

Cars waiting at the Calder Park Drive level crossing



Calder Park Drive and Holden Road

Publication of Preliminary Documentation
under the Environmental Protection and
Biodiversity Conservation Act 1999 (EPBC Act)

June 2024

LEVEL CROSSING REMOVAL PROJECT

000 - Multiple Sites **Victorian Grassland Earless Dragon Habitat Assessment - Calder Park Drive and Holden Road, Calder Park**

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1. Introduction

A population of the Victorian Grassland Earless Dragon (*Tympanocryptis pinguicolla*) was found in early 2023 in Victoria after not being seen for more than 50 years (since 1969) (DCCEEW 2023a). The species is listed as critically endangered under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and Victorian *Flora and Fauna Guarantee Act 1988* (FFG Act).

The Level Crossing Removal Project (LXRP) has requested an assessment of the Calder Park Drive and Holden Road LXRP (the Project) to determine potential occurrence of, and impacts to, Victorian Grassland Earless Dragon (VGED). VGED has been identified by the Australian Government Department of Climate Change, Energy, the Environment and Water (DCCEEW) as a species of interest in the Request for Information (RFI) issued following a decision that the Project is a controlled action under the EPBC Act (referral number EPBC 2023/09569). The Project is to be assessed by Preliminary Documentation as a means of providing supplementary information required by DCCEEW.

1.1 Scope of work

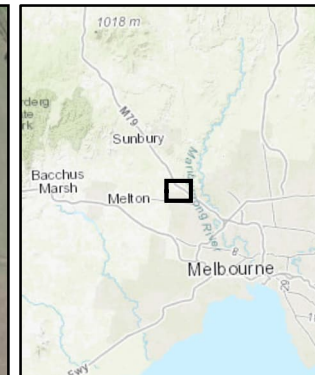
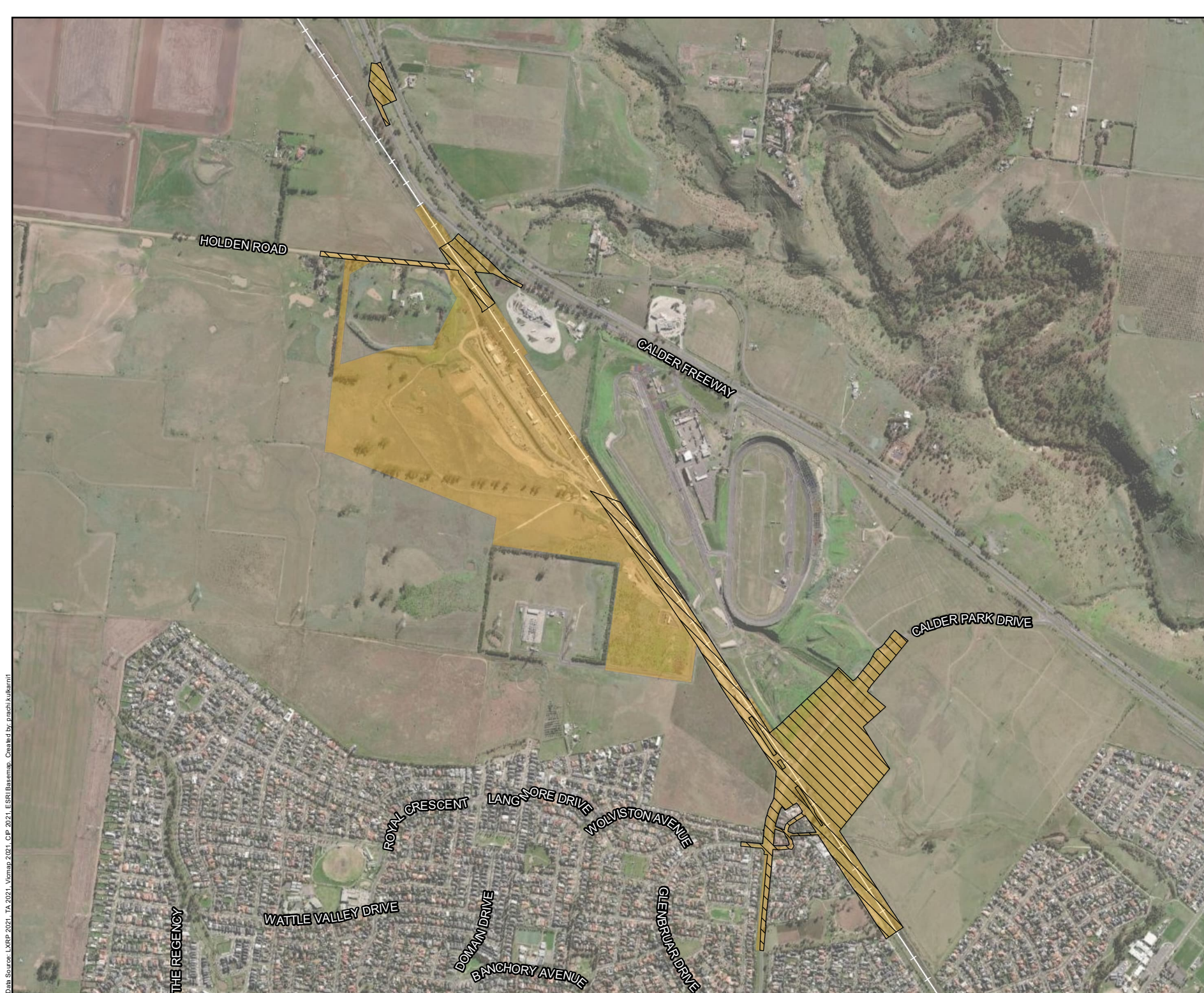
Given the rediscovery of VGED in Victoria and the location of the Project within the modelled distribution for the species, the AECOM-GHD Joint Venture (JV) as the Technical Advisor (TA) to LXRP, has undertaken an assessment of the potential for the VGED to occur in the construction footprint for the Project and the potential for the Project to impact on the species. The assessment comprised a review of existing information from key documents related to the VGED, the findings of the flora and fauna assessments completed for the Project at the time of referral under the EPBC Act and a species-specific habitat assessment undertaken in December 2023 and January 2024. The review will inform the Preliminary Documentation being prepared in response to the RFI.

1.2 Study area

The study area for this VGED assessment is defined by the construction footprint for the Project (black hatching in Figure 1). The construction footprint fits within a larger Project Area (PA) that was assessed for potential impacts on ecological values. The study area is located approximately 25 km north-west of the Melbourne Central Business District in the Victorian Volcanic Plain bioregion, the Brimbank, Hume and Melton City Local Government Areas and the Port Phillip and Westernport Catchment Management Authority area.

Although not in the construction footprint, Banchory Grove Reserve Grassland Nature Conservation Reserve (Banchory Grove Reserve) which is immediately adjacent, was included in the study area due to the potential for the Project to affect Banchory Grove Reserve through changes in hydrology.

Figure 1 Study area defined by the construction footprint for the Project



LEGEND

- Project area
- Construction footprint
- Railway

Study Area and Construction Footprint

Figure 1
Habitat Assessment



Paper Size A4

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

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Data Source: LXRP 2021, TA 2021, Vicmap 2021, CIP 2021, ESRI/Basemap, Created by: crachi/kuikami

2. Species Profile: Victorian Grassland Earless Dragon

The following species profile has been developed based on review of the following key reference documents for VGED:

- *Draft National Recovery Plan for Four Grassland Earless Dragons (Tymanocryptis spp.) of Southeastern Australia* (Draft National Recovery Plan) developed by the DCCEEW in July 2023 which outlines research and management actions for four species of threatened Grassland Earless Dragons, including the VGED (DCCEEW 2023b)
- *Conservation Advice for Tymanocryptis pinguicilla (Victorian Grassland Earless Dragon)* in effect under the EPBC Act from 1 June 2023 which combines the approved conservation advice and listing assessment for the species (DCCEEW 2023c)
- *National Recovery Plan for the Grassland Earless Dragon Tymanocryptis pinguicollis* now superseded by DCCEEW (2023b) but still provides background information (Robertson and Evans 2009/2012)

2.1 Taxonomy

The VGED is one of four species of threatened Grassland Earless Dragon in south-eastern Australia (Melville et al. 2019):

- *Tymanocryptis pinguicollis* (Victorian Grassland Earless Dragon)
- *Tymanocryptis lineata* (Canberra Grassland Earless Dragon)
- *Tymanocryptis mcartneyi* (Bathurst Grassland Earless Dragon)
- *Tymanocryptis osbornei* (Monaro Grassland Earless Dragon)

Prior to recent taxonomic revisions, the four species were considered to be a single species – the Grassland Earless Dragon *Tymanocryptis pinguicollis* which was listed under the EPBC Act in July 2000 and was regarded as four disjunct populations (Melville et al. 2019).

