potential mitigation actions (e.g. changing development directions);
    - Has a KMP been prepared for any neighbouring land parcel?
- Address increased risks to humans and EGK welfare that may arise as a result of land locking EGKs;
- An assessment of potential population management actions for land-locked EGKs (if required);
    - Culling;
    - Translocation; and
    - Reproductive management.
- Consultation with DELWP to determine most appropriate population management action. Outcome will be based on size of population, health and amount of time EGK can persist in the area before development proceeds or available resources are used up.
- 6 monthly monitoring of high-risk populations (i.e. populations that are land locked or at risk of becoming land locked in the immediate future). More regular monitoring may be recommended by the ecologist and/or DELWP based on the risks to EGKs.

All Kangaroo Management Plans must be submitted to DELWP for review and approval before development can commence.