VPA

# Casey Fields South & Devon Meadows Biodiversity Assessment Report

## 2025 Update

March 2025

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# Casey Fields South & Devon Meadows Biodiversity Assessment Report 2025 Update

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| Rev | Date | Details |
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| 01 | 03/05/2023 | First revision |
| 02 | 16/06/2023 | Second revision addresses feedback from VPA and includes additional mapping updates |
| 03 | 25/07/2023 | Third revision addresses feedback from VPA on figures 3.6 and 5.1 |
| 04 | 28/02/2025 | Report review based on provision of Melbourne Water DSS alignment |
| 05 | 06/03/2025 | Response to VPA comments on report update |

| | Name | date | signature |
|---|---|---|---|
| Prepared by: | Imogen Merlo | 02/05/2023 |  |
| Reviewed by: | Justin Pegg | 02/05/2023 |  |

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| Updated by: | Imogen Merlo | 27/02/2025 |  |
| Reviewed by: | Nic McCaffrey | 27/05/2025 |  |

WSP acknowledges that every project we work on takes place on First Peoples lands.
We recognise Aboriginal and Torres Strait Islander Peoples as the first scientists and engineers and pay our respects to Elders past and present.

# Table of contents

# Executive Summary

## Project Background

The Victorian Planning Authority (VPA) engaged WSP Australia to provide qualified experts to assess existing ecological values relating to the Southern Brown Bandicoot within the Casey Fields South and Devon Meadows precincts. The assessment was prepared to inform the development of the Devon Meadows and Casey Fields South Precinct Structure Plan (PSP). The study area for this assessment includes the Devon Meadows (~261 ha) and Casey Fields South (~275 ha) precincts as indicated in the Request for Quote (RFQ) COR/22/4570.

The study area sits within the Extension of the Urban Growth Boundary, within close proximity to the Southern Brown Bandicoot Management Area as designated by the Sub-regional Species Strategy for Southern Brown Bandicoot *Isoodon obesulus obesulus* (DEPI 2014a).

In August 2024 the Victorian Planning Authority (VPA) engaged WSP Australia to undertake an update of this report in light of the provision of updated Development Services Scheme (DSS) from Melbourne Water.

The current update incorporates the DSS and current impact footprint into this report.

## Methodology

The first stage of this project was to conduct a literature review and contextual analysis of the study area, detailed in Section 3.1.

The literature review included a review of relevant strategies, plans, technical documentation and aerial photography to:

- Summarise the relevant planning and policy context including the requirements for Southern Brown Bandicoot conservation under the MSA Program, Section 3.1.5.
- Summarise any relevant research and existing spatial data related to conservation of the Southern Brown Bandicoot, Section 3.2.1.
- Summarise any relevant research related to movement preferences of the Southern Brown Bandicoot through manmade infrastructure (e.g., road crossings, culverts, etc.), Section 3.1.4.
- Identify locations for ground-truthing surveys, Section 3.2.1.

The literature review included a review of current literature on the habitat and movement preferences of Southern Brown Bandicoot, and also included the following documents:

- Sub-regional Species Strategy for the Southern Brown Bandicoot (DEWLP, 2014).
- Sub-Regional Species Strategy for the Southern Brown Bandicoot – Supplement: habitat connectivity (DEWLP, 2014).
- Implementation Plan for the Southern Brown Bandicoot Sub-Regional Species Strategy (DEWLP, 2016).
- Southern Brown Bandicoot Habitat Protection Strategy & Environmental Significance Overlay (Ecology Australia, 2016, prepared on behalf of Cardinia Shire Council).

Based on the results of the literature review and contextual analysis, WSP ecologists Imogen Merlo, Briony Mitchell and Nic McCaffrey conducted field assessments of selected properties within Casey Fields South and Devon Meadows three days: 16 and 21 December 2022, and 14 February 2023.

The site assessments involved ground-truthing and mapping areas of potential habitat for the Southern Brown Bandicoot within the PSP areas and identifying potential threats and dispersal barriers. Potential habitat patches were categorised as High Medium or Low, based on their current capacity to provide habitat to Southern Brown Bandicoot. Habitat patches

were further categorised based on their potential for providing suitable habitat to Southern Brown Bandicoot if habitat enhancement was implemented.

Following receipt of the Melbourne Water DSS alignment, the proposed habitat corridors have been revised to align with the DSS.

The Sub-regional Strategy requires habitat corridors to be placed on non-developable land and align with drainage corridors and open space areas. This presents a significant limitation to preserving high-quality and connected habitat currently present within the Devon Meadows precinct, most of which does not align with non-developable land.

## Results

### LITERATURE REVIEW & CONTEXT ANALYSIS

The Southern Brown Bandicoot (south-eastern mainland sub-species) is listed as Endangered under both the EPBC Act and Flora and Fauna Guarantee Act 1988 (FFG Act). Across its range, the Southern Brown Bandicoot inhabits a variety of habitats including heathland, shrubland, sedgeland and heathy open forest. They show a preference for areas of dense vegetation cover in the understorey and are also found in native bushland and areas dominated by exotic shrubby and grassy vegetation species, with vegetation structure of more importance to the species than specific vegetation species. Suitable habitat generally requires 50-80% vegetation cover in the 0.2-1 m height range (DSEWPaC 2011). In a highly disturbed and modified environment where large tracts of suitable habitat are absent, dense exotic vegetation along drainage channels and roadside verges provides crucial connectivity corridors among populations in the wider area.

Within the local area, a large number of records stems from RBGC, situated within one kilometre to the west of the study area, and further sightings have been recorded in habitat corridors and remnant patches surrounding the Casey Fields South and Devon Meadows precincts. Three Southern Brown Bandicoot habitat corridors connect the study area with RBGC. The long-term viability of the Southern Brown Bandicoot population in the region is likely to rely on the protection and enhancement of habitat, the creation and restoration of habitat connectivity throughout habitat fragments in the local area, and control of introduced predators.

Waterways are particularly important in providing habitat to this species, which has been shown to occur in higher numbers along drainage lines when compared with roadside vegetation or remnant bushland (Bruce et al. 2023). As a dispersal corridor, waterways do not impose the risk of roadkill, and increased noise and light pollution associated with roads and other transport corridors (Bennett 1991). Improving habitat quality along waterways is therefore a key measure for enhancing dispersal corridors for Southern Brown Bandicoot in the local landscape. Artificial structures can also be used to supplement habitat for Southern Brown Bandicoot in areas where suitable shelter may be lacking (Masters, Taylor & Maclagan 2019).

Wildlife crossing structures are important additions into road design in order to reduce the risk and impact of roadkill (Taylor, B. D. & Goldingay 2004). Crossing structures can include land bridges, rope canopy bridges, underpasses or culverts, and in the case of Southern Brown Bandicoot, under-road options are typically favoured among land managers (Taylor, B 2010). The uptake and effectiveness of culverts or underpasses for Southern Brown Bandicoot dispersal depends on a number of factors, including tunnel length, internal visibility and the co-occurrence of wildlife-exclusion fencing (Taylor, B D & Goldingay 2003).

Research supports the uptake of underpasses by bandicoots in Australia, including Southern Brown Bandicoot (Harris, Mills & Bencini 2010; Hayes & Goldingay 2009; Taylor, B D & Goldingay 2003), and rates of roadkill are typically lower at locations where roads include underpasses compared to sections of road without underpasses (Hayes & Goldingay 2009). Pre-existing culverts can sometimes be retro-fitted with fauna passageways by installing substrate for animals to use to cross. Royal Botanic Gardens Cranbourne has seen a significant reduction in roadkill of Southern Brown Bandicoots following the installation of several culverts and wildlife-exclusion fencing along Stringybark Drive (pers. comms Tricia Stewart, RBGC; https://www.abc.net.au/gardening/how-to/wild-cranbourne/13172220). Design features include lightwells along the length of the tunnel, combined with wildlife-exclusion fencing.

The Casey Fields South and Devon Meadows PSP area falls within the Melbourne Strategic Assessment (MSA) area under the federal Biodiversity Conservation Strategy (BCS). As part of the program, the Victorian Government prepared

the Sub-regional Species Strategy for the Southern Brown Bandicoot (the Strategy) (DEPI 2014) and Implementation Plan (DELWP 2016), which has implications for adjacent developments, Botanic Ridge (not within the current scope) and Devon Meadows. Of the goals outlined in the Strategy, the current development of a PSP for Devon Meadows contributes to maintaining and increasing the extent of available linkages between sub-populations. As part of the development of the Devon Meadows PSP, the VPA must provide for the creation and enhancement of Southern Brown Bandicoot habitat along drainage corridors (shown in Figure 3.3) and, where possible open space areas, in order to support movement of Southern Brown Bandicoot from RBGC into neighbouring suburbs. Landscape design in these areas should create habitat a minimum of 30m wide (wider in the power easement) and the habitat should provide a minimum of 50% average foliage density in the 0.2–1m height range, which aligns with the habitat requirements for Southern Brown Bandicoot as specified in Masters, Taylor and Maclagan (2019).

### FIELD ASSESSMENT

During the field assessments, suitable and potential habitat for Southern Brown Bandicoot was mapped in parcels identified during the scoping stage, noting that permission was not provided to visit all parcels within the study area. The habitat identified throughout the study area was of varying condition, with the habitat classified as high, medium, or low quality depending on vegetation species present, vegetation structure, geographical features, and proximity to other suitable patches of habitat.

All high quality and high potential habitat was located within Devon Meadows, while significant gaps in habitat were identified in Casey Fields South, with the area largely devoid of remnant vegetation. Areas of suitable habitat were further classified according to the potential for habitat enhancement. Key threats for Southern Brown Bandicoot throughout the study area were also identified, including introduced predators, roadkill, high-impact weed, fencing, habitat fragmentation and Bell Miner Associated Dieback (BMAD).

Devon Meadows supports suitable habitat for Southern Brown Bandicoot, including patches of Heathy Woodland, Swamp Scrub and Swampy Riparian Woodland, which are known preferred EVC types for this species. A number of native and exotic flora species were recorded within Devon Meadows which provide suitable habitat structure for Southern Brown Bandicoot. By contrast, Casey Fields South supports little suitable habitat and is considered to have low potential for habitat enhancement. Devon Meadows may support Southern Brown Bandicoot, while Casey Fields South is considered less likely to support Southern Brown Bandicoot habitat, although individuals may move through the area on occasion.

## Design Considerations

### CONSIDERATION OF POLICY REQUIREMENTS

The Commonwealth Government approved urban development in Melbourne's expanded Urban Growth Boundary, on the condition that development is undertaken in accordance with the endorsed program outlined in Delivering Melbourne's Newest Sustainable Communities (program report) (DPCD 2009). The program report outlines the commitments the Victorian Government made to mitigate the impacts of urban development on MNES, including the Southern Brown Bandicoot (DELWP 2016). Under the Sub-regional Species Strategy for Southern Brown Bandicoot and associated Implementation Plan, the Victorian government through DEECA, the Victorian Planning Authority (VPA), Melbourne Water and the City of Casey, will create and enhance habitat within drainage reserves, passive open space reserves and other areas unsuitable for urban development in the Devon Meadows precinct for the Southern Brown Bandicoot and link these areas with the areas of habitat connectivity provided in the Botanic Ridge precinct (DELWP 2016; DEPI 2014a). The Habitat Connectivity Supplement document stipulates that the provision of habitat connectivity will not result in any loss of developable land in the Devon Meadows precinct (DEPI 2014b).

Requirements include:

- Primarily, the Devon Meadows precinct must include enhancement of habitat corridors for Southern Brown Bandicoot along two designated drainage lines (shown in Figure 3.5) and, where possible, open space areas (DELWP 2016). Implementation is the responsibility of DEECA, Melbourne Water and City of Casey.

- Habitat corridors for Southern Brown Bandicoot within Devon Meadows must connect with suitable habitat within adjacent development, Botanic Ridge via suitably-designed culverts.
- Culverts must be installed at internal roads greater than 5m wide planned within Devon Meadows where roads intersect designated Southern Brown Bandicoot habitat corridors, with wider roads requiring a vegetated median strip. Responsible agencies would be City of Casey and Department of Transport and Planning (DTP), and Melbourne Water where roads intersect drainage lines.
- As a new sub-division, Casey Fields South and Devon Meadows PSP must impose a ban on cat ownership within the precinct (DEPI 2014a). Casey City Council would be responsible for implementing the ban.

Monitoring of the success of habitat connectivity will be the responsibility of DEECA (DEPI 2014b).

## RETENTION OF HABITAT

Under the current scenario, the footprint for the DSS and Open Space areas intersects the habitat recommended for retention at 45.1% (Figure 4.3). While some high quality and high potential areas will be retained as a wildlife movement corridor, construction activities are expected to result in the removal of almost all understorey habitat, which will prevent usage by Southern Brown Bandicoots.

Casey Fields South supports little habitat of value for Southern Brown Bandicoot and therefore there are no recommendations for retention within this precinct. Rather, design should focus on enhancement of drainage corridors in line with the concept design.

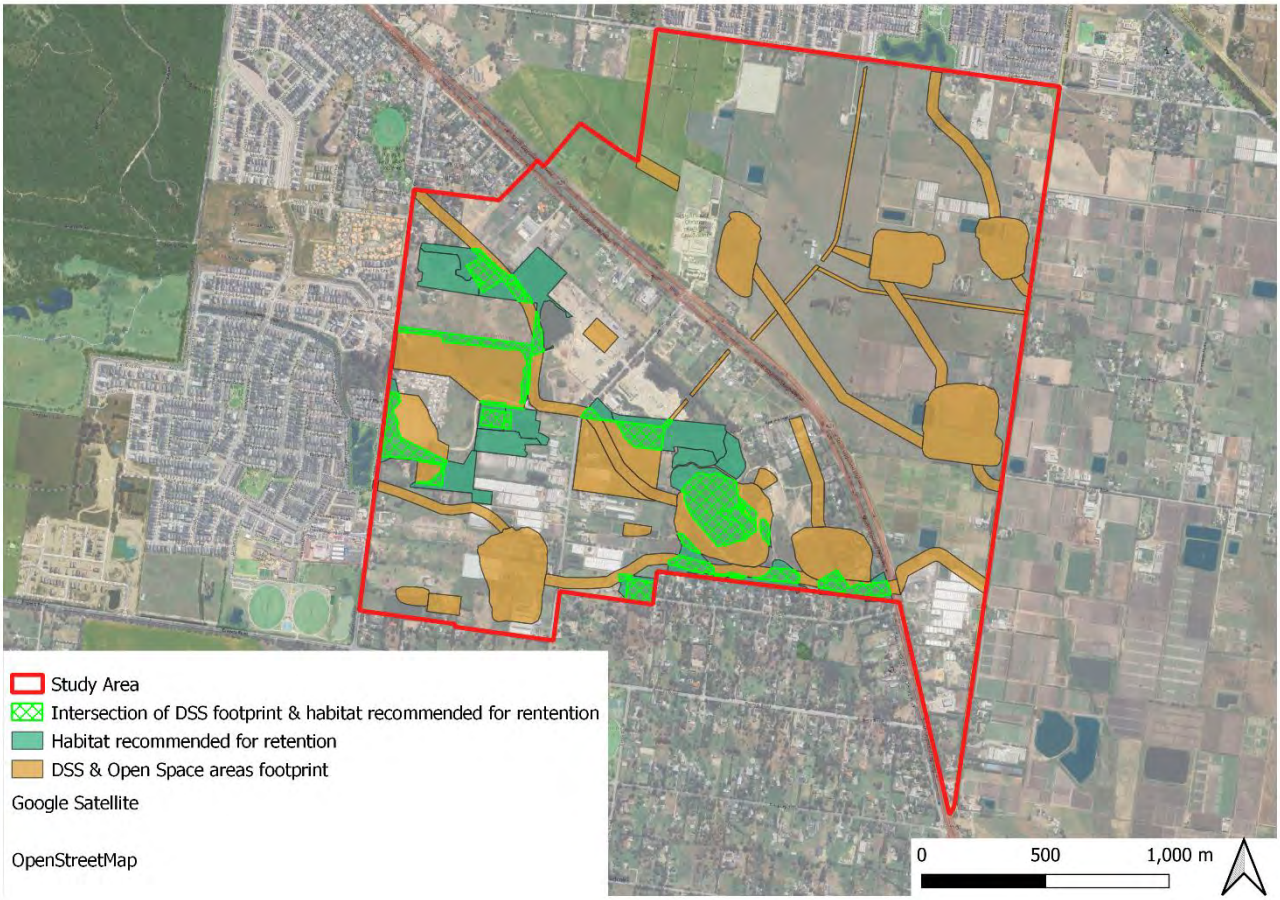



Figure 4.3 Intersection of habitat for retention with current DSS drainage alignment and Open Space areas.