All four species were individually listed as threatened under the EPBC Act in May 2023. The VGED is identified as Australia's most imperilled of the four species having not been recorded for over 50 years (DCCEEW 2023b).

2.2 Description

The VGED is a small dark brown lizard of the dragon (Agamidae) family (Plate 1). A key feature that separates the *Tymanocryptis* genus from other members of the Agamidae is the lack of an external ear opening and functional tympanum (ear drum) (DCCEEW 2023b). Adult VGED are approximately 50-70 mm snout-vent length (SVL) with a head to tail length generally less than 150 mm (DCCEEW 2023b).



Plate 1 Grassland Earless Dragon (credit Peter Robertson. Grassland Earless Dragon, *Tympanocryptis pinguicolla*, Canberra (Majura) ACT from Robertson and Evans, 2009/2012)

2.3 Distribution

In Victoria, the species' current distribution is unknown. Until recently, there had been no confirmed sightings since 1969 despite extensive surveys being undertaken across much of its former range (DCCEEW 2023c). Multiple, but not all, extinction risk analyses showed a high probability that this species was extinct and the chance of undetected occurrences of the species in unsurveyed patches were considered slim (DCCEEW 2023c).

However, in early 2023 a population of the species was discovered at a location currently undisclosed (DCCEEW 2023a) approximately 50 km west of Melbourne. This discovery has led to reassessment of the species' potential presence in the region.

The VGED was formerly common on the plains near Sunbury and around the Melbourne CBD prior to development, with specimens and validated records from Sunbury, Maribyrnong River, the mouth of the Yarra River and Coode Island, Essendon and Moonee Ponds, and Prahran (DCCEEW 2023c and references within).

All specimens, and confirmed and unconfirmed records, are from temperate grasslands within a 100 km radius of the Melbourne CBD (Figure 2) in an area formerly known as the Keilor Plains, a subset of the Victorian Volcanic Plains (DCCEEW 2023c and references within).

The Draft National Recovery Plan (DCCEEW 2023b) provides a modelled distribution which identifies the potential geographic range of the VGED based on known records and habitat attributes. The

modelled distribution map is intended as initial guidance to instigate further investigation as the map is not the outcome of a species-specific assessment.

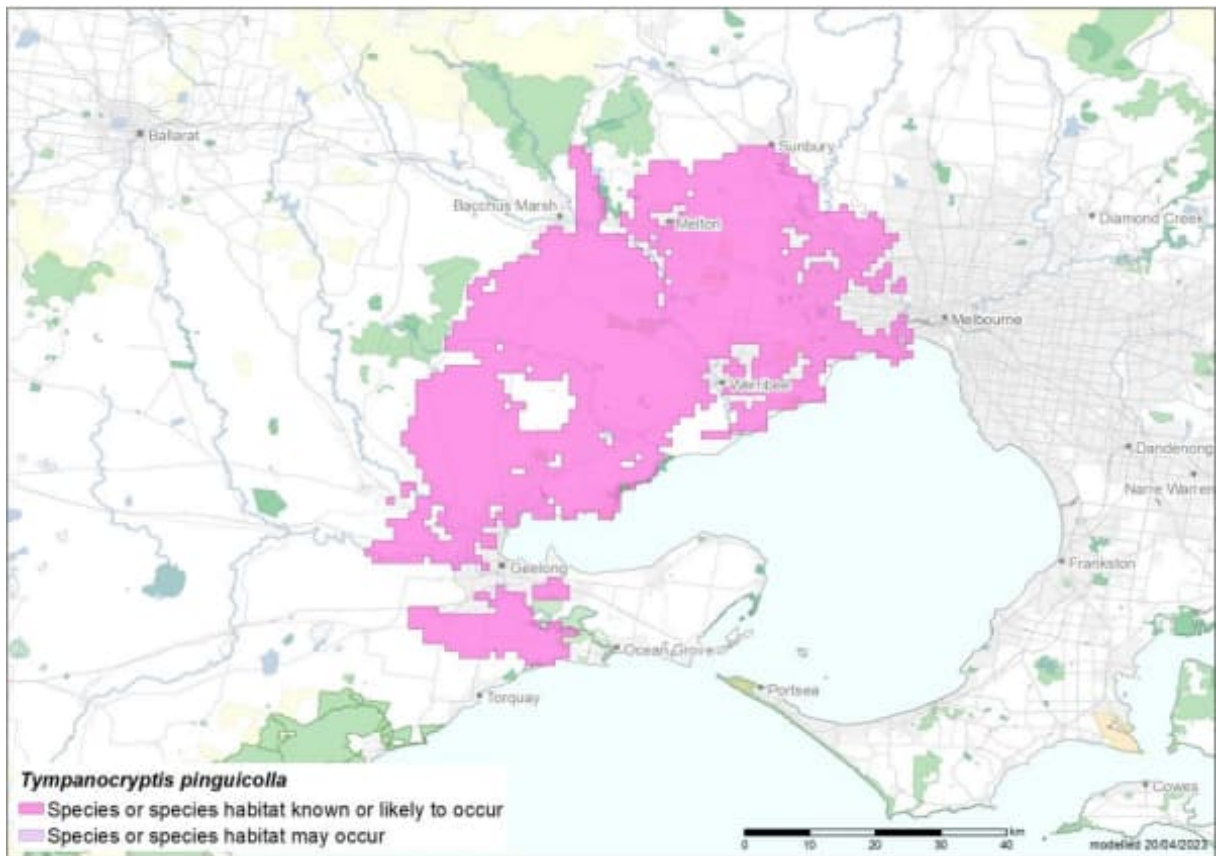


Figure 2 Modelled distribution of the Victorian Grassland Earless Dragon

Prior to the draft National Recovery Plan for Four Grassland Earless Dragons (DCCEEW 2023b), the National Recovery Plan for Grassland Earless Dragon (i.e. the single species) identified the known populations in Victoria (Robertson and Evans 2009/2012). While no populations were known to be extant in Victoria, the plan identified unconfirmed sightings that had been made since the 1960s at:

- Craigieburn Grassland (1990)
- Little River (1990)
- Holden Flora Reserve (1990)
- Donnybrook (Bald Hill) (1988)
- Cooper Street Grasslands (1985)