## DESIGN CONSIDERATIONS FOR RETAINED HABITAT & CORRIDORS

Barriers to movement include within the study area that will need to be considered in future planning include:

- Roads (Craig Road, Devon Road, South Gippsland Highway)
- Gaps in connectivity (particularly where gaps are greater than 7m wide)
- Fencing.

Addressing key barriers to removal will require the installation of wildlife crossing structures suitable for ground-dwelling fauna, namely culverts; and enhancing existing habitat to close gaps in connectivity. Culvert design standards are outlined in Section 4.4.1.1.

Permanent wildlife exclusion fencing should be installed to prevent fauna from entering the road, and to funnel fauna towards culvert and underpass entrances. Design specifications for permanent wildlife exclusion fencing are outlined in Section 4.5.1.5.

### CONSIDERATIONS FOR FUTURE URBAN PLANNING & RETAINED HABITAT

Several threats were identified within Devon Meadows and Casey Fields South, which will need to be considered and mitigated in future planning. Threats and controls include:

- Introduced predators such as feral cats and foxes
- Habitat fragmentation
- Roads and vehicle collisions
- Sweet Pittosporum infestation suppressing growth of suitable habitat species in the understorey
- Fencing as a barrier to movement
- Bell Miner Associated Dieback

When addressing weed control, the *Guidelines for best-practice management of modified habitats for Southern Brown Bandicoots* (Masters, Taylor & Maclagan 2019) are to be followed as outlined in Section 4.5.2. In the case of habitat corridors within the study area, it is recommended weed control be undertaken at no more than 10% weed removal below an average of 50% foliage density cover at any given time or in any given area.

## Recommendations

### PRIORITY AREAS FOR CONNECTIVITY

Although the Habitat Connectivity Plan stipulates that habitat and connectivity enhancement is to occur on non-developable land within Devon Meadows, i.e. open space areas and drainage corridors, there is limited overlap between these areas and the highest quality habitat within Devon Meadows (Figure 4.3) with the maximum percentage overlap between DSS and highest quality and highest potential habitat being 45.1%.

While the concept of connecting landscapes for movement of fauna is important in guiding rehabilitation efforts, connectivity should prioritise the retention of potential or known habitat, and under the current scenario, almost 55% of the highest quality and highest potential habitat within Devon Meadows would be lost as it constitutes developable land. When further considering the consequence of removal of understorey habitat to facilitate construction of the drainage corridors, the anticipated reduction in habitat is expected to decimate any population of Southern Brown Bandicoot that may exist in the precinct if construction and habitat removal are not handled with careful consideration of Southern Brown Bandicoot.

The previous version of this report identified high, medium and low priority habitat linkages within the PSP. The updated DSS roughly follows the previously-identified medium priority corridor within Devon Meadows with some overlap of the high priority corridor at the sand quarry at 55 Devon Rd, and 1934 South Gippsland Highway in the south-east corner of the precinct. This alignment captures some of the high-quality habitat available within Devon Meadows precinct, but will result in the loss of high quality habitat at 32-34 Craig Road, Junction Village, and 65, 70 and 75 Devon Road, Devon Meadows.

Importantly the current DSS alignment includes a planned drainage corridor within Devon Meadows precinct which extends to the north-west corner of the precinct where there is no option to connect with suitable habitat within Botanic Ridge Estate. This alignment should be revised to instead connect to the vegetated drainage corridor within Botanic Ridge just south of Bandicoot Boulevard (Figure 5.2). This alternative corridor would provide a connection to potential viable habitat to Southern Brown Bandicoots that may be present within the Botanic Ridge Estate. It is also a requirement under the Sub-regional Species Strategy for Southern Brown Bandicoot to establish two viable habitat linkages between Devon Meadows and Botanic Ridge (DEPI 2014a), while the current DSS alignment would result in only one functional connection. A wildlife underpass will need to be installed at both linkages along Craig Road to establish viable connections between these drainage lines.

Casey Fields South has limited available habitat for Southern Brown Bandicoot, so in this precinct the current DSS alignment and Open Space areas are considered sufficient assuming extensive revegetation efforts are implemented as per Section 5.3.

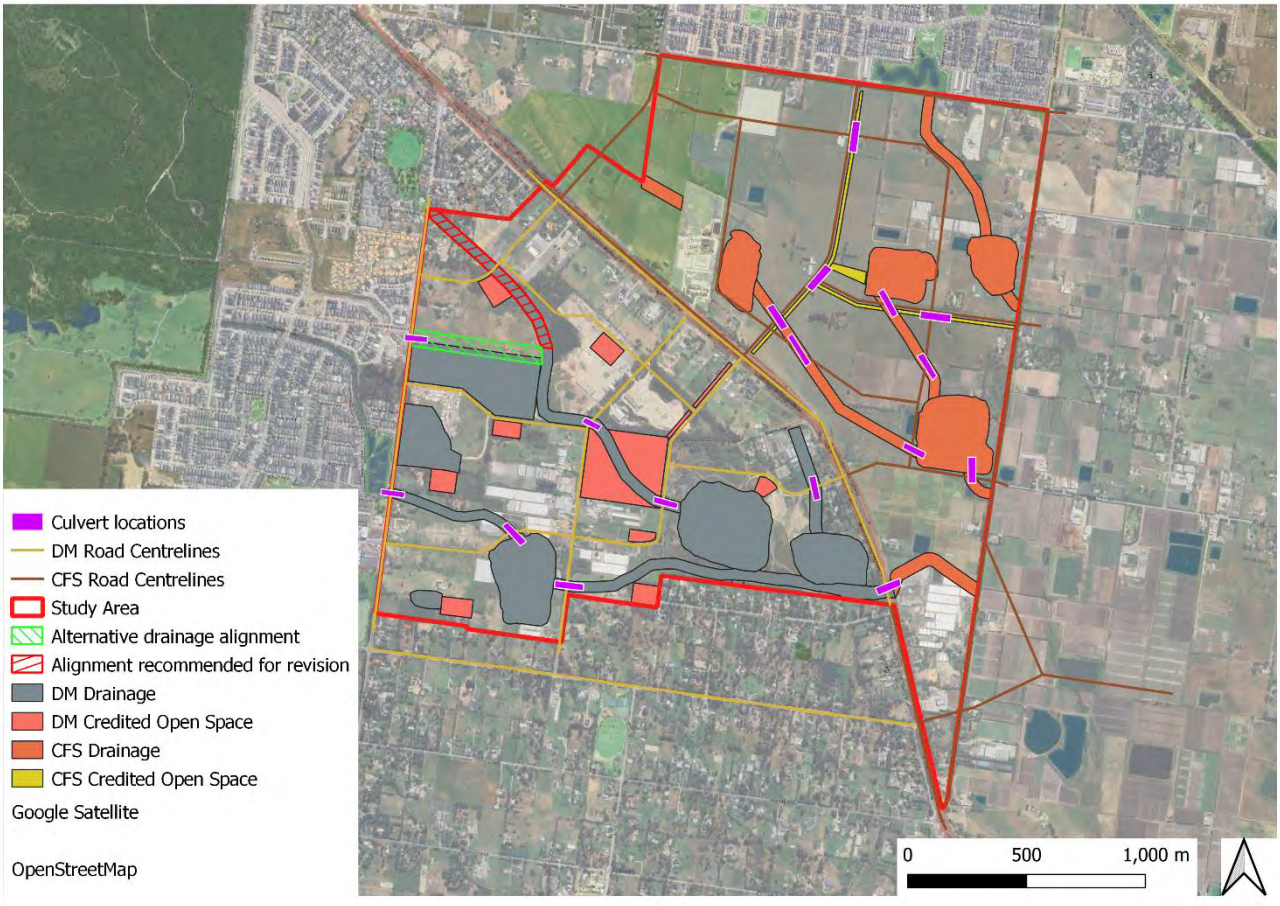



Figure 5.2 Habitat Corridor Priority with proposed linkages to habitat outside of the precinct.

Required wildlife underpass locations are identified in Figure 5.2. Where possible, culverts should be designed to best-practice standards and guided by research, detailed in Section 3.1.4 and where possible include lightwells, as well as associated wildlife-exclusion fencing (as per Figure 3.4). The Department of Transport and Planning, City of Casey and Melbourne Water should be responsible for culvert installation, with VPA responsible for including culverts into design plans. It is recommended that advice on culvert design be sought from RBGC at the design stage.

Where planned roads within Devon Meadows intersect the proposed habitat corridor for Southern Brown Bandicoot, culverts must be installed to mitigate barriers to movement. Section 4.4.1.1 outlines the characteristics of optimal, suitable and incidental crossing structures and how they align with the ecological need at each location shown in Figure 5.1. Where culverts are installed as wildlife underpasses, permanent wildlife exclusion fencing should be installed to prevent fauna from entering the road, and to funnel fauna towards culvert and underpass entrances in line with

specifications listed in Section 4.5.1.5. DEECA would be responsible for funding the construction of dry culverts within Devon Meadows and to connect these areas with Botanic Ridge (DELWP 2016).

### STAGED HABITAT REMOVAL

Current plans to construct the DSS alignment within Devon Meadows and Casey Fields South involve removal of suitable habitat for Southern Brown Bandicoot. Habitat removal must be staged so as to avoid creating gaps in habitat greater than 7m, which would make a habitat linkage unviable to Southern Brown Bandicoot. This is critical when undertaking habitat removal in the understorey in the 0.2-1 m height range.

### REGENERATION AND ENHANCEMENT OF HABITAT

Habitat regeneration should target gaps in connectivity, particularly those greater than 7m wide within the Southern Brown Bandicoot movement corridors. Based on the current DSS scenario, the entire alignment will require habitat regeneration in order to improve the quality of habitat within areas of medium and low quality habitat, while also replacing current high quality habitat that is planned to be lost during construction. Improving floristic structure and density will be critical to promote connectivity across the DSS alignment to facilitate dispersal of Southern Brown Bandicoot from one end of the precinct to the other, and more broadly to promote gene flow across the local landscape. Open Space areas should also be a strong focus for establishing suitable foraging and breeding habitat for Southern Brown Bandicoot.

Where culverts are installed in the landscape it will also be important to enhance habitat quality in those areas to promote use of those corridors and aid dispersal further east in the landscape.

Habitat enhancement should follow key guidelines for enhancing habitat for Southern Brown Bandicoot outlined in Masters, Taylor and Maclagan (2019), and summarised in Section 5.2.

### FURTHER SURVEY

There is an absence of records of Southern Brown Bandicoot within the study area, which is likely due to a lack of survey effort within the precinct. To support design decisions, further targeted surveys within Devon Meadows are recommended if none have yet been undertaken. Information yielded from remote camera trapping and other recommended methods would supplement existing information about the presence, distribution and density of Southern Brown Bandicoot within and surrounding the study area and could in turn inform prioritisation of habitat retention and enhancement.

# 1 Project background

## 1.1 Current Update

The Victorian Planning Authority (VPA) engaged WSP Australia to undertake an update of this report in light of the provision of updated Development Services Scheme (DSS) from Melbourne Water.

The current update incorporates the DSS and current impact footprint into this report.

## 1.2 Original Scope

The VPA engaged WSP Australia to provide qualified experts to assess existing ecological values relating to the Southern Brown Bandicoot within the Casey Fields South and Devon Meadows precincts. The assessment will inform the development of the Devon Meadows and Casey Fields South Precinct Structure Plan (PSP).

The purpose of this study is to assess existing ecological values relating to the Southern Brown Bandicoot within the Devon Meadows and Casey Fields South precincts, and to provide recommendations to support conservation objectives under the Melbourne Strategic Assessment (MSA). The current report addresses opportunities for conservation outcomes within the study area, including:

- The potential for protection and/or enhancement of existing habitat for the Southern Brown Bandicoot; and
- The provision of habitat connectivity corridors that follow drainage and recreational reserves through the Devon Meadows precinct.

## 1.3 Study Area

The study area for this assessment includes the Devon Meadows (~261 ha) and Casey Fields South (~275 ha) precincts as indicated in the Request for Quote (RFQ) COR/22/4570, which are bounded by Ballarto Road to the north, Clyde-Fiveways Road to the east and Craig Road to the west, with South Gippsland Highway running north-west to south-east between the precincts (Figure 1.1). The southern boundary to the study area runs along the backs of existing rural lifestyle lots that front onto Browns and Facey Roads.

A large number of records of Southern Brown Bandicoot stem from Royal Botanic Gardens Cranbourne (RBGC) (see Figure 3.6 in Section 3.2.1), which is situated within one kilometre to the west of the study area, and further sightings have been recorded in habitat corridors and remnant patches surrounding the Casey Fields South and Devon Meadows precincts. Three Southern Brown Bandicoot habitat corridors currently connect the study area with RBGC.

The study area sits within the Extension of the Urban Growth Boundary, within close proximity to the Southern Brown Bandicoot Management Area as designated by the Sub-regional Species Strategy for Southern Brown Bandicoot *Isoodon obesulus obesulus* (DEPI 2014a), and shown in Figure 1.2

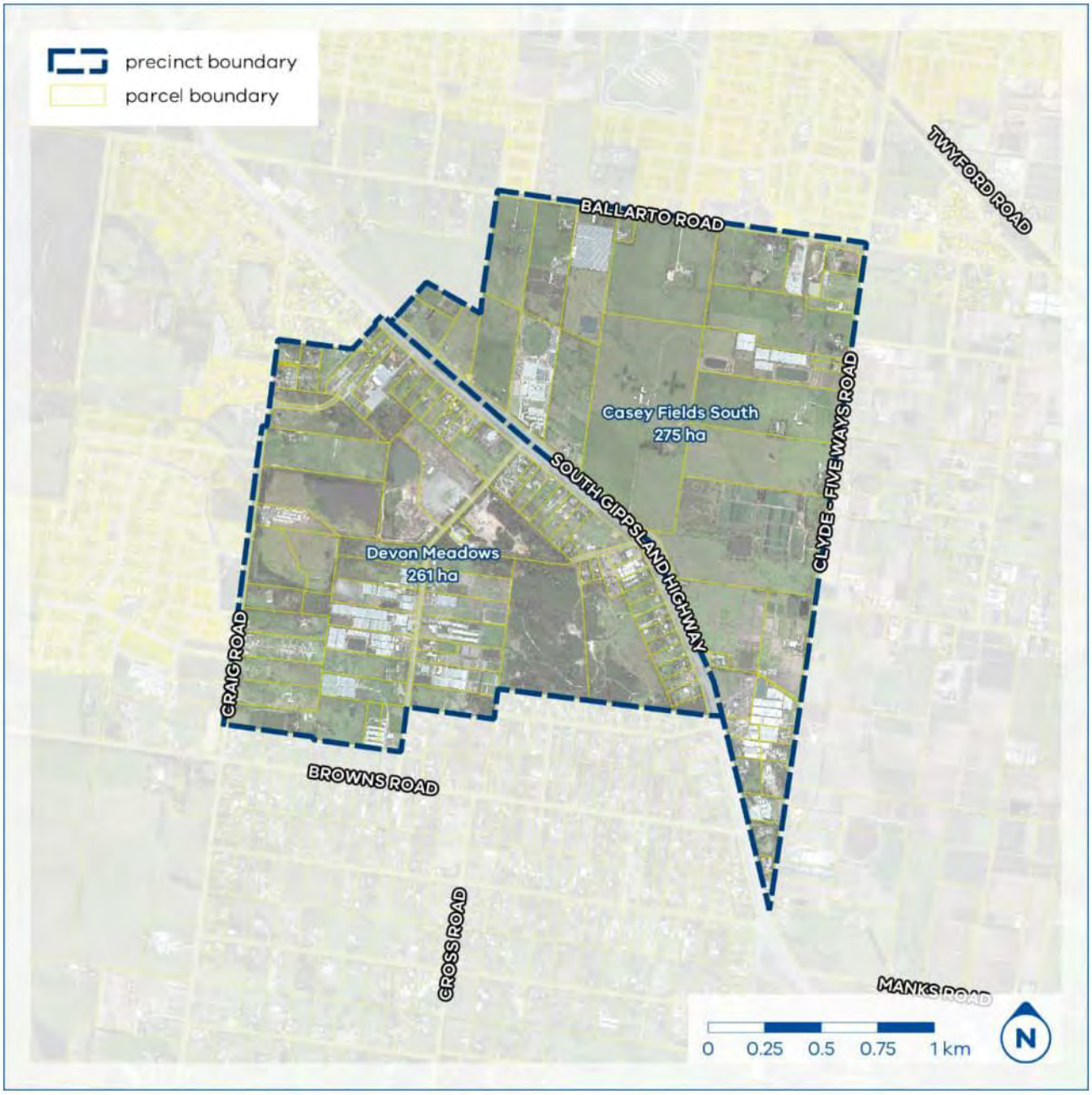



Figure 1.1 Casey Fields South and Devon Meadows precincts (the study area)

## 1.4 Over-arching Project Goals

The project is to be guided by the conservation outcomes of the Sub-regional Strategy for Southern Brown Bandicoot which aims to achieve:

- Functioning sustainable populations within and adjacent to the growth areas, with connectivity between populations
- Protection and enhancement of all populations, including the population at the RBGC.