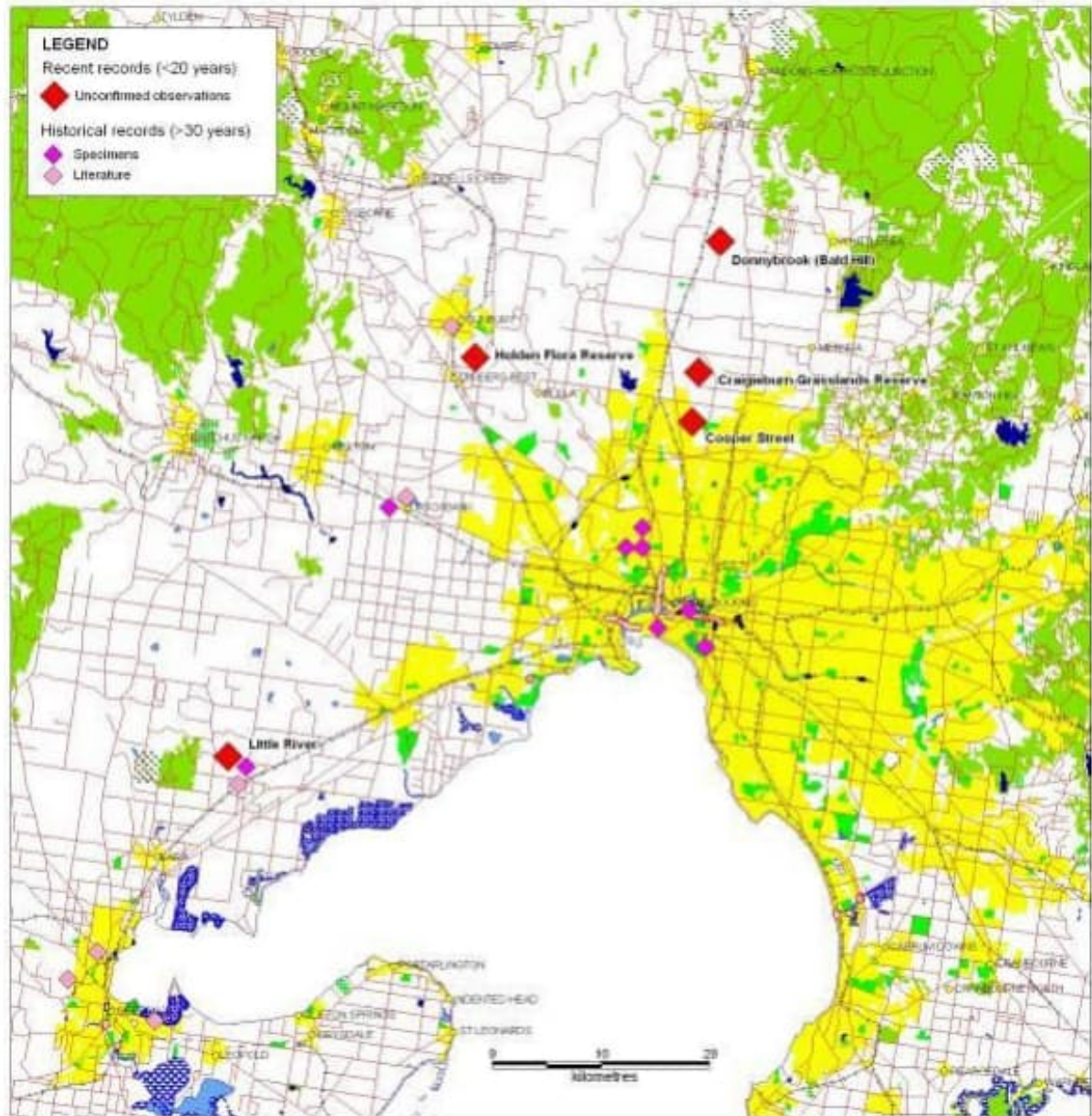
Other records from >30 years prior to 2012 were noted from:

- Geelong area – North Geelong (1969), Newcomb (1968), Hamlyn Heights (1964)
- Rockbank area (1968)
- Little River (1967)
- Port Melbourne, Coode Island, Prahran, Essendon, Moonee Ponds, Sunbury (late 1800s and early 1900s)

The last confirmed sightings were from the Laverton area in 1960, Little River in 1967, Rockbank area in 1968 and Geelong area in 1969.

An extract of the map of localities of Grassland Earless Dragon in Victoria (including unconfirmed observations) from Robertson and Evans (2009/2012) is provided in Figure 3 below for reference.

Surveys for this species were conducted to the north and west of Melbourne in the 1990s and early 2000s with the species not detected (Robertson and Evans 2009/2012). Up until recently it had largely been accepted that the species was likely extinct within northern Melbourne and potentially within Victoria with no confirmed sightings since 1969 (Melville et al. 2019; DCCEEW 2023c). Even within the modelled distribution area, areas of high disturbance and development are unlikely to support the species.



Source: Robertson and Evans (2009/2012) page 51

Figure 3 Map of localities for Grassland Earless Dragon in Victoria from 2012

2.4 Habitat

The VGED occurs in native tussock grasslands with little or no trees and shrubs (DCCEEW 2023b). Habitat can include the EPBC Act listed Natural Temperate Grasslands of the Victorian Volcanic Plains (NTGVVP) and also native grasslands and pastures with low floristic diversity that fall below the condition threshold for the ecological community.

Soil type and substrate are important habitat attributes with those attributes varying between the four earless dragon species (DCCEEW 2023b). Soils at the known locations of the four species vary from

limestone, granite or basalt devoid of loose or partially embedded surface rock to heavy basalt-derived clay with an abundance of surface rock and/or deep cracks (DCCEEW 2023b).

Low-lying areas that become waterlogged in winter and continue to be wet in spring are likely to be avoided as overwintering sites (Stevens et al. 2010). In Victoria, the heavy clay soils of the Keilor Plains dry and crack in summer and are waterlogged in winter (DCCEEW 2023c). During prolonged dry periods, areas such as low-lying swales previously deemed unsuitable may be utilised by the species (Stevens et al. 2010).

The presence – but not necessarily dominance – of native grass tussocks is an important habitat attribute. For the VGED historical records are from areas dominated by tufted grasses such as Slender Wallaby-grass (*Rytidosperma penicillatum*), Kangaroo Grass (*Themeda triandra*) and Tussock Poa (*Poa labillardierei*) (DCCEEW 2023b and references within).

Their habitat preference includes grasslands with undisturbed soil, containing spider burrows, loose surface stones and large deep soil cracks for refuge (Robertson and Evans, 2009/2012).

The VGED is reported to primarily occur on open basalt stony plains and along riverbanks (DCCEEW 2023c and references within). The Conservation Advice (DCCEEW 2023c) for the species reports that:

- *Victorian volcanic and coastal grasslands with the greatest likelihood of harbouring a remnant Victorian Grassland Earless Dragon population are likely to have:*
 - *native vegetation cover with open patches of bare earth and/or naturally short open swards due to low-level disturbance (e.g. managed fire, grazing);*
 - *invertebrate burrows and/or rock cover and/or cracking vertisol (also known as vertosol) soils;*
 - *adequate invertebrate prey;*
 - *minimal weed cover;*
 - *not been de-rocked, ploughed or fertilised to improve pasture quality.*
- *Grasslands with these attributes, and that are located broadly within the recorded historical range of the Victorian Grassland Earless Dragon (see Map 1: 'may' and 'likely' to occur) are likely to have been occupied by this species prior to European colonisation and may retain a remnant population. (p7 DCCEEW 2023c)*

Representative photos of habitat for the VGED are provided in the Draft National Recovery Plan (DCCEEW 2023b). An extract of images showing examples of known habitat for the other Grassland Earless Dragon species are provided in Appendix A for reference.

Photograph 23. Example of grassland condition and structure found to be supporting the Victorian GED.



Photographer and source: Garry Peterson

Source: DCCEEW 2023b p 59

Photograph 10 Examples of known habitat for the Victorian GED habitat on the Keilor plains during summer (top left and right) and in early autumn (bottom left) and late autumn (bottom right).

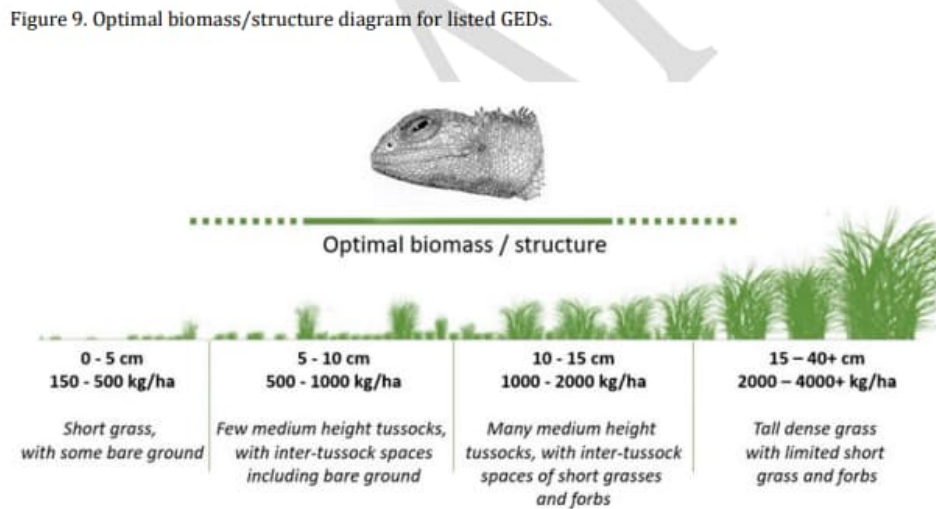


Photographed and supplied by Nick Clemann.

Source: DCCEEW 2023b page 20

Plate 2 Known habitat examples for Victorian Grassland Earless Dragon (Source: DCCEEW 2023b p. 20 and 59)

Optimal biomass/structure has been presented diagrammatically in Figure 9 in the draft National Recovery Plan (DCCEEW 2023b, sourced from NSW DPE and modified from ACT Government 2017a) and is extracted here as Figure 4 for reference.



Source: NSW DPE, modified from ACT Government (2017).

Figure 4 Optimal biomass/structure diagram (extract from DCCEEW 2023b p 57)

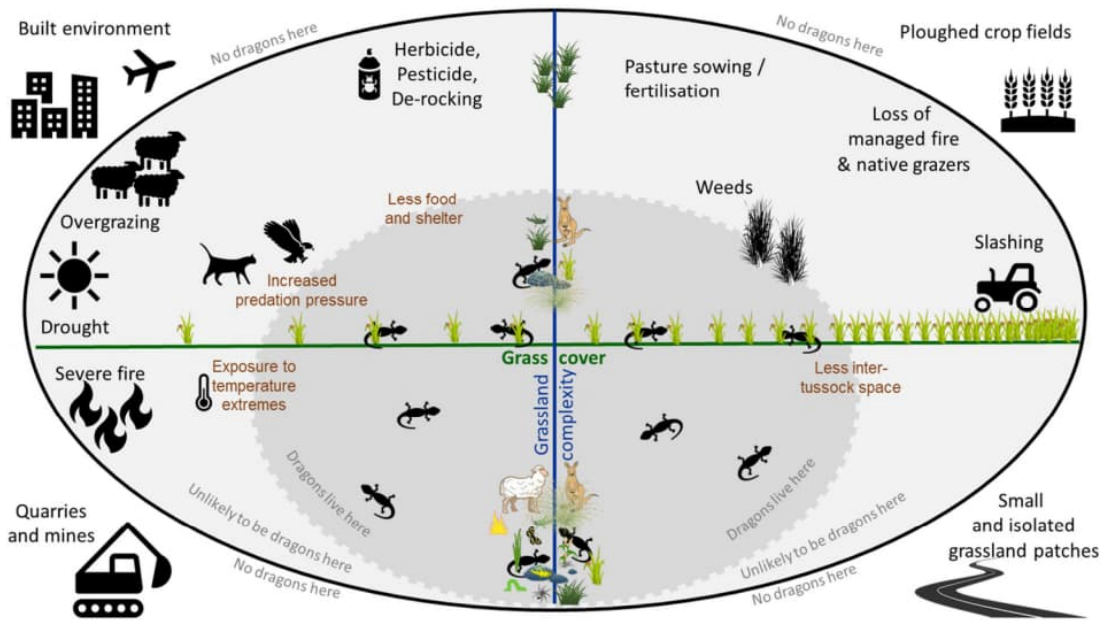
Grassland Earless Dragons shelter and lay their eggs in burrows that are either existing burrows created by invertebrates or burrows they dig themselves. The species shows site fidelity to one or two burrows and usually remain within 1 m of a burrow (DCCEEW 2023b). Individual adults rarely move more than 40 m over days or weeks but are capable of longer movements over time with distances of 67 m over three days, 110 m over summer and 80 m in a week reported for Monaro and Canberra earless dragons (Robertson and Evans 2009/2012; DCCEEW 2023b).

2.5 Threats

Historical causes of decline and local extirpation of Grassland Earless Dragons has been the loss, degradation, and fragmentation of their habitat by development (agricultural and urban). Current threats to Grassland Earless Dragons are identified in DCCEEW (2023b) and include:

- Development, particularly ongoing urban expansion and renewable energy programs, quarries and mines
- Agricultural activities (cropping and pasture supplementation)
- Grazing
- Weeds
- Fire
- Drought
- Climate change
- Predation

Figure 5 provides a generalised overview of threats and impacts on Grassland Earless Dragons (extract of Figure 7 from DCCEEW 2023b p 30). Table 1 provides a description of the current threats based on the Conservation Advice (DCCEEW 2023c p217-218) and the ACT Action Plan (ACT Government 2017b).



Source: Symbols courtesy of Creative Commons licencing and the NESP Resilient Landscapes Hub: www.neslandscapes.edu.au

Figure 5 Generalised overview of threats and impacts on Grassland Earless Dragons (extract of Figure 7 from DCCEEW 2023b p 30)

Table 1 Threats to Victorian Grassland Earless Dragon

Threat	Description (based on DCCEEW 2023c and ACT Government 2017b)
Urbanisation	<p>Loss and fragmentation of habitat through clearing of native grasslands for agricultural purposes and urban, industrial and infrastructure development has been, and continues to be, a major threat to the survival of Victorian Grassland Earless Dragon.</p> <p>Less than 2% of the Victorian volcanic grasslands remain and most of the higher quality remnants that remain within the modelled distribution of the VGED occur in small and isolated areas on public land (DCCEEW 2023c). Larger remnants occur on private land and are mostly degraded; this includes the Western Grasslands Nature Conservation Reserve that was proposed to offset actions arising from the Melbourne Strategic Assessment urban growth areas. The Western Grasslands Nature Conservation Reserve has a high proportion of de-rocked, fertilised or weed invaded areas and only 10% of the reserve area has been purchased in the 10-year timeframe for establishing the reserve (DCCEEW 2023c).</p>
Agricultural land modification	<p>Ploughing, the use of fertilisers, and de-rocking to improve agricultural land are actions that are incompatible with grassland earless dragon occurrence and are likely to have caused significant loss of habitat for the species (DCCEEW 2023c).</p> <p>Ploughing and rock removal destroy spider burrows, soil cracks and rock cover which are critical shelter resources for the grassland earless dragons (DCCEEW 2023c).</p> <p>Pasture improvement leads to damage like weed invasion (ACT Government 2017b).</p>
Overgrazing	<p>Overgrazing by kangaroos, rabbits or stock (or close mowing) leads to soil compaction, loss of tussock structure and increase in bare ground. Reductions in vegetation cover are likely to reduce availability of invertebrates (as prey and creators of shelter burrows) and increase exposure to predation and/or overheating. Impacts of overgrazing are exacerbated during drought conditions (DCCEEW 2023c; ACT Government 2017b).</p> <p>Grassland Earless Dragons in other states (ACT and NSW) occur in areas with intermittent or light levels of managed grazing (DCCEEW 2023c).</p>