The primary objectives of the strategy are:

- Prevention of any further local extinctions
- Achievement of a net increase in distribution of occupied habitat

- Achievement of a net increase of overall population size
- Prevent loss of genetic diversity from the metapopulation.

The secondary objectives of the strategy are:

- Greater public awareness of Southern Brown Bandicoot biology, conservation, and its importance in ecosystem function
- Local community support for management actions
- Increase in knowledge of species biology, distribution and management in the sub-region.

The Sub-regional Species Strategy for Southern Brown Bandicoot is guided by a metapopulation approach. According to the Strategy, a metapopulation is a group of spatially distant, interacting subpopulations combined with patches of suitable unoccupied habitat. Individuals and genes are exchanged among populations and connected habitat patches. Immigration of individuals from connected populations and resultant re-colonisation of unoccupied habitat left open by population decline or extinction, stabilises populations and reduces the risk of overall decline or extinction (Practical Ecology 2011). Protecting and enhancing habitat connectivity within the region is therefore critical to the Sub-regional Species Strategy and is consequently emphasised within this project.

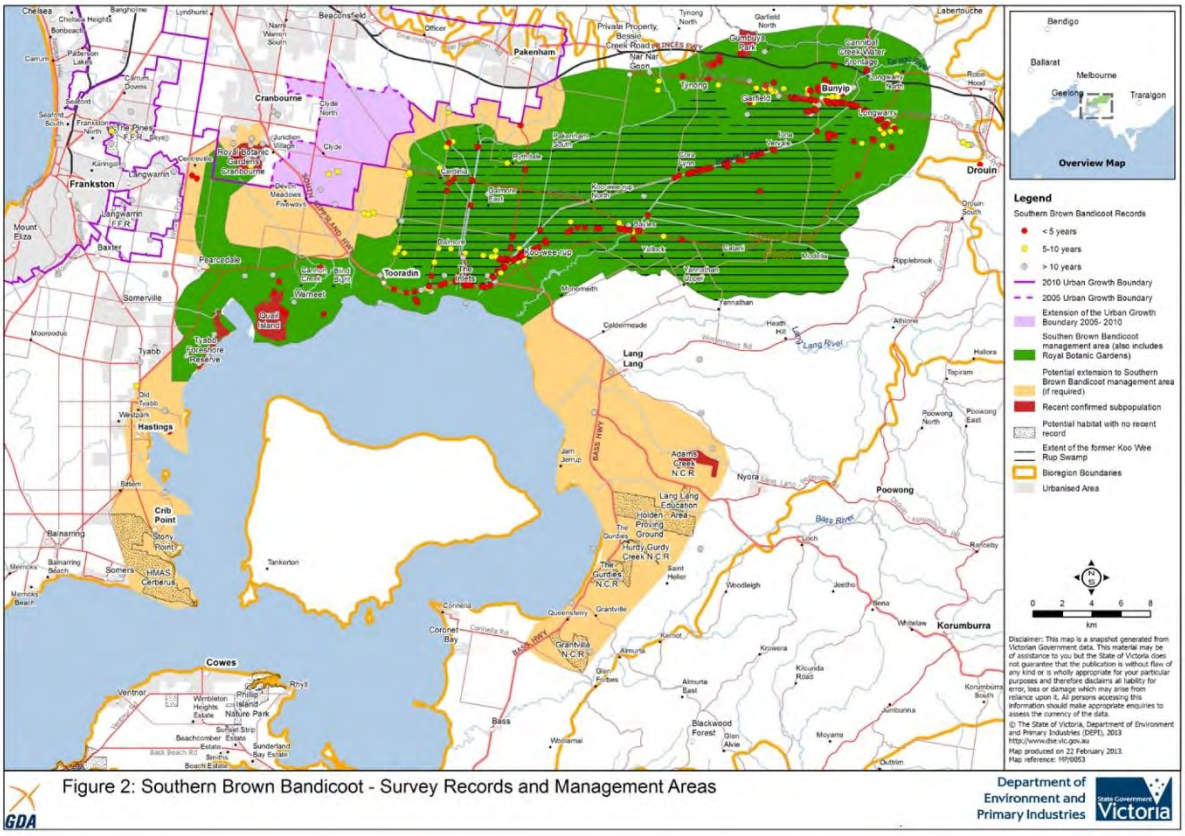



Figure 1.2 Southern Brown Bandicoot Management Area and regional records (DEPI 2014a).

# 2 Methodology

## 2.1 Literature Review & Context Analysis

The first stage of this project was to conduct a literature review and contextual analysis of the study area, detailed in Section 3.1.

The literature review included a review of relevant strategies, plans, technical documentation and aerial photography to:

- Summarise the relevant planning and policy context including the requirements for Southern Brown Bandicoot conservation under the MSA Program, Section 3.1.5.
- Summarise any relevant research and existing spatial data related to conservation of the Southern Brown Bandicoot, Section 3.2.1.
- Summarise any relevant research related to movement preferences of the Southern Brown Bandicoot through manmade infrastructure (e.g., road crossings, culverts, etc.), Section 3.1.4.
- Identify locations for ground-truthing surveys, Section 3.2.1.

The literature review included a review of current literature on the habitat and movement preferences of Southern Brown Bandicoot, and included the following documents:

- Sub-regional Species Strategy for the Southern Brown Bandicoot (DEWLP, 2014).
- Sub-Regional Species Strategy for the Southern Brown Bandicoot – Supplement: habitat connectivity (DEWLP, 2014).
- Implementation Plan for the Southern Brown Bandicoot Sub-Regional Species Strategy (DEWLP, 2016).
- Southern Brown Bandicoot Habitat Protection Strategy & Environmental Significance Overlay (Ecology Australia, 2016, prepared on behalf of Cardinia Shire Council).

## 2.2 Field Assessment

Based on the results of the literature review and contextual analysis, WSP ecologists Imogen Merlo, Briony Mitchell and Nic McCaffrey conducted field assessments of selected properties within Casey Fields South and Devon Meadows over three days: 16 and 21 December 2022, and 14 February 2023.

The site assessments involved ground-truthing and mapping areas of potential habitat for the Southern Brown Bandicoot within the PSP areas and identifying potential threats and dispersal barriers. Potential habitat patches were categorised as High Medium or Low, based on their current capacity to provide habitat to Southern Brown Bandicoot. Habitat patches were further categorised based on their potential for providing suitable habitat to Southern Brown Bandicoot if habitat enhancement was implemented.

Habitat mapping was undertaken in line with understood metrics for Southern Brown Bandicoot, i.e. vegetation structure with 50–80% average foliage density in the 0.2–1 m height range (Masters, Taylor & Maclagan 2019). We note that although parameters used for habitat mapping were specific to Southern Brown Bandicoot, these metrics correlate to suitable habitat for a range of other native ground-dwelling species, such as skinks, snakes, antechinus and native rats, as well as small understorey-dwelling birds.

During the site assessments potential barriers to movement and conservation threats were also recorded, including fencing, pest species, high-impact weeds (e.g. Sweet Pittosporum *Pittosporum undulatum*, a large shrub which inhibits growth in the 0.2–1m understorey).

The purpose of the habitat mapping was to identify areas which could provide a potential movement corridor to Southern Brown Bandicoot and to inform suitable recommendations to improve connectivity such as:

- Areas of existing ecological value within corridors and existing habitat (e.g. heathy woodland) that could be retained and incorporated into the future urban structure.
- Highly modified areas of low ecological value that may be suitable for regeneration/enhancement.
- Any considerations that may influence the design and/or delivery of habitat areas or corridors (e.g., width of corridors, planting density, lighting, fencing, etc.).
- Consideration of how the future urban structure could be designed to minimise impacts to connectivity.
- Considerations relating to the design of road crossings, culverts (e.g., height/length and exposed light within culverts, planting at culvert entrances), or other necessary infrastructure.
- Any management or implementation measures that may assist in avoiding or mitigating potentially adverse effects on ecological values in the study area.
- Consideration into who will be the land managers (e.g., Melbourne Water, Council, DEECA) to create, enhance and maintain the habitat corridors to a standard to encourage a healthy Southern Brown Bandicoot population.
- How Devon Meadows PSP will achieve habitat connectivity requirements outlined in the Sub-regional Species Strategy for Southern Brown Bandicoot - Habitat Connectivity.

## 2.3 Update to Include DSS

Following receipt of the Melbourne Water DSS alignment, the proposed habitat corridors have been revised to align with the DSS.

## 2.4 Limitations

As the study area includes many parcels of land, it was considered impractical and not necessary to cover the entire area on-ground. The approach to this assessment therefore included a review of aerial photography and current site information in order to inform where to target the field assessment within Devon Meadows and Casey Fields South. Given the need to make decisions from aerial information, it is possible that suitable habitat or habitat with high potential were missed during the field assessment based on limitations and dates of aerial photography.

The on-ground assessments were limited by access and not all landholders within the Devon Meadows and Casey Fields South PSP area provided permission to access to their land during the site assessments. In cases where suitable habitat was identified during the desktop assessment within parcels that did not permit access, over-the-fence assessments were conducted where possible. However, these assessments are limited by aerial photography available and habitat that is visible from roadsides/through fences. Assumptions have been made about the suitability of habitat in some cases based on visible habitat, adjacent habitat and aerial photography.

On-ground assessments were conducted in December 2022 and February 2023, which was considered suitable timing to ascertain suitability of habitat potential for Southern Brown Bandicoot, which is dependent primarily on structure rather than species composition, so it was not critical to pick up seasonally-detectable flora species.

The Sub-regional Strategy requires habitat corridors to be placed on non-developable land and align with drainage corridors and open space areas. This presents a significant limitation to preserving high-quality and connected habitat currently present within the Devon Meadows precinct, most of which does not align with non-developable land.

# 3 Results

## 3.1 Literature Review & Context Analysis

### *3.1.1 Southern Brown Bandicoot ecology & range*

The Southern Brown Bandicoot (south-eastern mainland sub-species) is listed as Endangered under both the EPBC Act and *Flora and Fauna Guarantee Act 1988* (FFG Act). Across its range, the Southern Brown Bandicoot inhabits a variety of habitats including heathland, shrubland, sedgeland and heathy open forest. In Victoria, it is restricted largely to coastal areas. Within these vegetation types they show a preference for areas of dense vegetation cover in the understorey and are also found in native bushland and areas dominated by exotic shrubby and grassy vegetation species, with vegetation structure of more importance to Southern Brown Bandicoot than specific vegetation species. Eucalyptus and Banksia assemblages with a dense understorey under 2m in height are considered optimal habitat for Southern Brown Bandicoot (DoE 2018). Suitable habitat generally requires 50-80% vegetation cover in the 0.2-1 m height range (DSEWPaC 2011). Southern Brown Bandicoots have a home range of 0.5 to 5.3 ha, which can fluctuate with the availability of food resources, age of the individual, and the landscape habitat matrix (Haby & Long 2005). Interestingly, in comparisons of novel and remnant habitats, Maclagan, S, Coates and Ritchie (2018) found that novel sites (narrow linear strips of vegetation along linear infrastructure) supported higher abundances of Southern Brown Bandicoot than remnant sites, with body condition relatively consistent across sites, highlighting the importance of retaining structural habitat elements and connectivity within the landscape.

In a highly disturbed and modified environment where large tracts of suitable habitat are absent, dense exotic vegetation along drainage channels and roadside verges provides crucial connectivity corridors among populations in the wider area. The Southern Brown Bandicoot will use dense cover provided by weeds such as thickets of Common Blackberry **Rubus anglocandicans* particularly around waterways and drainage lines (Schmidt, Quin & McMahon 2015). The species is known to inhabit drains and roadside vegetation along including extensive stands of dense thickets of weeds such as Common Blackberry, Flax-leaf Broom **Genista linifolia* and Toowoomba Canary-grass **Phalaris aquatica* and native vegetation including Swamp Scrub dominated by Swamp Paperbark *Melaleuca ericifolia*.

Within the local area, a large number of records stems from RBGC, situated within one kilometre to the west of the study area, and further sightings have been recorded in habitat corridors and remnant patches surrounding the Casey Fields South and Devon Meadows precincts. It is estimated that the RBGC supports a population of 400-500 Southern Brown Bandicoots. Three Southern Brown Bandicoot habitat corridors connect the study area with RBGC. Although RGBC is bounded by a large predator-proof fence, young Southern Brown Bandicoots have been known to pass through the fence and disperse into the local landscape (DEPI 2014a). Populations of Southern Brown Bandicoot inhabiting the RBGC may be acting as a metapopulation, provided there is dispersal occurring between patches of vegetation within local sites. The long-term viability of the Southern Brown Bandicoot population in the region is likely to rely on the protection and enhancement of habitat, the creation and restoration of habitat connectivity throughout habitat fragments in the local area, and control of introduced predators.

Both narrow linear corridors and the broader fragmented matrix have been shown to be important to dispersal of Southern Brown Bandicoot in local populations (Maclagan, SJ et al. 2020). In a study examining functional connectivity in closely-related species Northern Brown Bandicoot *Isoodon macrourus*, the species' presence is positively correlated to the connectedness of habitat within landscapes (FitzGibbon, Putland & Goldizen 2007). Habitat connectivity is therefore considered critical to the viability of local populations of Southern Brown Bandicoot.

### *3.1.2 Habitat enhancement*

Given that Southern Brown Bandicoot can persist in novel habitats and are largely constrained by connectivity in the landscape, it is critical to protect and enhance existing habitat linkages, while removing and minimising the impact of any barriers to dispersal within the landscape. Gaps in suitable habitat greater than 7m are understood to hinder movements in

Southern Brown Bandicoot (Masters, Taylor & Maclagan 2019). Without protection and enhancement of dispersal corridors, local populations of Southern Brown Bandicoot are at risk of loss of genetic diversity and local extinctions (Maclagan, S, Coates & Ritchie 2018). Waterways are particularly important in providing habitat to this species, which has been shown to occur in higher numbers along drainage lines when compared with roadside vegetation or remnant bushland (Bruce et al. 2023). As a dispersal corridor, waterways do not impose the risk of roadkill, and increased noise and light pollution associated with roads and other transport corridors (Bennett 1991). Improving habitat quality along waterways is therefore a key measure for enhancing dispersal corridors for Southern Brown Bandicoot in the local landscape.

Southern Brown Bandicoots are known to use several Ecological Vegetation Classes (EVCs), and habitat enhancement should aim to restore gaps in connectivity and enhance existing habitat to align with the following EVCs depending on what is supported by the study area, with reference to likely pre-1750 native vegetation modelling:

- Swamp Scrub (EVC 53) – example species: Swamp Paperback *Melaleuca ericifolia*, Prickly Currant-bush *Coprosma quadrifida*, Prickly Tea-tree *Leptospermum continentale*, Common Tussock Grass *Poa labillardierei*.
- Swampy Riparian Woodland (EVC 83) – example species: Swamp Gum *Eucalyptus ovata*, Sweet Bursaria *Bursaria spinosa*, Tall Sedge *Carex appressa*.
- Lowland Forest (EVC 16) – example species: Blackwood *Acacia melanoxylon*, Swamp Goodenia *Goodenia ovata*, Spiny-headed Mat-rush *Lomandra longifolia*.
- Damp Heathy Woodland (EVC 793) – example species: Silver Banksia *Banksia marginata*, Swamp Goodenia *Goodenia ovata*, Prickly Tea-tree *Leptospermum continentale*.