Threat	Description (based on DCCEEW 2023c and ACT Government 2017b)
Weed invasion	<p>Weeds which are aggressive colonisers that form monocultures by outcompeting native species are of particular concern as they can obscure invertebrate burrows and fill inter-tussock spaces (DCCEEW 2023c). Those weeds include African Lovegrass (<i>Eragrostis curvula</i>), Chilean Needlegrass (<i>Nassella neesiana</i>), Capeweed (<i>Arctotheca calendula</i>), Saffron Thistle (<i>Carthamus lanatus</i>), Paterson's Curse (<i>Echium plantagineum</i>) and St John's Wort (<i>Hypericum perforatum</i>) (ACT Government 2017b). The young forbs have rosettes that can fill inter-tussock spaces and obscure burrows. The mature plants can shade the ground and release excess nutrients into the soil when they die at the end of the season. Weeds may reduce the density of prey species (ACT Government 2017b).</p> <p>Invasive weeds are often unpalatable to grazers leading to their dominance where heavy grazing occurs (DCCEEW 2023c).</p>
Biomass	<p>Excessive vegetation biomass that can develop due to insufficient grazing leads to a reduction in inter-tussock spaces for hunting and basking, a reduction in soil surface temperatures, and may also increase the risk of wildfire.</p> <p>A study of kangaroo density and vegetation condition at ACT sites showed moderate levels of kangaroo grazing (or light sheep grazing) are required to maintain structural heterogeneity by preventing a few grass species from dominating the sward (ACT Government 2017b).</p>
Slashing	<p>Urbanisation has resulted in a change in management approach in fragmented grassland remnants in the greater Melbourne area. Those grassland remnants are typically managed through slashing and spraying of herbicides rather than through grazing animals and/or fire. Slashing creates a homogenous structure with reduced availability of inter-tussock spaces (DCCEEW 2023c). Slashing also creates mats of cut grass that increase nutrient release which promotes weed growth and increase the risk of severe fire (DCCEEW 2023c).</p>
Pesticide use	<p>Pesticides to control insects is likely to constrain the availability of invertebrate prey and burrows for VGED (DCCEEW 2023c).</p>
Fire	<p>Fire can be used to rejuvenate native grasslands by reducing biomass and maintaining diversity in the grassland structure (structural heterogeneity). However, although arthropod burrows may protect VGED, fire could still result in direct mortality of VGEDs. Fire could also result in reduced body condition post-fire of any individuals that persist by temporarily reducing availability of food and shelter. Predation risk also increases in open areas when ground cover has been removed by fire (DCCEEW 2023c).</p> <p>A small-scale patch burning trial in grasslands in the ACT suggests grassland earless dragons may be resilient to patchy fires of low severity but suffer declines following large-scale high-severity fires (DCCEEW 2023c).</p>
Predation	<p>Predation by cats, dogs and foxes may impact populations particularly in areas in proximity to urban areas and/or where vegetation cover has been reduced by grazing or unmanaged fire. Foxes are likely to be more numerous on the rural sites. Predation by domestic pets might cause increased predation rates where housing is developed close to VGED sites (DCCEEW 2023c; ACT Government 2017b).</p> <p>Predation by native animals is another potential threat to the species. Increase predation may occur due to an increase in artificial perches for birds such as magpies, ravens and raptors (posts, fences, buildings); exposure due to loss of groundcover (grazing and/or unmanaged fire); or enhanced shelter for snakes (e.g. dumped materials or added logs/woody debris near habitat) (ACT Government 2017b).</p>

3. Method

Consideration of the potential for the construction footprint to support habitat for VGED has been based on desktop information (reference material and findings of flora and fauna assessments undertaken for the Project) and a species-specific habitat assessment.

3.1 Desktop information

Desktop information considered in the assessment:

- Key reference documents for the VGED listed in Section 2 and review of known information on species' habitat requirements (see Section 2.4)
- Findings of flora and fauna existing conditions and targeted assessments undertaken for the Project to the time of referral under the EPBC Act (AECOM-GHD JV 2023a) as an indication of the nature and extent of habitat and likelihood of that habitat being suitable for VGED. Those assessments included:
 - General site assessments undertaken between 2020 and early 2023 to identify ecological values. The first site assessment was undertaken across two days in September and October 2020 as part of a rapid field assessment, to gain a high-level understanding of the potential ecological constraints of the Project. Due to changes in the IA over time, several additional site assessments were undertaken across six days in November and December 2021 (05/11/21, 17/11/21, 25/11/21, 07/12/21, 21/12/2021 and 23/12/2021) on 29 July 2022 and 5 April 2023
 - Targeted transect surveys for Spiny Rice-flower (*Pimelea spinescens* subsp. *spinescens*) undertaken on 23 and 24 August 2021 in areas of suitable habitat
 - Targeted Striped Legless Lizard (*Delma impar*) habitat assessment undertaken over multiple days between August and December 2021. Identification of habitat was based on suitable habitat features as per the Striped Legless Lizard referral guidelines (DSEWPaC 2011) which are similar requirements to those of the VGED. The habitat assessment considered presence of:
 - Surface rock
 - Embedded rock
 - Soil cracks
 - Arthropod burrows
 - Suitable vegetation such as grasslands dominated by tussock forming grasses
 - Follow-up targeted survey for Spiny Rice-flower undertaken in Banchory Grove Reserve on 5 April 2023 to inform the Project impact assessment
- Searches of the Victorian Biodiversity Atlas (VBA) and Atlas of Living Australia (ALA) for records within 20 km of the construction footprint
- Searches of Victorian Government Maps and Spatial Data (Department of Transport and Planning 2024) for land use history and barriers to movement – aerial photographs

As for many grassland-dependent fauna species, defining habitat suitability can be difficult and without recent examples of areas known to support the species, parallels between the VGED and the Striped Legless Lizard are likely to be relevant, especially given the overlap in predicted habitat requirements. As such, information obtained for Striped Legless Lizard for the Project is particularly relevant to potential habitat for the VGED in the construction footprint.

3.2 Habitat assessment

Surveys were undertaken in December 2023, January 2024 and February 2024 to assess potential for habitat to be suitable for VGED to inform the likelihood of occurrence assessment of the species in the area. Survey areas were defined by previous mapping of Plains Grassland (and/or Natural Temperate Grasslands of the Victorian Volcanic Plain), potential habitat for Striped Legless Lizard and other areas with tufted grass structure within the construction footprint, MTM biosites and Banchory Grove Reserve.

At the time of undertaking the habitat assessment, specific detailed guidance of habitat parameters and sampling methods had not been released by the Victorian Grassland Earless Dragon Recovery Team. As such the method applied to the survey was developed based on the aim of answering the fundamental question as to whether the construction footprint, MTM biosites and/or Banchory Grove Reserve support potential habitat for VGED.

The habitat in those areas was systematically sampled using 1x1 m quadrats to collect information on parameters thought to influence presence of VGED based on the understanding of habitat requirements of the species (from the conservation advice and other literature as outlined in Section 2.4).

The parameters sampled within each quadrat were invertebrate burrow presence, burrow occupancy, biomass, tussock height, crack length, embedded rock cover, surface rock cover, cryptogam cover, total forb cover, total native species cover, total vegetation cover, inter-tussock spaces and dominant tussock grass species. These parameters were selected to provide an indication of the habitat structure and composition and availability of shelter resources for VGED.

Any arthropod burrows encountered during the habitat assessment were inspected for occupancy using an endoscope (Plate 3).

Landscape context mapping of suitable habitat and barriers to VGED movement (Section 4.3) were informed from the surveys undertaken in late 2023 and early 2024, and general and targeted ecological surveys from 2020 to 2023 as outlined above.

The detailed survey method and results are provided in the survey report in Appendix B. A summary of the findings has been incorporated into this report.



Plate 3 Habitat assessment and inspection of spider burrow, Banchory Grove Reserve (Dec 2023)

4. Results

4.1 Proximity to records

Records of VGED on the Victorian Biodiversity Atlas and Atlas of Living Australia are shown in Figure 6. There is a record of VGED at the Holden Flora Reserve from 1990. Holden Flora Reserve is located approximately 5 km north of Holden Road and 7 km north of Banchory Grove Reserve.

There are other historic records from 1884, 1895 and 1908 from areas that are now the suburbs of Essendon, Flemington, Footscray and Yarraville over 20 km to the south-east of the study area.