Artificial structures can be used to supplement habitat for Southern Brown Bandicoot in areas where suitable shelter may be lacking (Masters, Taylor & Maclagan 2019). Figure 3.3 shows demonstrates the design of a Southern Brown Bandicoot hide (Masters, Taylor & Maclagan 2019).

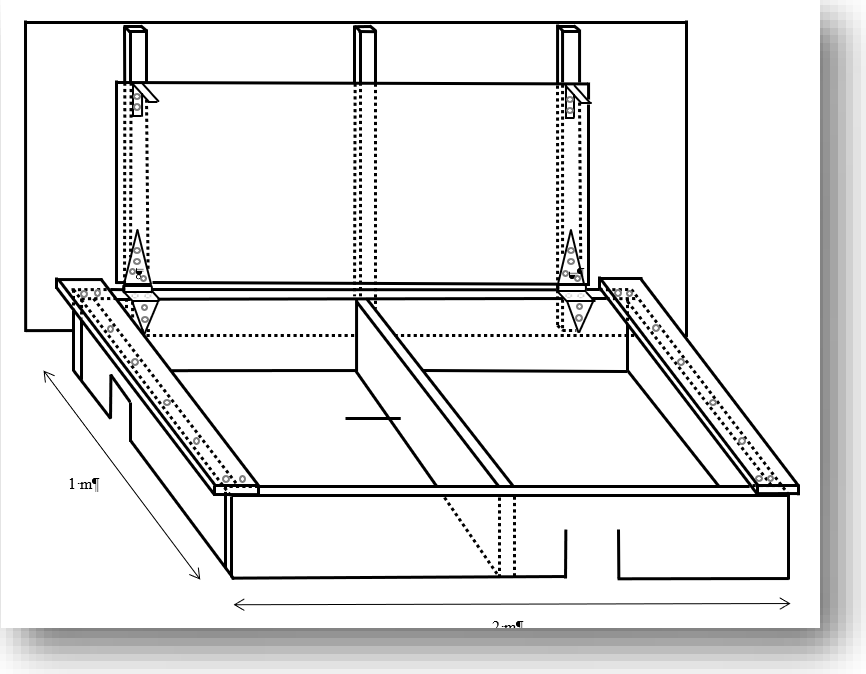



Figure 3.1 Artificial shelter (hide) – plan with dimensions (Masters, Taylor & Maclagan 2019)

### 3.1.3 Habitat Corridors

An evaluation of corridor width, buffer widths and edge effects was undertaken by Practical Ecology (2010) for the then-proposed Botanic Ridge Stage 3. Whilst this assessment evaluated various fauna species for the design of habitat corridors, the concepts of ecologically sustainable reserve design are relevant to this study. Figure 3.2 shows an optimal layout of a reserve in context with urban landscapes which enhances public interface, reduces management issues with houses backing onto bushland and allows for better access for management.

Southern Brown Bandicoots have been found persisting in narrow linear corridors (Maclagan, SJ et al. 2020), particularly where there is a broader population matrix. However, Masters, Taylor and Maclagan (2019) stated corridors should be as wide as possible to maximise habitat potential. This is particularly important where the Southern Brown Bandicoot population may not currently be present or is in lower numbers, as expected in the study area. As such, habitat corridors should be 30 metres or greater, as suggested in (Masters, Taylor & Maclagan 2019). Ideally this would be the 'core area' as above with buffer areas either side.

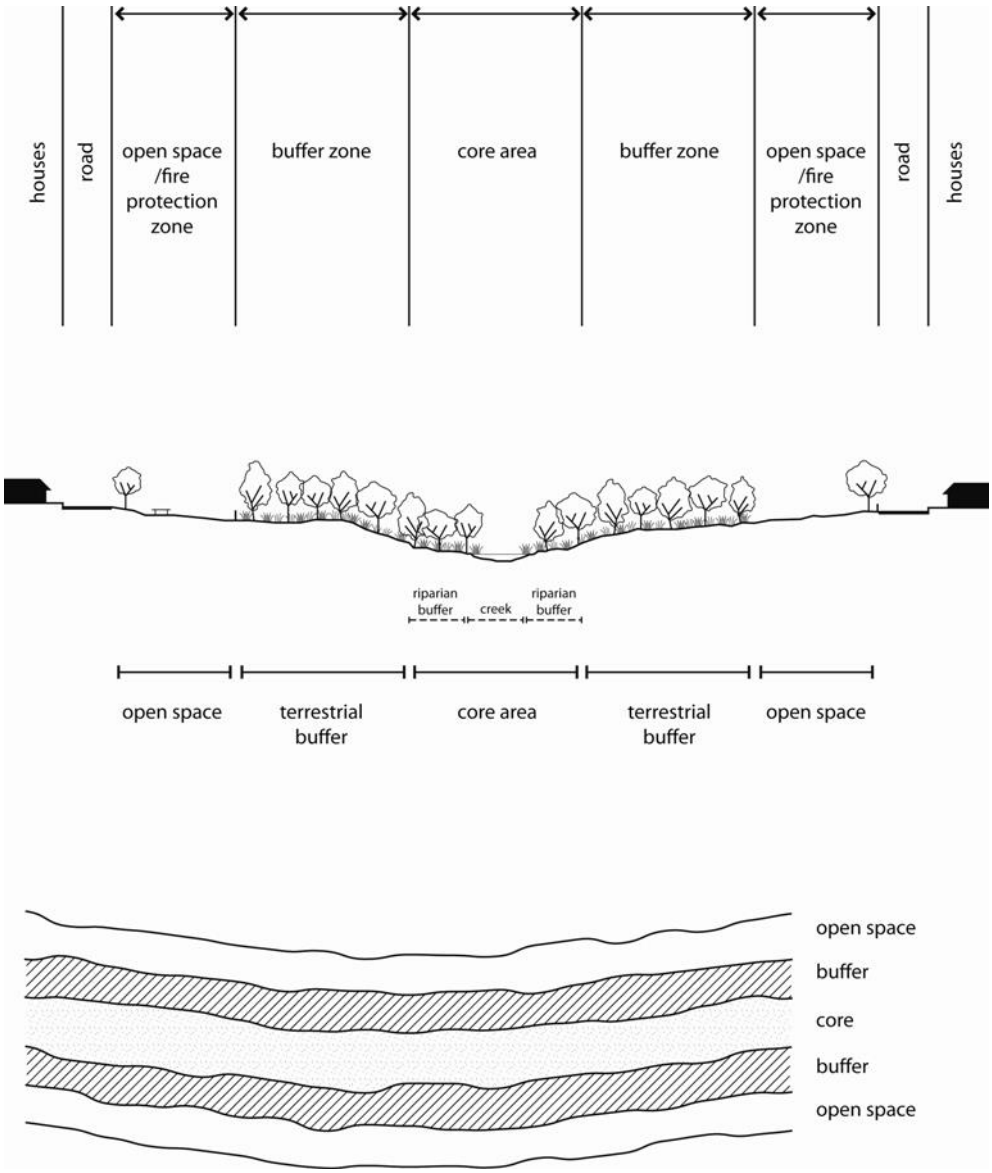



Figure 3.2 Indicative cross section profile of a riparian corridor in Botanic Ridge (extract from Practical Ecology (2010))

### 3.1.4 *Movement preferences of Southern Brown Bandicoot through man-made infrastructure*

Development of transport corridors such as roads and railways causes widespread detriments to native fauna, with impacts ranging from direct removal of suitable habitat, roadkill and physical barriers within the landscape to indirect impacts such as reduction in connectivity, and increased noise and light pollution (Bennett 1991; Hayes & Goldingay 2009; Taylor, B 2010). Wildlife crossing structures are important additions into road design in order to reduce the risk and impact of roadkill (Taylor, B. D. & Goldingay 2004). Crossing structures can include land bridges, rope canopy bridges, underpasses or culverts, and in the case of Southern Brown Bandicoot, under-road options are typically favoured among land managers (Taylor, B 2010). While drainage culverts are typically designed primarily to convey water flows beneath the road, when considered carefully at the planning stage, they can also present an opportunity to install fauna crossing structures designed to facilitate fauna species like Southern Brown Bandicoot to safely cross roads. Culverts and underpasses are regularly recommended to mitigate impacts of transport corridors to native fauna species, particularly in the northern hemisphere, and have become increasingly common practice as a mitigation measure in Australia over the last 20 years (Taylor, B D & Goldingay 2003). The uptake and effectiveness of culverts or underpasses for Southern Brown Bandicoot dispersal depends on a number of factors, including tunnel length, internal visibility and the co-occurrence of wildlife-exclusion fencing (Taylor, B D & Goldingay 2003).

Research supports the uptake of underpasses by bandicoots in Australia, including Southern Brown Bandicoot (Harris, Mills & Bencini 2010; Hayes & Goldingay 2009; Taylor, B D & Goldingay 2003), and rates of roadkill are typically lower at locations where roads include underpasses compared to sections of road without underpasses (Hayes & Goldingay 2009). Southern Brown Bandicoots and related species have been shown to have higher uptake of underpasses where they are shorter, with the use of road islands as an intermediary between culverts providing more benefit than simply extending the length of culverts (Chambers & Bencini 2015; Taylor, B D & Goldingay 2014). Harris, Mills and Bencini (2010) examined use of three underpasses by Southern Brown Bandicoots following the construction of a highway which divided bandicoot-occupied habitat in Perth, Western Australia. The study found that Southern Brown Bandicoots utilised the underpasses with a total of 278 passes by 8 individuals over a 12-month period, with a dramatic decline in use coinciding with a European Foxes *Vulpes vulpes* building a den near the opening of one of the underpasses and presumably predating on bandicoots in the area. Design of crossing structures should therefore consider density of introduced predators within the landscape and include safety measures such as lightwells in crossing structures to minimise predation risk.

In cases where culverts are already present under roadways, these can sometimes be retro-fitted with fauna passageways by installing suitable substrate for animals to use to cross. Natural substrates like native vegetation, small rocks and logs are known to be more effective in encouraging movement than non-natural substrates like smooth concrete. For culverts to provide effective passageway to Southern Brown Bandicoot and other small terrestrial fauna, they must support the following features:

- A flat, dry substrate, for instance, ramped elevated walkways above the high flood mark where culverts are regularly inundated,
- Shelter from introduced predators,
- Design that funnels target species towards the culvert entrance, including deterrents to prevent animals from accessing the roadway, and
- Accessible design.

Royal Botanic Gardens Cranbourne has seen a significant reduction in roadkill of Southern Brown Bandicoots following the installation of several culverts and wildlife-exclusion fencing along Stringybark Drive (pers. comms Tricia Stewart, RBGC; https://www.abc.net.au/gardening/how-to/wild-cranbourne/13172220). An important aspect of the culvert design is the inclusion of lightwells along the length of the tunnel, which promotes utilisation by bandicoots as lightwells improve visibility, allowing bandicoots to see the other side of the underpass, improving detection of predators (Figure 3.3). An added benefit of the lightwells is that increased airflow through the tunnels reduces bacterial growth. The

roadkill reduction strategy implemented by RBGC also includes installation of wildlife-exclusion fencing (Figure 3.4), which has been designed with several features to improve its effectiveness:

- The fencing is black, which deters wildlife from expending energy seeking passage through.
- The fence includes a habitat-facing floppy overhang which inhibits animals from climbing over.
- Several one-way gates have been included into the fence design to allow animals trapped in the roadway to exit safely.

Figure 3.3 Culvert underpass design implemented at RBGC (left), with Southern Brown Bandicoot shown using the culvert (right).

Figure 3.4 Culvert installed at RBGC (left) with lightwells visible in the roof of the culvert. Wildlife-exclusion fencing (right), which includes habitat-facing floppy overhang to deter wildlife from crossing.

Road escape ramps are another method of reducing rates of roadkill, and have been shown to be used by Northern Brown Bandicoot, but more evidence is needed to demonstrate their necessity on Australian roads (Goldingay et al. 2018), therefore culverts are the preferred method of wildlife crossing, except in cases where escape ramps serve as a safeguard for wildlife trapped between the road and wildlife-exclusion fencing.

### *3.1.5 Planning and Policy Requirements under the MSA*

The Casey Fields South and Devon Meadows PSP area falls within the Melbourne Strategic Assessment (MSA) area under the federal Biodiversity Conservation Strategy (BCS). The MSA program was created to streamline environmental approvals for development applications in areas of rapid population growth in Melbourne (DELWP 2016). The program report outlines the commitments the Victorian Government made to mitigate the impacts of urban development on Matters of National Environmental Significance (MNES), including the Southern Brown Bandicoot.

As part of the program, the Victorian Government prepared the Sub-regional Species Strategy for the Southern Brown Bandicoot (the Strategy) (DEPI 2014a). The purpose of the sub-regional strategy is to:

- ensure functioning sustainable populations within and adjacent to the growth areas, with connectivity between populations, and
- protect and enhance all Southern Brown Bandicoot populations, including the population at the Royal Botanic Gardens Victoria's Cranbourne Gardens (RBGC).

The Strategy has implications for adjacent developments, Botanic Ridge (not within the current scope) and Devon Meadows. Of the goals outlined in the Strategy, the current development of a PSP for Devon Meadows contributes to maintaining and increasing the extent of available linkages between sub-populations.

The development of an Implementation Plan for the Southern Brown Bandicoot Sub-regional Species Strategy (Implementation Plan) by DEECA was a requirement under the approved Sub-regional Species Strategy for Southern Brown Bandicoot, and has since been developed (DELWP 2016). The Strategy and the Implementation Plan focus on the Southern Brown Bandicoot Management Area (management area). The management area is approximately 60,000 ha and includes the RBGC and the habitat connectivity corridors in Botanic Ridge and Devon Meadows, the latter of which forms part of the study area via two Melbourne Water drainage corridors.

As part of the development of the Devon Meadows PSP, the VPA must provide for the creation and enhancement of Southern Brown Bandicoot habitat along drainage corridors (shown in

Figure 4.2) and, where possible open space areas, in order to support movement of Southern Brown Bandicoot from RBGC into neighbouring suburbs. Developers within Devon Meadows will be responsible for developing a landscape plan for each of the corridors in consultation with the relevant authorities to detail the revegetation and landscaping specifications for Southern Brown Bandicoot habitat. Landscape design in these areas should create habitat a minimum of 30m wide and the habitat should provide a minimum of 50% average foliage density in the 0.2–1m height range. This specification aligns with the habitat requirements for Southern Brown Bandicoot as specified in Masters, Taylor and Maclagan (2019). Habitat enhancement must support drainage capabilities of the drainage corridors and must not increase the fire risk.

In order to mitigate roadkill risk and support movement of Southern Brown Bandicoot within the development area, the plan has also detailed requirements for internal roads:

- construction and maintenance of culverts on roads greater than 5m wide
- large vegetated median strips on wide roads
- appropriate speed limits or speed abatement devices in areas running through Southern Brown Bandicoot habitat.

Implementation of provisions related to road construction will be the responsibility of developers, City of Casey and VicRoads.

The Implementation Plan designates that priority acquisition may be suitable for parcels of land which provide habitat and/or key connectivity between habitat areas. These would be voluntary sales, acquired for the reserve system and managed by Parks Victoria or as local reserves owned and managed by local government, secured through an on-title permanent protection agreement.

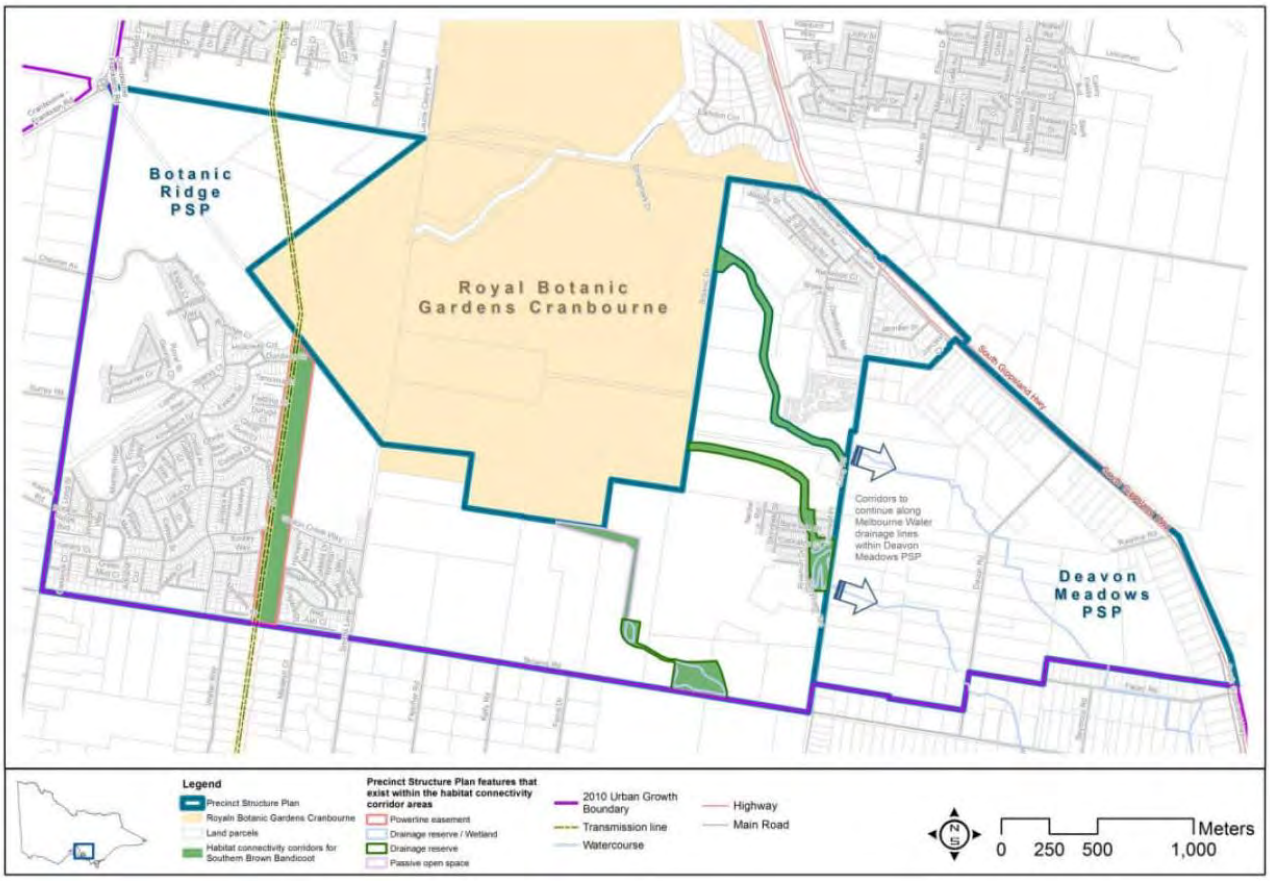



Figure 3.5 Drainage lines within Devon Meadows earmarked for habitat enhancement to provide habitat corridors for Southern Brown Bandicoot (DELWP 2016).

## 3.2 Field Assessment

Review of the Sub-regional Species Strategy and supplementary documents, as well as current literature formed the basis of where field assessments were located.

Potential habitat for Southern Brown Bandicoot was identified during the scoping stage, noting that permission was not provided to visit all parcels within the study area. During the field assessments, 31.36 hectares of high quality Southern Brown Bandicoot habitat was identified within Devon Meadows, alongside 9.84 hectares of habitat considered to have high potential for enhancement. The habitat identified throughout the study area was of varying condition, with the habitat classified as High, Medium, or Low quality depending on vegetation species present, vegetation structure, geographical features, and proximity to other suitable patches of habitat (Figure 3.6). Areas of suitable habitat were further classified according to the potential for habitat enhancement.

All high quality and high potential habitat was located within Devon Meadows, as was anticipated following a review of aerial photography. Significant gaps in habitat were identified in Casey Fields South, with the area largely devoid of remnant vegetation. Design recommendations to enhance priority areas (namely drainage corridors) in Casey Fields South are outlined in Section 5.1.

Key threats for Southern Brown Bandicoot throughout the study area were also identified during the field assessment. These include direct threats through mortality, indirect impacts through declining habitat quality, and barriers to dispersal throughout the wider area. The primary threats identified are listed below, with further detail provided in Section 4.4:

- Introduced predators: cats and foxes
- Roads and vehicle collisions

- Sweet Pittosporum infestations in areas of habitat linkages
- Fencing
- Fragmentation of habitat, such that gaps wider than 7m are present between patches of suitable habitat
- Bell Miner Associated Dieback (BMAD).

The purpose of the field assessment was to categorise the current state and potential of Southern Brown Bandicoot habitat, and therefore did not involve collection of a comprehensive list of flora and fauna.

### 3.2.1 Likelihood of occurrence of Southern Brown Bandicoot within study area

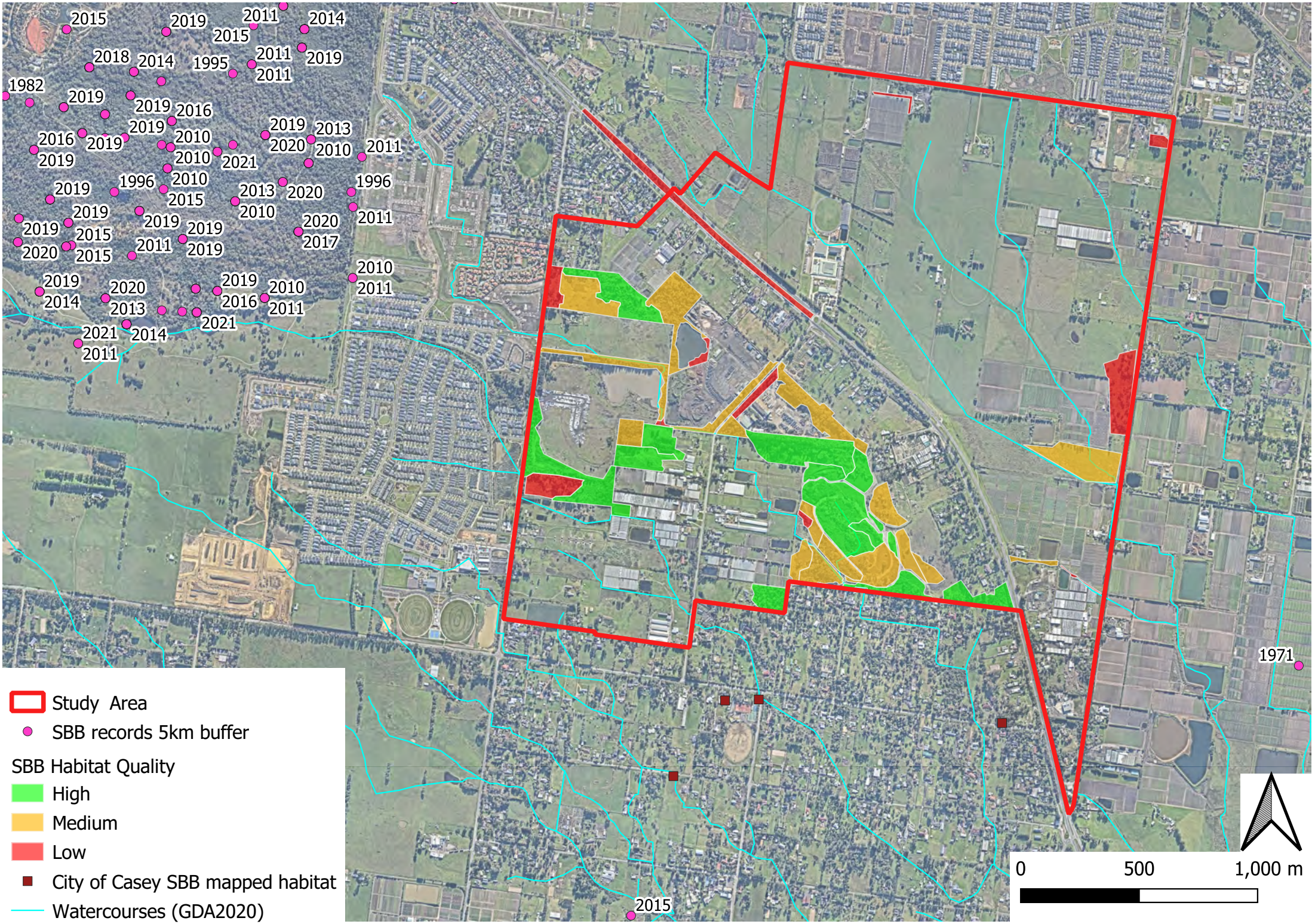
Royal Botanic Gardens Cranbourne contains a high density of records for Southern Brown Bandicoot (Figure 3.6). This is unsurprising given that the gardens support a large population of this species. Nearest records of Southern Brown Bandicoot outside of RBGC include a 2015 sighting approximately 1.5km south of Devon Meadows, bounded by Worthing Road, Cross Road, Craig Road and Olive Road. Other records within the last 20 years include a 2005 and 2006 record within 2km east of Casey Fields South adjacent to Yallambee Road and Derricks Road respectively, with both records occurring nearby existing drainage lines. These records support observations that Southern Brown Bandicoots are dispersing out of RBGC into neighbouring areas, likely along suitable corridors associated with drainage lines and other suitable linkages.

MSA time-stamped data designates effectively all parcels of Devon Meadows and approximately a third of Casey Fields South as Southern Brown Bandicoot habitat, with the scattered trees layer showing high concentrations of scattered trees in areas of Devon Meadows that correspond with higher quality habitat mapped during the field assessments. Tract conducted a Landscape Assessment of Casey Fields South and Devon Meadows, and mapped the density of vegetation within the precincts (Tract 2022). Vegetation density was highest in Devon Meadows compared with Casey Fields South and largely followed existing drainage lines. Areas of high vegetation density roughly correspond to mapped areas of high-quality habitat shown in Figure 3.6.

Devon Meadows supports suitable habitat for Southern Brown Bandicoot, including patches of Heathy Woodland, Swamp Scrub and Swampy Riparian Woodland, which are known preferred EVC types for this species. A number of native and exotic flora species were recorded within Devon Meadows which provide suitable habitat structure for Southern Brown Bandicoot, including Bracken Pteridium esculentum, Thatch Saw-sedge *Gahnia radula*, Swamp Paperbark *Melaleuca ericifolia* Common Blackberry *Rubus fruticosus**, Kikuyu *Cenchrus clandestinus**. Devon Meadows supports large patches of habitat with high and medium suitability with many sections suitable for habitat enhancement (Figure 3.6). By contrast, Casey Fields South supports little suitable habitat and is considered to have low potential for habitat enhancement.

Devon Meadows may support Southern Brown Bandicoot given the site's proximity to Royal Botanic Gardens Cranbourne (Figure 1.2), and suitable habitat that persists within this area. However, gaps in habitat connectivity in the form of roads, fences and cleared land limit the dispersal capacity for Southern Brown Bandicoot in the landscape. Predation pressure from foxes and cats is likely amplified by the gaps in connectivity in Devon Meadows and may inhibit Southern Brown Bandicoot presence or activity in these areas. Drainage lines within Devon Meadows and Casey Fields South are also interrupted and move underground at points, which reduces their current capacity to support movement of Southern Brown Bandicoot.

Casey Fields South also supports some suitable Southern Brown Bandicoot habitat; however, this area is extensively clearly and is largely devoid of suitable linkages to support dispersal, with just small, isolated pockets of mostly weed-dominated potential habitat. As such, it is considered less likely that Casey Fields South would support Southern Brown Bandicoot, although individuals may move through the area on occasion.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1971
2015
Study Area
SBB records 5km buffer
SBB Habitat Quality
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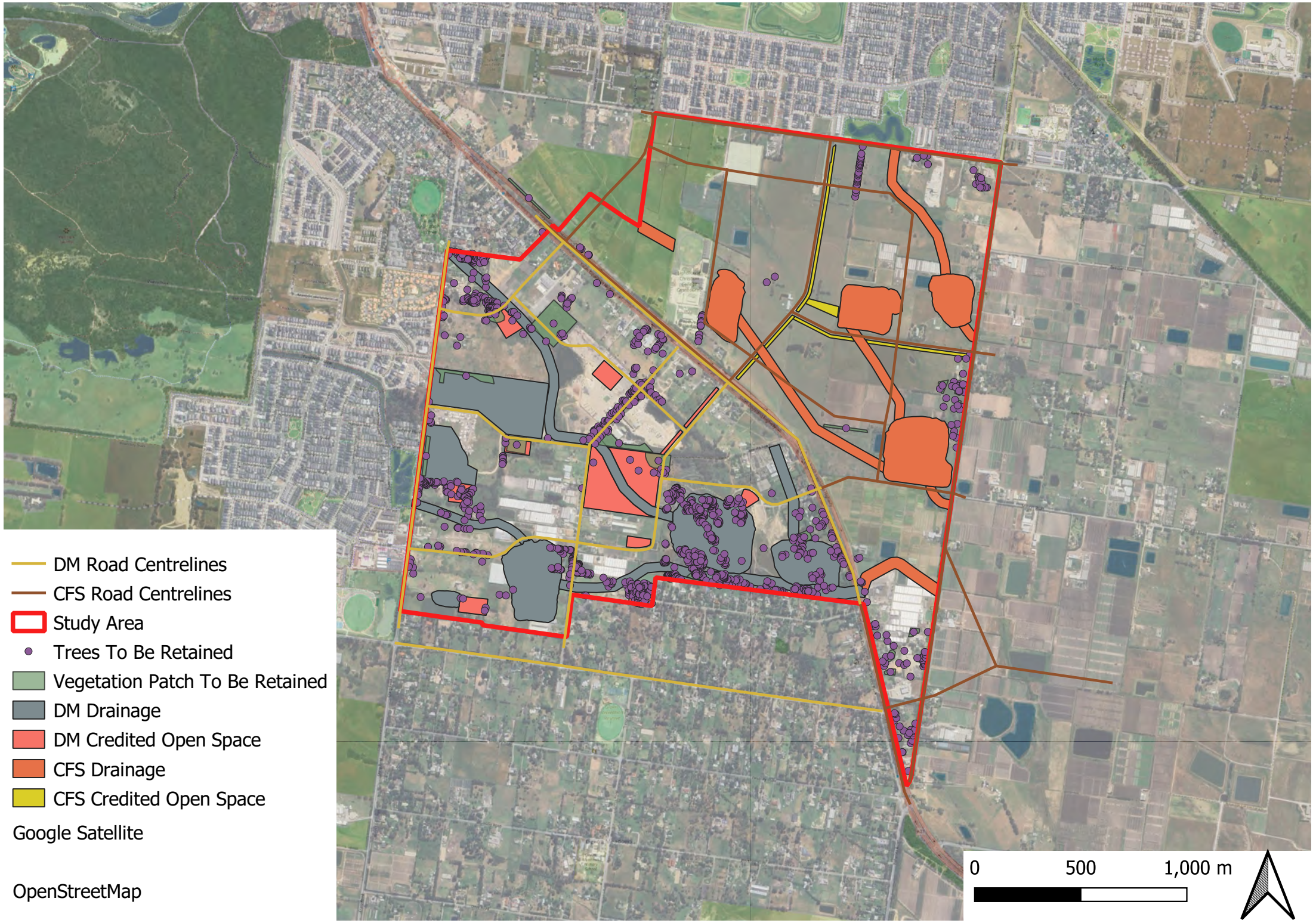
Medium
Low
City of Casey SBB mapped habitat
Watercourses (GDA2020)
0
500
1,000 m

# 4 Design considerations

## 4.1 Current DSS alignment

The current DSS alignment includes three drainage corridors in Casey Fields South, one which transverses the north-east corner of the precinct, another which extends from the west to the centre-east section of the precinct (Figure 4.1). This drainage corridor is interrupted on the western side by a school. There is also an offshoot along this alignment from a planned retarding basin which extends up into the centre of the precinct. Finally, a drainage line in the south-east of the precinct forms an extension of a planned drainage line within Devon Meadows precinct.

In Devon Meadows the DSS alignment includes two primary drainage lines to the north-west and south-west which connect up in the south-east (Figure 4.1). Both precincts include sections of credited Open Space.