4.2 Land use history of the area

The Project is in a highly modified landscape dominated by exotic vegetation. Native vegetation has largely been cleared and degraded by a long history of agriculture and by construction of rail, road, and transmission line infrastructure, residential development, and the Calder Park Motorsport Complex (Appendix B). Aerial photograph sequence shows the progression of disturbance in the landscape from 1951 to 2021 (see Appendix B). The change is particularly stark when comparing 1951 to later images, with Calder Park Motorsport Complex and other developments significantly changing the mostly agricultural landscape.

The Cultural Heritage Management Plan (CHMP) prepared by Chandlee and Welsh (2023) for the Project delved into the land use history of the area and has been drawn on in the outline of the history of land use below (Figures 12 to 16).

Agriculture

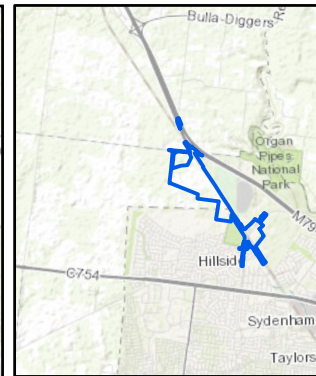
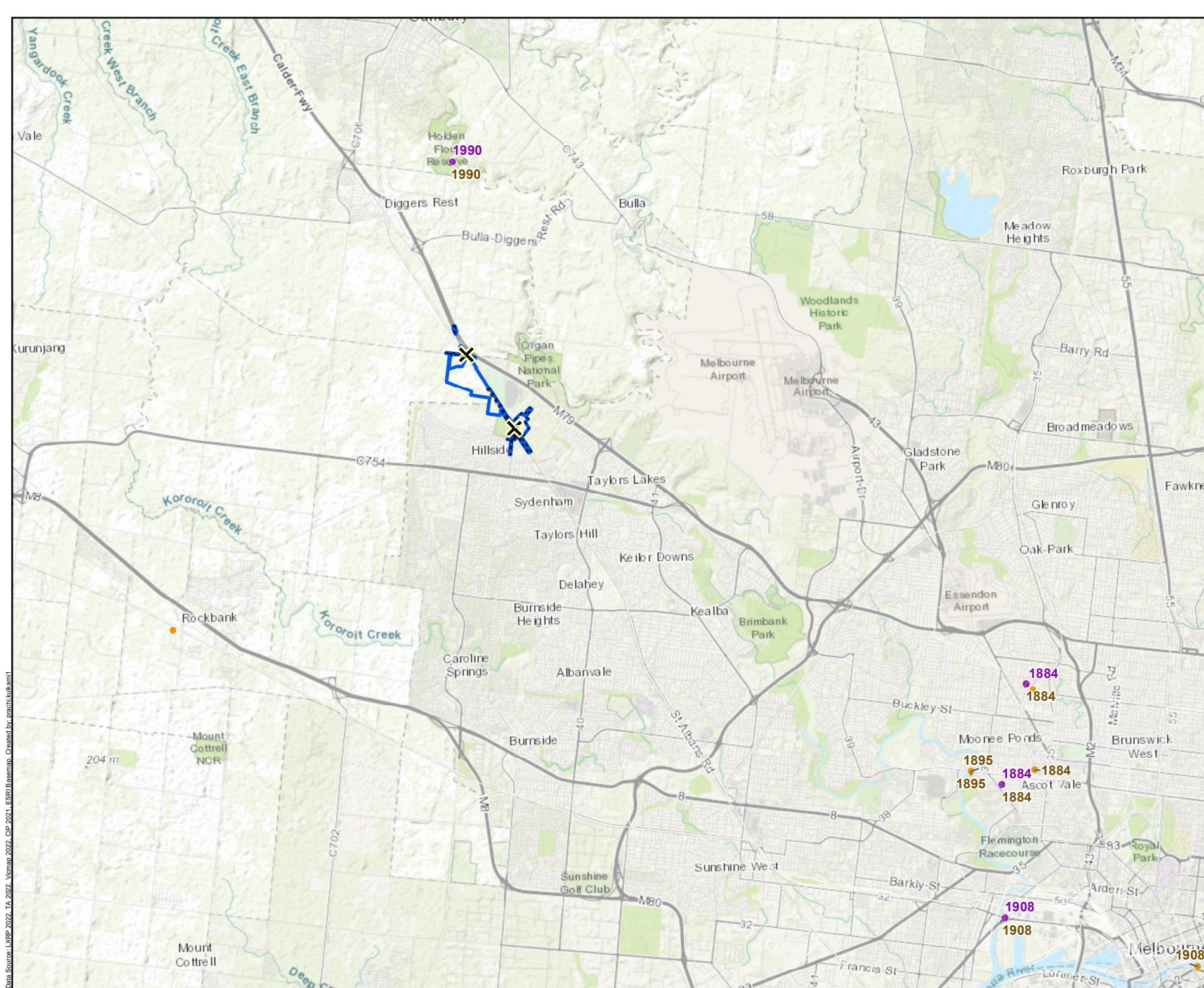
From the 1860s the area was primarily utilised for dryland agriculture. Timber production and reserves were also present in the geographic region (Figure 12). Changes occurred in the 1900s when land use shifted to animal grazing as its focus. Minimal development occurred in the early twentieth century (Chandlee and Welsh 2023).

Pastoral and agricultural activities have impacted the areas not under residential or other development. Agricultural activities have included grazing, ploughing, fencing, formation of dirt tracks and construction of drystone walls (Chandlee and Welsh 2023). It is unknown to what extent pasture improvement and the application of herbicides and pesticides has been undertaken in the area.

Residential development

In the 1900s residential development extending from Keilor appeared in subdivision planning (Chandlee and Welsh 2023). Construction of the suburbs adjacent to the study area did not appear to have commenced in 1951 (based on the 1951 aerial in Figure 14 and Appendix B) and the northern extent of what are now the suburbs of Hillside and Sydenham was completed in the early 2000s (based on Google Earth images). Calder Park Drive was presumably established at this time as a link between Melton Highway and the residential estates to the Calder Freeway. Imagery from 1991 indicates that Calder Park Drive was a series of tracks in the south and a road in the north and by 2001 is a connected road, with possible unsealed sections in the north (Appendix B).

Figure 6 Records of Victorian Grassland Earless Dragon within 20 km of the study area

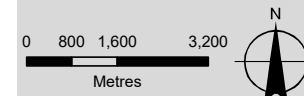


LEGEND

- Level crossing site
- VBA records of Grassland Earless Dragon
- ALA records of Grassland Earless Dragon
- Construction footprint
- Project area
- Railway

VBA and ALA records of Grassland Earless Dragon
Figure 6

Habitat Assessment



Paper Size A4
Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

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Data Source: LXRP 2022, TA 2022, Vmapa 2022, QIP 2021, ESRI Basemap, Created by: rachel.kulkarni

Linear infrastructure (road, rail and transmission lines)

In 1951 the area was subject to intensive vegetation clearance in preparation for construction of the current railway line, an upgrade from the railway to Bendigo that commenced construction in 1858 and opened in 1862 (Bendigo Regional Archive Centre online).

From 1951 to 1985 additional roadways were constructed and utility connections installed (Chandlee and Welsh 2023). The Calder Freeway was built in 1972 and expanded in the late 1980s.

Sydenham Terminal Station (electrical substation) was established sometime after 1974, but before 1982.

Construction of infrastructure (road, rail and transmission line) has led to material stockpiling and illegal dumping in the rail corridor and roadsides, which has resulted in degradation of native vegetation and fauna habitat.

Calder Park Motorsport Complex

The Calder Park Motorsport Complex construction began in the 1960s with the Calder Park Raceway opening in 1962 and the Calder Park Thunderdome constructed in 1984 and opened in 1987. A license was issued in 1983 under the *Environment Protection Act 1970* to use the property at 377 Calder Park Hwy (Calder Park Motorsport Complex) as a landfill site for solid, inert waste and shredded tyres.