DM Road Centrelines
CFS Road Centrelines
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Trees To Be Retained
Vegetation Patch To Be Retained
DM Drainage
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CFS Drainage
CFS Credited Open Space
Google Satellite
OpenStreetMap
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## 4.2 Consideration of policy requirements

The Commonwealth Government approved urban development in Melbourne's expanded Urban Growth Boundary, on the condition that development is undertaken in accordance with the endorsed program outlined in Delivering Melbourne's Newest Sustainable Communities (program report) (DPCD 2009). The program report outlines the commitments the Victorian Government made to mitigate the impacts of urban development on MNES, including the Southern Brown Bandicoot (DELWP 2016). Under the Sub-regional Species Strategy for Southern Brown Bandicoot and associated Implementation Plan, the Victorian government through DEECA, the Victorian Planning Authority (VPA), Melbourne Water and the City of Casey, will create and enhance habitat within drainage reserves, passive open space reserves and other areas unsuitable for urban development in the Devon Meadows precinct for the Southern Brown Bandicoot and link these areas with the areas of habitat connectivity provided in the Botanic Ridge precinct PSP (DELWP 2016; DEPI 2014a). The Habitat Connectivity Supplement document stipulates that the provision of habitat connectivity will not result in any loss of developable land in the Devon Meadows precinct (DEPI 2014b). The concept design for the PSP shows three potential wildlife movement corridors along drainage lines within the study area (

Figure 4.2).

In line with the requirement for habitat enhancement and connectivity, several actions are required for the development of the Casey Fields South and Devon Meadows PSP, including:

- Primarily, the Devon Meadows precinct must include enhancement of habitat corridors for Southern Brown Bandicoot along two designated drainage lines (shown in Figure 3.5) and, where possible, open space areas (DELWP 2016). Implementation is the responsibility of DEECA, Melbourne Water and City of Casey.
- Habitat corridors for Southern Brown Bandicoot within Devon Meadows must connect with suitable habitat within adjacent development, Botanic Ridge via suitably-designed culverts.
- Culverts must be installed at internal roads greater than 5m wide planned within Devon Meadows where roads intersect designated Southern Brown Bandicoot habitat corridors, with wider roads requiring a vegetated median strip. Responsible agencies would be City of Casey and Department of Transport and Planning (DTP), and Melbourne Water where roads intersect drainage lines.
- As a new sub-division, Casey Fields South and Devon Meadows PSP must impose a ban on cat ownership within the precinct (DEPI 2014a). Casey City Council would be responsible for implementing the ban.

Monitoring of the success of habitat connectivity will be the responsibility of DEECA (DEPI 2014b).

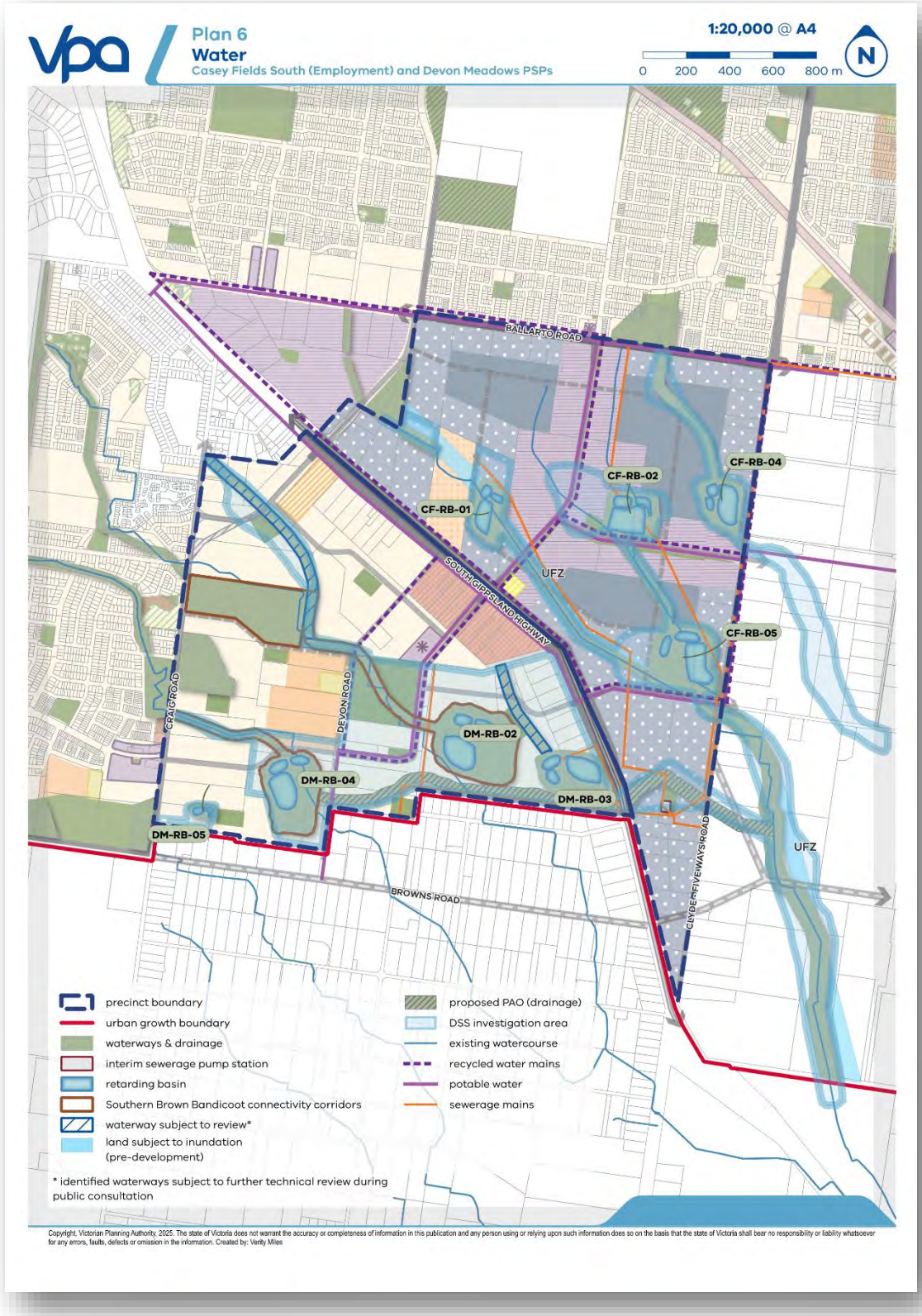



Figure 4.2 Concept design for drainage corridors and wetlands, which coincide with proposed wildlife movement corridors (VPA 2025).

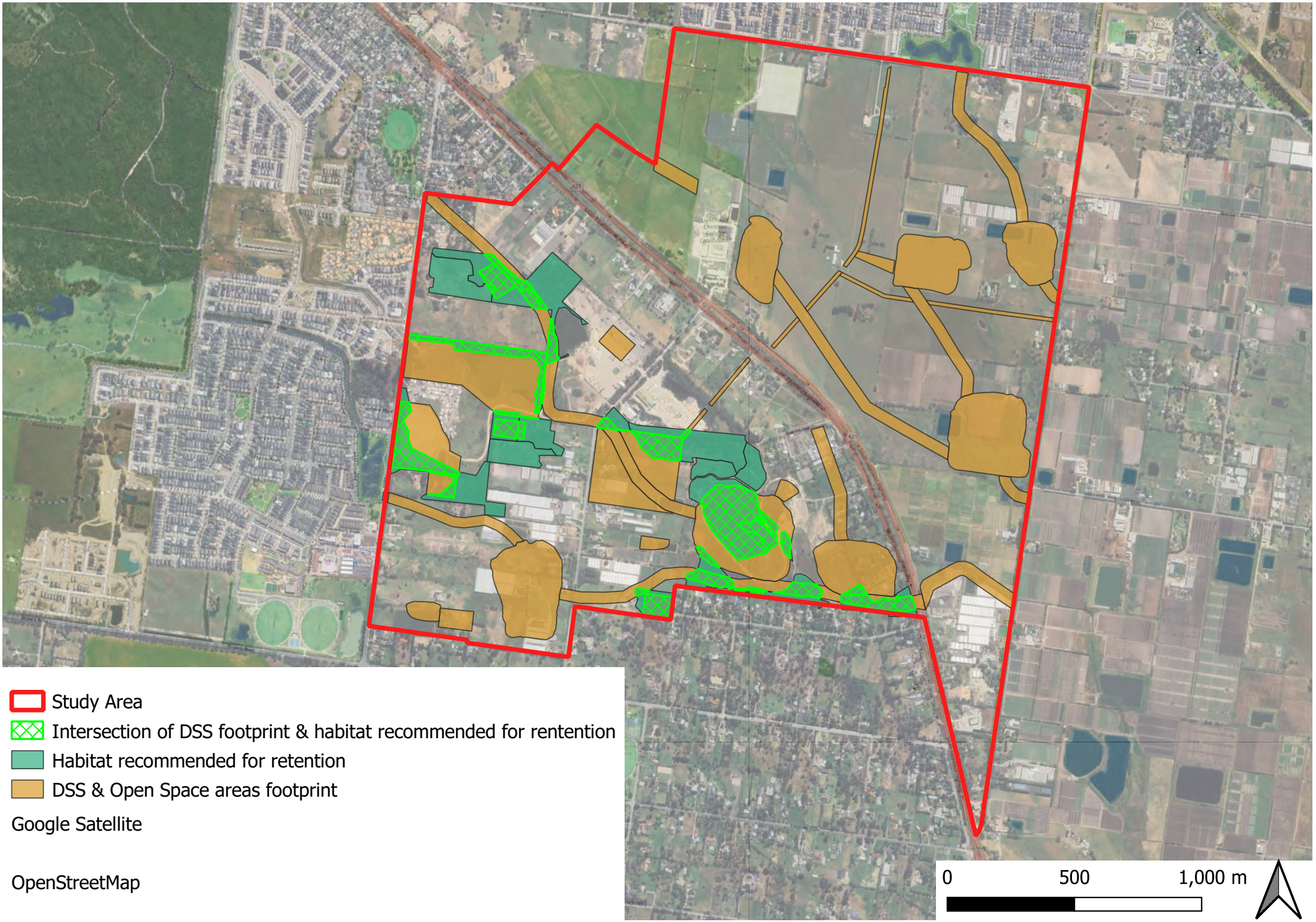
## 4.3 Retention of habitat

The Implementation Plan stipulates that habitat connectivity corridors within Devon Meadows should follow drainage corridors (DELWP 2016).

Under the current scenario, the footprint for the DSS and Open Space areas intersects the habitat recommended for retention at 45.1% (Figure 4.3). While some high quality and high potential areas will be retained as a wildlife movement corridor, construction activities are expected to result in the removal of almost all understorey habitat, which will prevent usage by Southern Brown Bandicoots.

Recommendations for retention and enhancement area discussed in Section 5.1, 5.2 and 5.3.

Casey Fields South supports little habitat of value for Southern Brown Bandicoot and therefore no specific recommendations for retention have been made for this precinct.


Study Area
Intersection of DSS footprint & habitat recommended for rentention
Habitat recommended for retention
DSS & Open Space areas footprint
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## 4.4 Design considerations for retained habitat and corridors

### *4.4.1 Removing barriers to movement*

Barriers to movement include within the study area that will need to be considered in future planning include:

- Roads (Craig Road, Devon Road, South Gippsland Highway)
- Gaps in connectivity (particularly where gaps are greater than 7m wide)
- Fencing.

Threats to Southern Brown Bandicoot within the study area, including barriers to dispersal are detailed in Section 4.5.1.

Addressing key barriers to removal will require the installation of wildlife crossing structures suitable for ground-dwelling fauna, namely culverts; and enhancing existing habitat in order to close gaps in connectivity. Removal of connectivity gaps is addressed in 5.2, and wildlife crossing structures and associated infrastructure are detailed in Sections 5.1.1 and 4.4.1.2.

#### 4.4.1.1 Fauna Crossing Structure Design Standards

Three fauna crossing design standards for Southern Brown Bandicoot have been developed to correspond with ecological priority of each location:

- ‘Optimal’ crossing structures: optimised to facilitate wildlife crossings and are to be installed at high priority locations.
- ‘Suitable’ crossing structures: meet optimal standard where possible and are to be installed at moderate priority locations, and at a small number of high priority locations with location constraints.
- ‘Incidental’ crossing structures: meet optimal or suitable standards where possible and are to be installed in low priority locations and a small number of moderate and high priority locations with severe location constraints.

Wildlife crossing culvert designs for Southern Brown Bandicoot are detailed below in Table 4.1 with diagrams shown in Figure 4.4.

Table 4.1 Standards for Southern Brown Bandicoot crossing structures

| Features | ‘Optimal’ Crossing structure for high priority Southern Brown Bandicoot crossings | ‘Suitable’ crossing structure | ‘Incidental’ crossing structure |
|---|---|---|---|
| Design | Open span bridge with continuous natural vegetation and/or artificial hides/shelters underneath.<br>Where open span bridge is not feasible, box culverts should be used and be a minimum of 2.4 m wide and wherever possible, 1.2 to 1.5 m high, with a natural substrate floor.<br>Where height space is constrained and a culvert of 1.2 to 1.5m cannot be achieved, a minimum culvert height of 0.6m must be used. | Box culverts, a minimum of 0.9m high and 1.2 m wide, preferably 2.4 m wide. Where height space is constrained and a culvert of 0.9m cannot be achieved, a minimum culvert height of 0.45m must be used.<br>Ideally a natural substrate floor.<br>If part of multi-cell culverts for drainage, the two outside culverts should be made suitable for Southern Brown Bandicoot movement. | Box culverts, minimum of 0.45 m high and 1.2 m wide. Where height space is constrained and a culvert of 0.45m cannot be achieved, a minimum culvert height of 0.3m must be used.<br>Concrete base to culvert.<br>Pipe culverts do not qualify as fauna crossing structures.<br>Alternatively, concrete ledges must be installed within wet culverts designed for Growling Grass Frog movement to allow |

| | | | |
|---|---|---|---|
| | Culvert entrances to be level with adjacent terrestrial land or not exceed a slope of 20 degrees and be capable of supporting suitably dense vegetation.<br><br>If part of multi-cell culverts for drainage, the two outside cells should be optimised for Southern Brown Bandicoot movement. | | for incidental Southern Brown Bandicoot passage. |
| Inundation and fauna furniture | The culvert will be as high as practicable within the road formation with an invert at least 300mm above the invert of the lowest wet culvert in the group. The dry culvert will be designed to be free draining such that any flood water will dissipate. Preferably a 'dry' culvert never be flooded, as this can remove/dislodge wildlife furniture.<br><br>Include Southern Brown Bandicoot shelter at the entrances (dense plantings and artificial shelters) and inside the culvert (artificial shelters and raised logs and rocks) under which they can hide. Artificial shelters should be constructed from treated pine planks fastened into a rectangular frame with a partition in the middle to form two chambers, as per design for shelter (Appendix C). Otherwise hardwood or marine ply for greater longevity, painted with non-toxic paint. | The culvert will be as high as practicable within the road formation with an invert at least 300mm above the invert of the lowest wet culvert in the group. The dry culvert will be designed to be free draining such that any flood water will dissipate.<br><br>Include a concrete ledge – minimum 450 mm wide - on the outer wall of the outer cells of the crossing which is level and continuous with embankment. | Does not hold water for extended periods after rain.<br><br>Shelves and ledges not required. |
| Light well | The culvert should be as short as possible, and where the central median is sufficiently wide, include split culverts under each carriageway with a fenced opening in the median to reduce the tunnel effect of the culvert. The longer the underpass, the higher and wider it should be. Include light wells in the median if a single culvert crosses both carriageways (i.e. >30 m in length). | If more than 30 m in length, include a light well in centre median. | No light well required. |
| Fencing | Must be fenced – at least 200 m on each side of each entrance (i.e. 400 m total at each end). | 50 m of fencing on each side of each culvert.<br><br>Where this intersects with driveways or other access routes, | No fencing required.<br><br>Where this intersects with driveways or other access routes, this distance may be |

| | | | |
|---|---|---|---|
| | Where this intersects with driveways or other access routes, this distance may be reduced to prevent animals from becoming trapped on the road side of fencing. If the distance is reduced, the fencing should terminate at the same spot on both sides of the road, to reduce trapping. | this distance may be reduced to prevent animals from becoming trapped on the road side of fencing.<br>If the distance is reduced, the fencing should terminate at the same spot on both sides of the road, to reduce trapping. | reduced to prevent animals from becoming trapped on the road side of fencing.<br>If the distance is reduced, the fencing should terminate at the same spot on both sides of the road, to reduce trapping. |
| Street lighting | Ideally, no street lighting to be installed within 200 m of the culvert entrances or light well. Where required to meet safety standards, ensure lighting conforms to the National Light Pollution Guidelines (DoEE 2020), including the use of adaptive light controls to manage intensity, timing and colour, lowest intensity possible, shielded to prevent light spill into adjacent habitat, the entrances to culverts and the light wells and no use of lights within the blue, violet and ultraviolet wavelengths. | Ideally, no street lighting to be installed within 100 m of the culvert entrances or light well. Where required to meet safety standards, ensure lighting conforms to the National Light Pollution Guidelines (DoEE 2020), including the use of adaptive light controls to manage intensity, timing and colour, lowest intensity possible, shielded to prevent light spill into adjacent habitat, the entrances to culverts and the light wells and no use of lights within the blue, violet and ultraviolet wavelengths. | Ideally, no street lighting to be installed within 50 m of the culvert entrances or light well. Where required to meet safety standards, ensure lighting conforms to the National Light Pollution Guidelines (DoEE 2020), including the use of adaptive light controls to manage intensity, timing and colour, lowest intensity possible, shielded to prevent light spill into adjacent habitat, the entrances to culverts and the light wells and no use of lights within the blue, violet and ultraviolet wavelengths. |
| Predator control | Predator control to be undertaken at each entrance and within 500 m of each underpass as part of a co-ordinated and strategic program. | Predator control to be undertaken at each entrance and within 500 m of each underpass as part of a co-ordinated and strategic program. | |

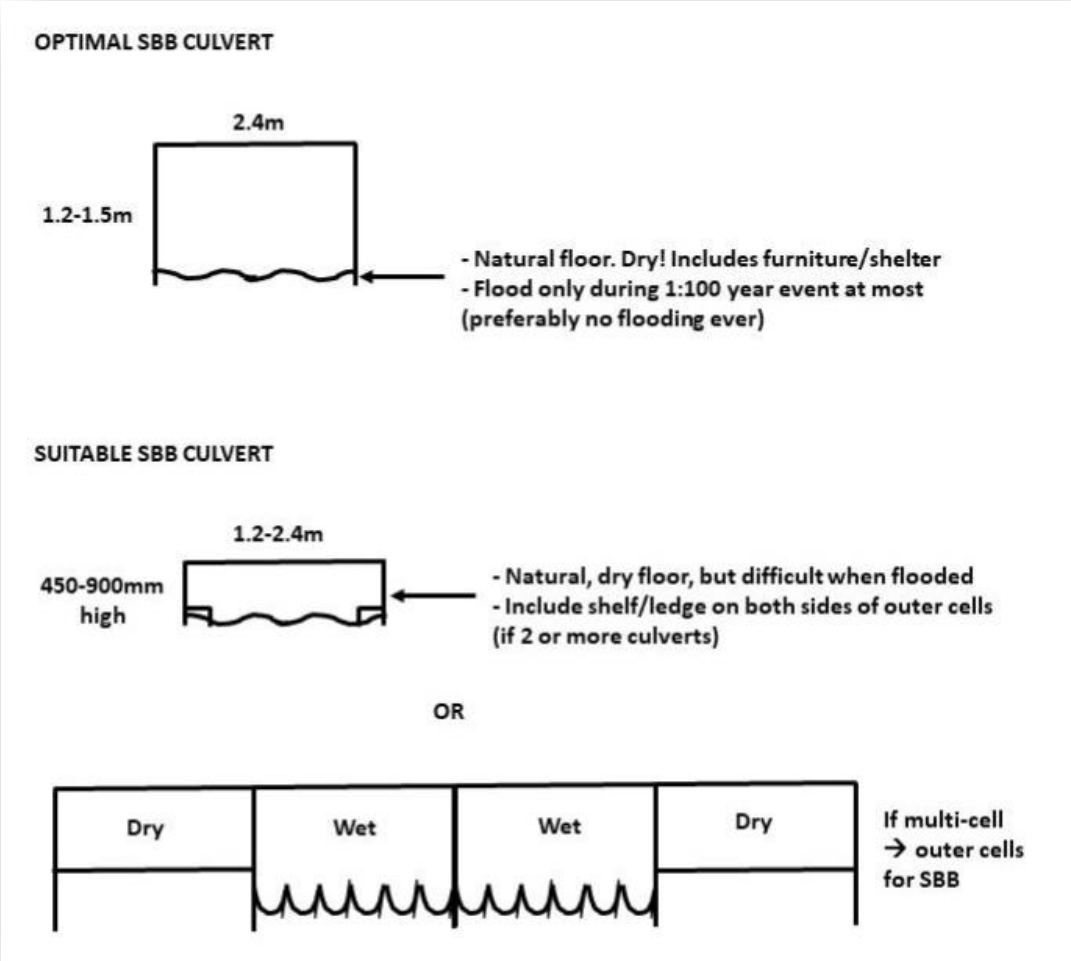



Figure 4.4 Southern Brown Bandicoot culvert design (refer to Table 4.1 for caveats on culvert heights)

#### 4.4.1.2 Fauna fencing

Effective fencing can reduce rates of roadkill significantly. Design specifications for permanent wildlife exclusion fencing are as follows:

- Fence construction materials and design:
  - Constructed to a height of 1.2 m and buried 0.3 m below ground.
  - Constructed using solid, opaque materials, such as high-density polyethylene (1-5mm thickness).
  - If the above is not possible, fence can be constructed as per temporary wildlife exclusion fencing. However, this is not considered to be viable in the long-term due to increased maintenance requirements.
- Where fencing is installed to funnel fauna towards culvert and underpass entrances it:
  - Should be installed flush with the culvert / underpass opening (no gaps between fence and underpass).
  - Should best be installed at least 200 m either side of culvert/underpass opening for optimal culverts, up to 50 m for suitable culverts and no fencing for incidental culverts. Where this intersects with driveways or other access routes, this distance may be reduced to prevent animals from becoming trapped on the road side of fencing. If the distance is reduced, the fencing should terminate at the same spot on both sides of the road, to reduce trapping.

- Should be set back approximately 10m from the road, where practicable.
- Where possible, the terminal 10 – 20 m of each section of fence should be angled to extend away from road to create a funnel shape.

- Ideally installed behind guard rails.
- Fencing must be regularly inspected for damage and rapidly repaired.
- Vegetation within 3m of the fence and escape ramp must be slashed or mowed to prevent fauna using vegetation to climb over fence or up the ramp.
- Fences should be located at culvert and underpass entrances and at key locations along the roadside. At a minimum, high-priority fences must be built with moderate and low-priority fence locations to be built where feasible.

Animals may breach fencing and can become trapped between the fencing and the road, increasing the risk of collision with vehicles. Escape ramps should be installed along Craig Road, Devon Road and other culvert locations to allow Southern Brown Bandicoot and other wildlife to escape. The design of the escape ramp for Southern Brown Bandicoot is to be based on designs trialled on the Oxley Bypass in NE NSW (Goldingay et al. 2018). These were earthen ramps, approximately 1 m wide and 3 m long, with a 60 – 80 cm drop down, with fauna fencing on either side.

## 4.5 Considerations for future urban planning and retained habitat

### *4.5.1 Mitigating threats*

#### 4.5.1.1 Introduced predators

Introduced predators such as feral cats and foxes are well-known threats to Southern Brown Bandicoot and are listed as a key threatening process to the species under the EPBC Act (Department of the Environment and Heritage 2006). Rates of predation are likely to be higher where habitat is fragmented and shelter structures are limited, such as urban and peri-urban areas where fox density is higher due to higher availability of resources (Environment Australia 1999). Fox control has been shown to be a cost-effective strategy in assisting recovery of native mammals in the critical weight range, including Southern Brown Bandicoot (Murray, Poore & Dexter 2006).

Similarly, cat predation in urban areas can be exacerbated if no cat controls are enforced by local councils. In the City of Casey, domestic cats must be kept inside their residence at all times, with fines administered if cats are found outside their registered property. In the neighbouring Botanic Ridge Estate, it is an offence under Section 126 of the *Planning and Environment Act 1987* to keep a cat, regardless of whether it is exclusively kept indoors. Likewise, under the Sub-regional Species Strategy for Southern Brown Bandicoot, new subdivisions within 1.5km of RBGC must be cat-free. Given that Devon Meadows and Casey Fields South are situated within 1.5km of RBGC, a cat ban is required for these precincts. City of Casey would be responsible for enforcing this restriction (DELWP 2016). This measure, in conjunction with a robust predator control program targeting foxes and feral cats, is expected to reduce the risk of predation for Southern Brown Bandicoot.

Within any designated reserve areas, predator-proof fencing will be an important factor in protecting local populations of Southern Brown Bandicoot from predation pressure.

#### 4.5.1.2 Habitat fragmentation

In its current state, Devon Meadows and Casey Field South have been highly modified by agriculture, development, and other human-driven processes, noting that Southern Brown Bandicoot is known to be hindered by gaps in suitable habitat greater than 7 m (Masters, Taylor & Maclagan 2019). Obstacles for movement in the landscape create additional pressures for Southern Brown Bandicoot by limiting gene flow in the broader meta-population, and can drive local extinctions. Habitat fragmentation is a current threat within Devon Meadows and Casey Fields South, and is likely to continue to exert pressure on Southern Brown Bandicoot during development of the PSP. Careful consideration must therefore be given to avoiding fragmentation in areas that serve as a habitat corridor for Southern Brown Bandicoot, and bridging gaps in connectivity in these areas through habitat enhancement as outlined in Section 5.2.

During construction, any habitat removal will need to be staged to prevent the creation of gaps in connectivity greater the 7m, which deters movement in Southern Brown Bandicoots.

#### 4.5.1.3 Roads and vehicle collisions

Given its tendency to occur in novel environments, such as road and railway corridors, Southern Brown Bandicoot is highly susceptible to the threat of roadkill. Typically risks associated with roads can be largely overcome through the provision of suitably-designed culverts or other wildlife crossings, in combination with wildlife-exclusion fencing designed to funnel target fauna into the culverts rather than onto roads. Design of roads and culverts should give due consideration towards minimising the planting of ideal habitat species such as Spiny-headed Mat-rush directly adjacent to roads so as not to encourage Southern Brown Bandicoot right up to the road edge.

#### 4.5.1.4 Sweet Pittosporum infestation

Sweet Pittosporum is recognised as a driver of ecological change throughout much of its introduced range (O'Leary et al. 2018), suppressing the growth of native understorey (strata 0.2 - 1 m) and leading to habitat loss for Southern Brown Bandicoot. Areas of Sweet Pittosporum infestation were identified during the field assessment, with understorey species largely absent in these areas. Some of these areas were designated as medium quality habitat for Southern Brown Bandicoot due to the presence of suitable native understorey species nearby as they present high suitability for remediation if Sweet Pittosporum is removed and high-density native understorey species are planted.

#### 4.5.1.5 Fencing

There are several fences within the study area which may inhibit movement to Southern Brown across the landscape. In these instances, short sections of polypipe may be installed to form tunnels to Southern Brown Bandicoot through fences; a strategy which has been implemented successfully by RBGC (pers. comms. Tricia Stewart RBGC).

#### 4.5.1.6 Bell Miner Associated Dieback

Bell Miner *Manorina melanophrys* Associated Dieback (BMAD) is a condition affecting canopy trees whereby they progressively lose canopy condition, eventually leading to the death of the tree (Stone 2005). Canopy loss and tree death are a result of infestation of psyllid insects, which produce lerps, a sugary sap on the back of the insects. Lerps are a highly valued food source for many woodland birds, particularly Bell Miner (Stone 2005). Growing populations of Bell Miners in some parts of the study area have led to the spread of psyllids, and thus several areas of native vegetation identified during the field assessment displayed signs of BMAD. While canopy trees are not considered vital habitat components for Southern Brown Bandicoots, loss of canopy trees can lead to altered understorey assemblages and potentially allow undesirable weedy species such as Sweet Pittosporum to establish. Although not currently considered a driving threat within Devon Meadows, control of Bell Miners may be required if BMAD leads to understorey decline or disturbance.

### *4.5.2 Reconciling weed control with habitat provision*

The invasion and spread of weeds pose a risk to biodiversity and may be a potential consequence of Project-related activities such as vegetation clearing and the resulting edge-effects. Weeds compete with native vegetation for resources, which can result in the degradation and transformation of ecosystems. However, in some situations, weeds can provide important resources for wildlife. Novel habitats along drains and formerly cleared sections within properties of Devon Meadows and Casey Fields South comprise patchy native vegetation and are often dominated by exotic vegetation, such as Blackberry **Rubus fruticosus* and weedy grasses, and native early colonisers like Bracken *Pteridium esculentum*. Such species are known to provide habitat, resources and refuge from predators (Ecology Australia 2009), and in some cases moreso than native vegetation (Maclagan, S, Coates & Ritchie 2018).

Weed control is an important tool for improving habitat quality and connectivity within the landscape, and preventing drainage lines from becoming choked with weeds. That said, weed control must be undertaken in a way that is sympathetic to Southern Brown Bandicoot so as to avoid further fragmenting potential suitable habitat within the landscape.

An allowance must therefore be made for tolerance of higher-than-normal weed levels, particularly Blackberry, Flax-leaf Broom **Genista linifolia* and other woody weeds, in areas where attempting to promote connectivity for Southern Brown Bandicoot.

The *Guidelines for best-practice management of modified habitats for Southern Brown Bandicoots* (Masters, Taylor & Maclagan 2019) are to be followed including but not limited to:

- Avoid creating gaps >7 m wide as these may hinder Southern Brown Bandicoot movement.
- Use targeted spot-spraying, wiping or cut-and-paint methods rather than spraying more broadly in areas known/likely to provide Southern Brown Bandicoot habitat.

- Herbicide spraying is acceptable in areas >30 m from known/likely Southern Brown Bandicoot habitat.
- Stagger/stage removal of pest plant species and replace with indigenous alternatives over time while ensuring >50% understorey cover remains intact at all times.

The last point is important to clarify that this does not equate to allowing up to 50% removal at any given time. In the case for a similar practice of fire management procedures, at any given time, if greater than 20% of suitable habitat comprises less than an average of 50% foliage density then this may have a significant impact on Southern Brown Bandicoot.

In the case of habitat corridors within the study area, it is recommended weed control be undertaken at no more than 10% weed removal below an average of 50% foliage density cover at any given time or in any given area. This is a more conservative measure to ensure staged removal is implemented across the habitat corridor.

Undertaking weed control works should be a well-planned process combining ecological and horticultural theories and applying them to practical bushland restoration. Weed control should be adaptive to site-specific conditions and management responses. Some guiding on-going principles are:

- Identify the highest quality areas and work out from these,
- Adopt a systematic approach,
- Weed management to protect and increase regeneration should be guided by bush regeneration principles,
- Consider the fauna habitat values before undertaking works,
- Continue follow-up management in sites where work has been started,
- Treat weeds at the appropriate time in their life cycle to maximise effectiveness, and
- Follow up all work with ongoing maintenance and resist starting on new projects until an adequate level of weed control has been achieved on current projects. Otherwise, there might be circumstances where Blackberry is removed and is replaced by a dense grassy and herbaceous weed which is undesirable habitat for Southern Brown Bandicoot.

Following up on areas that have been subjected to weed control is of paramount importance. Weed management requires consistent work over a long-term program (e.g. 10 years) in order to interrupt the life cycles of the weeds and allow indigenous species to gain an ecological advantage.

A Habitat Restoration and Revegetation Plan should be prepared once a suitable habitat corridor has been determined. The aim of revegetation/rehabilitation will be to re-establish a suitable habitat corridor for Southern Brown Bandicoot through the precinct, which should provide 50-80% average understorey foliage cover in the 0.2-1.0 m height range (DSEWPaC 2011). Any revegetation works should be followed up with a weeding and watering program that lasts for at least 24 months from planting to ensure the successful establishment of new habitat. Post-construction monitoring of rehabilitation/revegetation should be undertaken to ascertain the survival of plantings and success of habitat creation.

# 5 Recommendations

## 5.1 Priority areas for connectivity

Although the Habitat Connectivity Plan stipulates that habitat and connectivity enhancement is to occur on non-developable land within Devon Meadows, i.e. open space areas and drainage corridors, there is limited overlap between these areas and the highest quality habitat within Devon Meadows (Figure 4.3). The maximum percentage overlap between DSS and highest quality and highest potential habitat is 45.1%.

While the concept of connecting landscapes for movement of fauna is important in guiding rehabilitation efforts, connectivity should prioritise the retention of potential or known habitat, and under the current scenario, almost 55% of the highest quality and highest potential habitat within Devon Meadows would be lost as it constitutes developable land. When further considering the consequence of removal of understorey habitat to facilitate construction of the drainage corridors, the anticipated reduction in habitat is expected to decimate any population of Southern Brown Bandicoot that may exist in the precinct if construction and habitat removal are not handled with careful consideration of Southern Brown Bandicoot.