This facility involved extensive earthworks, including but not limited to, the construction of large earth bunds that have likely altered the hydrological system of Taylors Creek, and the soil composition and structure of the surrounding land (Chandlee and Welsh 2023).

Calder Park Stabling Yard

Calder Park Stabling Yard commenced construction in 2010 with the first stage opened in 2014. A second stage was completed in 2015 and continues to be expanded in stages.

Reserves

Several areas have been set aside in the landscape surrounding the study area. Those areas are listed as biosites and include Metro Trains Melbourne (MTM) biosites in the rail corridor and other reserves.

Metro Trains Melbourne (MTM) biosites

Some areas of remnant native grassland persist within the rail corridor in discrete MTM biosites. The majority of biosites are outside the construction footprint but some are surrounded by construction areas for the Project (Appendix E). There will be a direct impact on 0.025 ha of Plains Grassland within the biosite to the immediate south of Calder Park Drive level crossing. The biosites are degraded and are very small and isolated from other areas of native grassland.

Banchory Grove Reserve Grassland Nature Conservation Reserve (biosite 3549; Grass PPKE009)

Immediately adjacent to the construction footprint of Calder Park Drive is the 22 ha Banchory Grove Reserve. The grassland most closely represents the natural landscape of the area and is characterised by treeless areas of perennial native grass species such as Kangaroo Grass *Themeda triandra* and Wallaby Grass *Rytidosperma spp.*, as well as native herbs and small shrubs. Banchory Grove Reserve provides some of the last remaining habitat for threatened fauna and flora species in the local area.

Banchory Grove Reserve was declared a Natural Features Reserve under the International Union for the Conservation of Nature (IUCN) Category IA on 5 July 1999. Category IA refers to a 'strict nature reserve', which is an area protected from all but light human use to protect its biodiversity. Banchory Grove Reserve is managed by Parks Victoria.

Banchory Grove Reserve appears to have been used for agriculture and potentially residential development. There is clear agricultural division in the 1968 image (Figure 7). Whereas in the 1991 imagery there is a large structure encircled by tracks in the north-east corner that is now the T-junction of Victoria Road and Calder Park Drive (Figure 10). This structure is absent in 1985 and 2001 imagery (Figures 8 to 11). It is possible that the temporary structure is related to the construction of the residential development to the south as there are connecting tracks/roads (e.g. building/sale office). There is also a small structure or possibly a dam in the south-east corner (adjacent to now Calder Park Drive) in the 1985 and possibly in the 1974 imagery (Figure 8, Figure 9).



Figure 7 Close-up image of Banchory Grove Reserve in 1968, with division of cropping/grazing parcels evident



Figure 8 Close-up image of Banchory Grove Reserve in 1974



Figure 9 Close-up image of Banchory Grove Reserve in 1985, with a dam or structure in south-west corner



Figure 10 Close-up image of Banchory Grove Reserve in 1991, with large structure in north-east corner probably linked to the residential development in right-hand bottom corner of image



Figure 11 Close-up image of Banchory Grove Reserve in 2001, post protection, but with tracks from 1991 development in north-east corner and disturbance in south-east corner still evident

Organ Pipes National Park (biosite 3545; Grass PPKE005)

Organ Pipes National Park was established in the 1970s in recognition as an important area for conservation of native flora and fauna and as a site of geological significance (a 'geological monument'). The park supports remnant native grasslands and grassy woodlands and is an important link in a wildlife corridor along Jacksons and Deep Creeks (Parks Victoria 1998). The park is between 1 km and 1.5 km from the study area.

Pioneer Park – biosite 5270 (Sydenham Township Reserve)

Pioneer Park is 6.7 ha area of Crown Land set aside as a reserve in 1992. Pioneer Park contains 3.3 ha fenced areas that support Natural Temperate Grasslands of the Victorian Volcanic Plains that is actively managed by Council to protect and enhance its ecological values. The remaining area (3.4 ha) is managed as public open space (Brimbank City Council 2015). The reserve was earmarked in 2015 as a translocation recipient site for Spiny Rice-flower for the Watergardens Town Centre development with plants translocated in 2018 and additional plants and seedlings added in 2020 (DCCEEW 2022).

Watercourses

Two waterways flow through the area. Taylors Creek flows from north-west to south-east under the railway and under Calder Park Drive south of the Calder Park Motorsport Complex. The headwaters of Taylors Creek comprise unnamed drainage lines with a series of on-line dams within the Calder Park Stabling Yard paddock north of the Sydenham Terminal Station. Those tributaries join to form Taylors Creek near the rail corridor. Victoria Road Drain is a tributary of Taylors Creek that emerges from under the residential areas at the rail corridor at Darlington Road.

Shallow, unnamed tributaries of Jacksons Creek occur further north around Holden Road.

Where Taylors Creek crosses the construction footprint is dominated by a thick cover of Common Reed *Phragmites australis* surrounded by introduced species including Toowoomba Canary-grass and Artichoke Thistle.

Modification to the local waterways through agricultural use and vegetation clearing will have impacted the natural hydrology patterns within the area which in turn will have impacted on the drainage of flood plains, erosional processes (Chandlee and Welsh 2023).

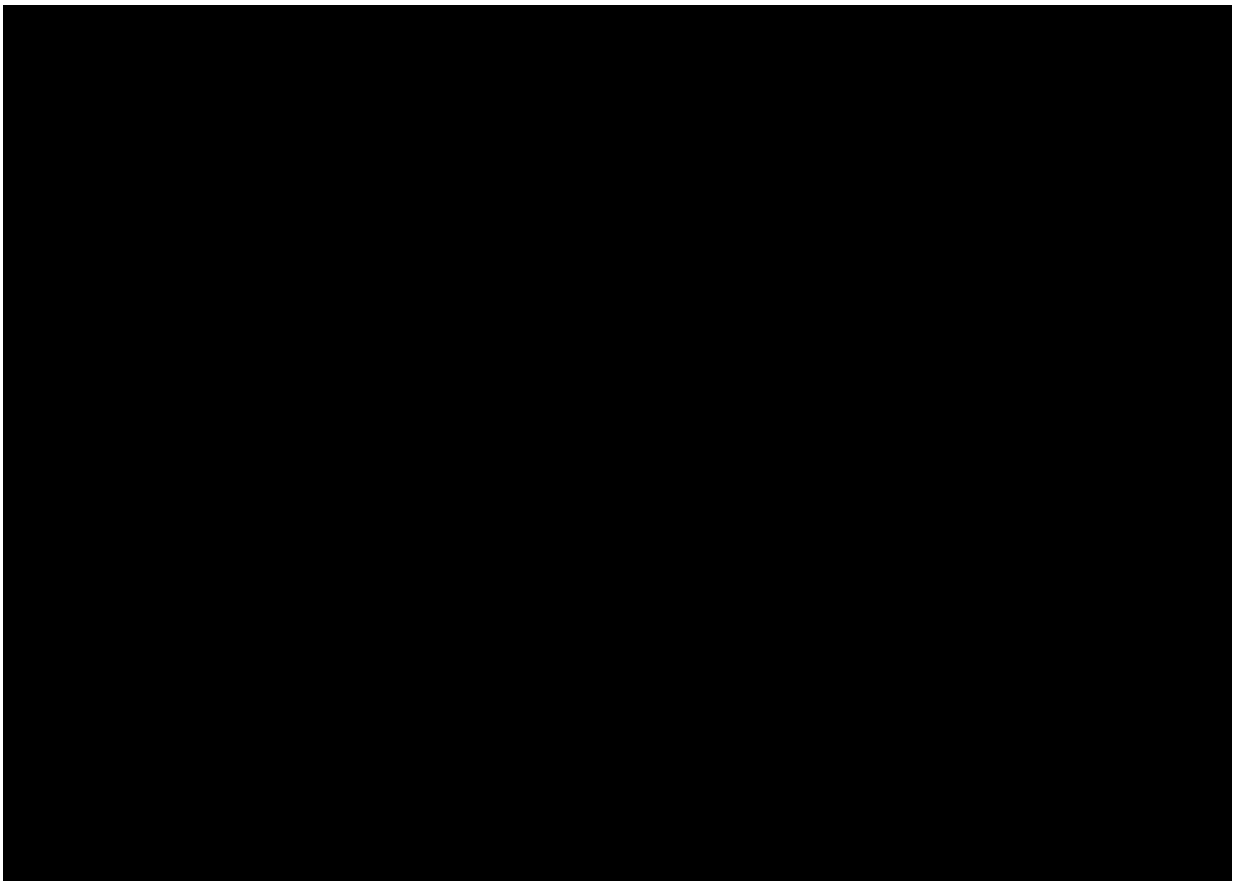


Figure 12 Land use in 1886 (extract of Figure 19 from CHMP; Source: DELWP 2022)