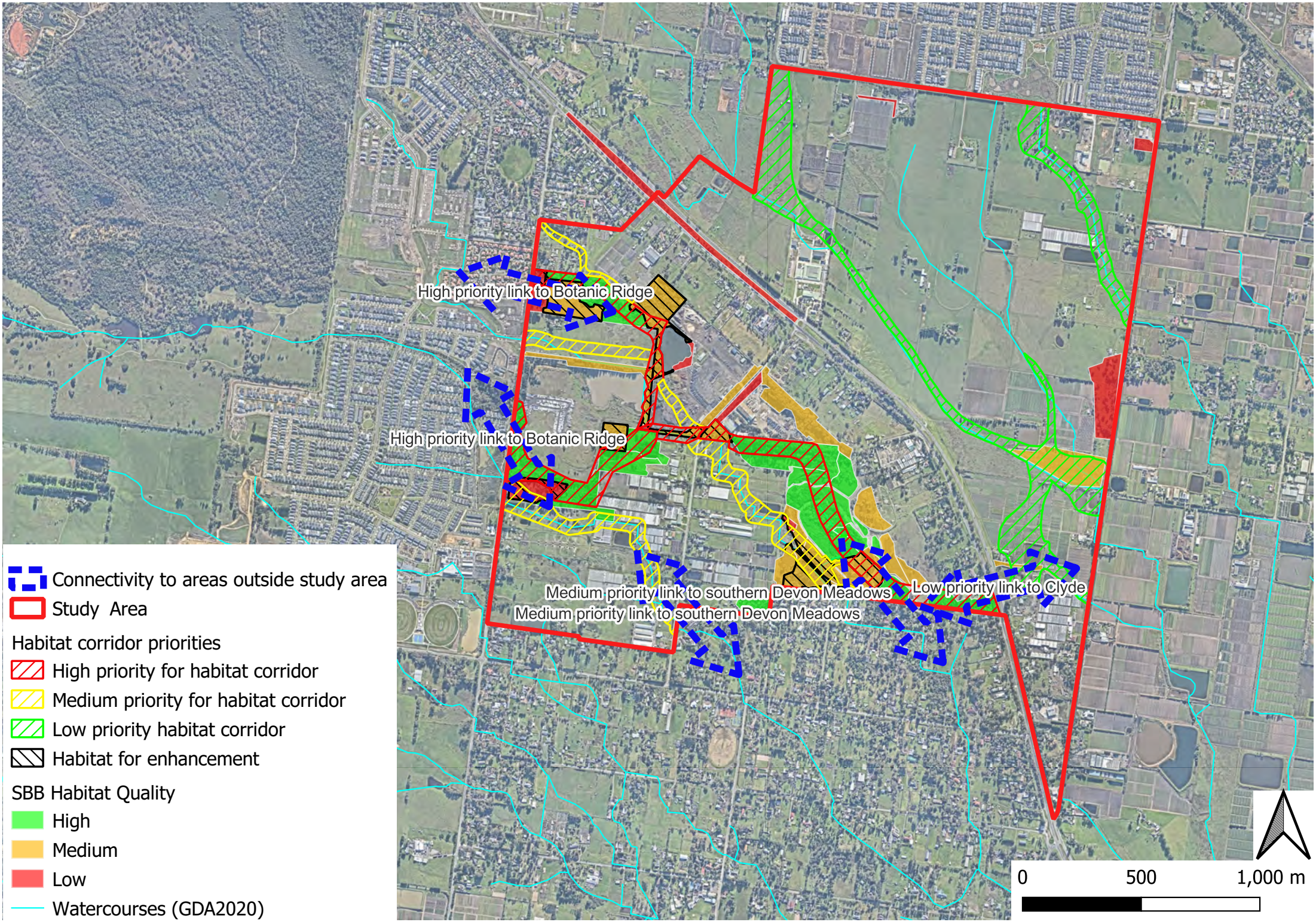
The Sub-regional Species Strategy for Southern Brown Bandicoot outlines the objective of achieving functioning sustainable Southern Brown Bandicoot populations within and adjacent to the growth areas, and the protection and enhancement of all populations, including the population at the RBGC. In order to support these objectives under Version 1 of the Biodiversity Assessment Report we had previously proposed an option for a corridor that was guided by the drainage lines and land subject to inundation overlay (LSIO), but notably diverged in areas where the areas of high quality habitat in Devon Meadows would otherwise have been lost. The high priority corridor incorporated linkages to habitat of high quality and habitat that is considered to have high potential for enhancement within Devon Meadows (Figure 5.1). It is noted that the LSIO is planned to be removed under an imminent planning scheme amendment. This option was identified to prioritise dispersal capacity through corridors and suitable habitat within the landscape, with the aim of promoting the persistence of Southern Brown Bandicoot within the Devon Meadows precinct. By contrast, the medium priority habitat corridor followed the current alignment of the drainage lines and LSIO in locations where these do not intersect with high-quality habitat. Lastly, the low priority corridor was guided by the current locations of the drainage lines and LSIO within Casey Fields South. These areas do not currently provide high-quality habitat to Southern Brown Bandicoot and would require significant enhancement in order to be considered suitable as a habitat corridor.

The updated DSS roughly follows the medium priority corridor within Devon Meadows with some overlap of the high priority corridor at the sand quarry at 55 Devon Rd, and 1934 South Gippsland Highway in the south-east corner of the precinct. This alignment captures some of the high-quality habitat available within Devon Meadows precinct, but will result in the loss of high quality habitat at 32-34 Craig Road, Junction Village, and 65, 70 and 75 Devon Road, Devon Meadows.

Importantly the current DSS alignment includes a planned drainage corridor within Devon Meadows precinct which extends to the north-west corner of the precinct where there is no option to connect with suitable habitat within Botanic Ridge Estate. This alignment should be revised to instead connect to the vegetated drainage corridor within Botanic Ridge just south of Bandicoot Boulevard (Figure 5.2). This alternative corridor would provide a connection to potential viable habitat to Southern Brown Bandicoots that may be present within the Botanic Ridge Estate. It is also a requirement under the Sub-regional Species Strategy for Southern Brown Bandicoot to establish two viable habitat linkages between Devon Meadows and Botanic Ridge (DEPI 2014a), while the current DSS alignment would result in only one functional connection. A wildlife underpass will need to be installed at both linkages along Craig Road to establish viable connections between these drainage lines.

Casey Fields South has limited available habitat for Southern Brown Bandicoot, so in this precinct the current DSS alignment and Open Space areas are considered sufficient assuming extensive revegetation efforts are implemented as per Section 5.3.

The conflict between areas stipulated for protection and enhancement as habitat corridors within the Implementation Plan and Habitat Connectivity Supplement document, and under the current DSS compared with the locations of the highest quality habitat is still recommended to be addressed through discussions with relevant stakeholders, including DEECA, the VPA, Melbourne Water, DTP, developers, landowners and RGBC.


High priority link to Botanic Ridge
High priority link to Botanic Ridge
Medium priority link to southern Devon Meadows
Medium priority link to southern Devon Meadows
Low priority link to Clyde
Connectivity to areas outside study area
Study Area
Habitat corridor priorities
High priority for habitat corridor
Medium priority for habitat corridor
Low priority habitat corridor
Habitat for enhancement
SBB Habitat Quality
High
Medium
Low
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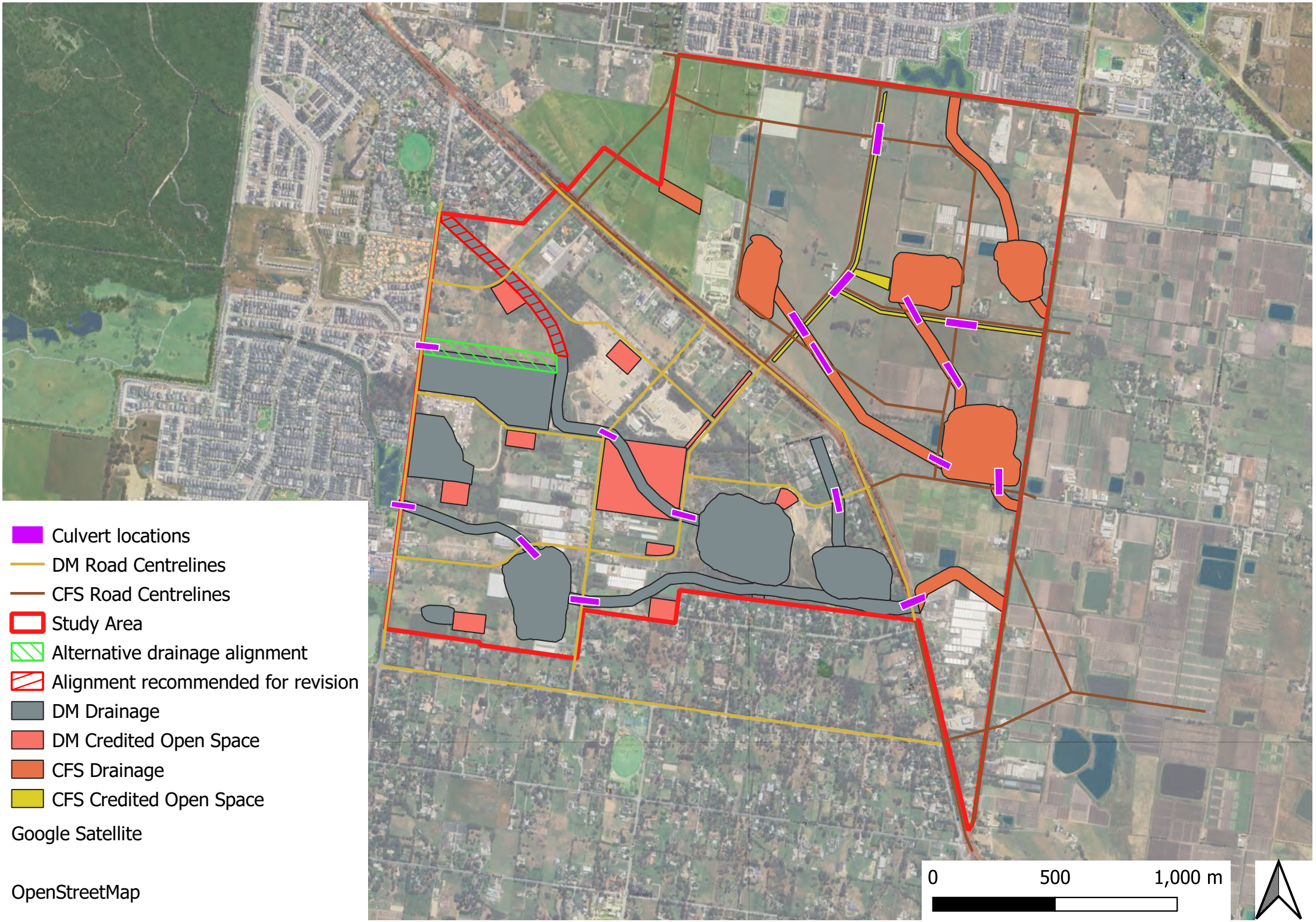
Culvert locations
DM Road Centrelines
CFS Road Centrelines
Study Area
Alternative drainage alignment
Alignment recommended for revision
DM Drainage
DM Credited Open Space
CFS Drainage
CFS Credited Open Space
Google Satellite
OpenStreetMap
0
500
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### 5.1.1 *Wildlife crossings and associated infrastructure*

Where planned roads within Devon Meadows intersect the proposed habitat corridor for Southern Brown Bandicoot, culverts must be installed to mitigate barriers to movement. Section 4.4.1.1 outlines the characteristics of optimal, suitable and incidental crossing structures and how they align with the ecological need at each location shown in Figure 5.1. Where drainage culverts are intended to also allow fauna passage these must meet the same minimum standards as required for fauna crossing structures so that use by wildlife is not compromised. Where culverts are installed as wildlife underpasses, permanent wildlife exclusion fencing should be installed to prevent fauna from entering the road, and to funnel fauna towards culvert and underpass entrances in line with specifications listed in Section 4.5.1.5. DEECA would be responsible for funding the construction of dry culverts within Devon Meadows and to connect these areas with Botanic Ridge (DELWP 2016).

Figure 5.1 identifies priority locations to create habitat linkages via wildlife underpasses. High priority links are identified at Craig Road where culverts can be installed to facilitate dispersal of Southern Brown Bandicoot between Botanic Ridge and Devon Meadows. The exact location of these culverts at these points will be guided by civil engineering constraints, however, they must be positioned to connect sites supporting suitable habitat for Southern Brown Bandicoot between Devon Meadows and Casey Fields. Additional culverts should be placed along Devon Road within Devon Meadows, positioned to connect the proposed habitat corridor. Where possible, culverts should be designed to best-practice standards and guided by research, detailed in Section 3.1.4, and where possible include lightwells, as well as associated wildlife-exclusion fencing (as per Figure 3.4) and escape ramps. The Department of Transport and Planning, City of Casey and Melbourne Water should be responsible for culvert installation, with VPA responsible for including culverts into design plans. Advice on culvert design should be sought from RBGC at the design stage.

## 5.2 Staged habitat removal

Current plans to construct the DSS alignment within Devon Meadows and Casey Fields South involves removal of suitable habitat for Southern Brown Bandicoot. Habitat removal must be staged so as to avoid creating gaps in habitat greater than 7m, which would make a habitat linkage unviable to Southern Brown Bandicoot. This is critical when undertaking habitat removal in the understorey in the 0.2-1 m height range.

Although sections of habitat are planned to be retained, trees are prioritised and it is unclear whether understorey plants will be retained. Under the current program of works it is considered unlikely that any Southern Brown Bandicoots that may be present within the Devon Meadows precinct would persist in the area during construction. Therefore, any opportunities to retain understorey habitat in the 0.2-1 m height range within the identified habitat corridors should be explored to minimise disruption and loss to habitat connectivity for Southern Brown Bandicoot.

## 5.3 Regeneration and enhancement of habitat

Habitat regeneration should target gaps in connectivity, particularly those greater than 7m wide within the Southern Brown Bandicoot movement corridors. Based on the current DSS scenario, the entire alignment will require habitat regeneration in order to improve the quality of habitat within areas of medium and low quality habitat, while also replacing current high quality habitat that is planned to be lost during construction. Improving floristic structure and density will be critical to promote connectivity across the DSS alignment to facilitate dispersal of Southern Brown Bandicoot from one end of the precinct to the other, and more broadly to promote gene flow across the local landscape. Open Space areas should also be a strong focus for establishing suitable foraging and breeding habitat for Southern Brown Bandicoot.

Where culverts are installed in the landscape it will also be important to enhance habitat quality in those areas to promote use of those corridors and aid dispersal further east in the landscape.

Habitat regeneration should follow key guidelines for enhancing habitat for Southern Brown Bandicoot outlined in Masters, Taylor and Maclagan (2019), including:

- Aim to provide dense groundcover with >50% average foliage density within the 0.2-1 m height range.
- Corridors should be as wide as possible to maximise habitat potential. Ideally, they should have a minimum width >10m, but a width of 30 m or greater is preferred.
- Avoid gaps in habitat corridor >7 m.
- Use indigenous plant species wherever possible.
- Ensure any revegetation works are followed up with a weeding and watering program that lasts for at least 24 months from planting to ensure the successful establishment of new habitat.
- Allow for a contingency planting of 20% in any revegetation project to replace any plants that fail during the first two years.
- Consider other local animal and plant species' requirements to maximise biodiversity outcomes, for instance, frogs, lizards, woodland birds and other native ground-dwelling mammals.

## 5.4 Further survey

There is an absence of records of Southern Brown Bandicoot within the study area, which is likely due to a lack of survey effort within the precinct. To support design decisions, further targeted surveys within Devon Meadows are recommended if none have yet been undertaken. Information yielded from remote camera trapping and other recommended methods would supplement existing information about the presence, distribution and density of Southern Brown Bandicoot within and surrounding the study area and could in turn inform prioritisation of habitat retention and enhancement.

# 6 Limitations

This Report is provided by WSP Australia Pty Limited (WSP) for The Victorian Planning Authority (Client) in response to specific instructions from the Client and in accordance with WSP's proposal dated 12 August 2024 and agreement with the Client dated 7 November 2024 (Agreement).

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