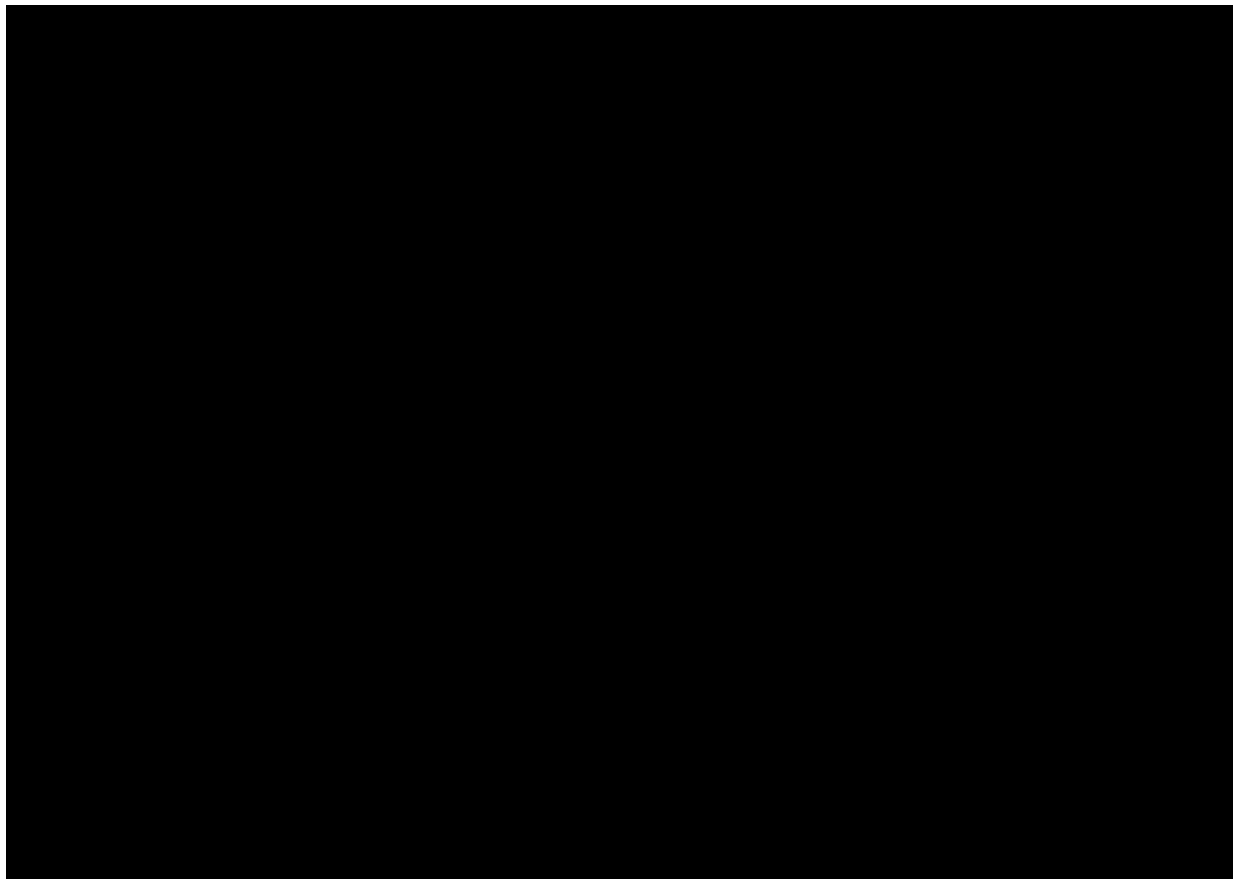


Figure 13 Land use in 1901 (extract of Figure 20 from CHMP; Source: DELWP 2022)

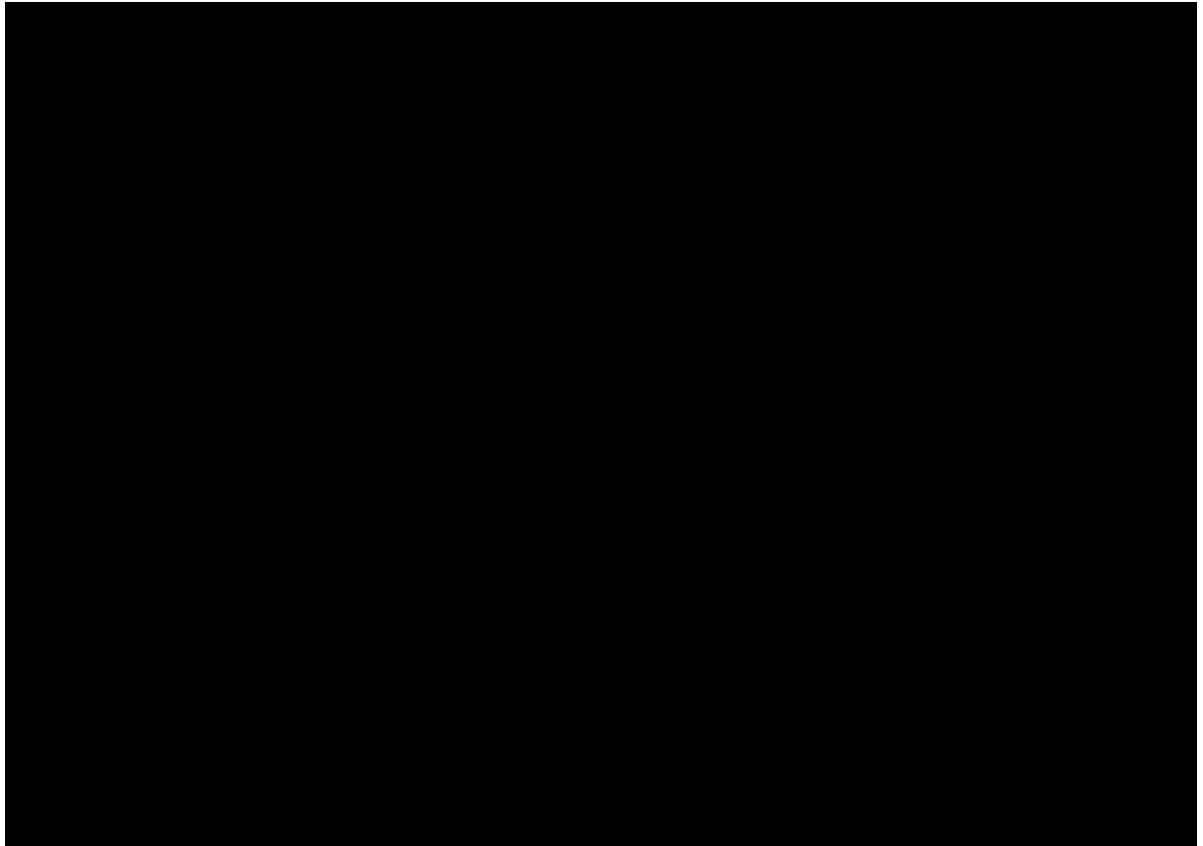


Figure 14 Historical aerial from 1951(extract of Figure 21 from CHMP; Source: DELWP 2022)

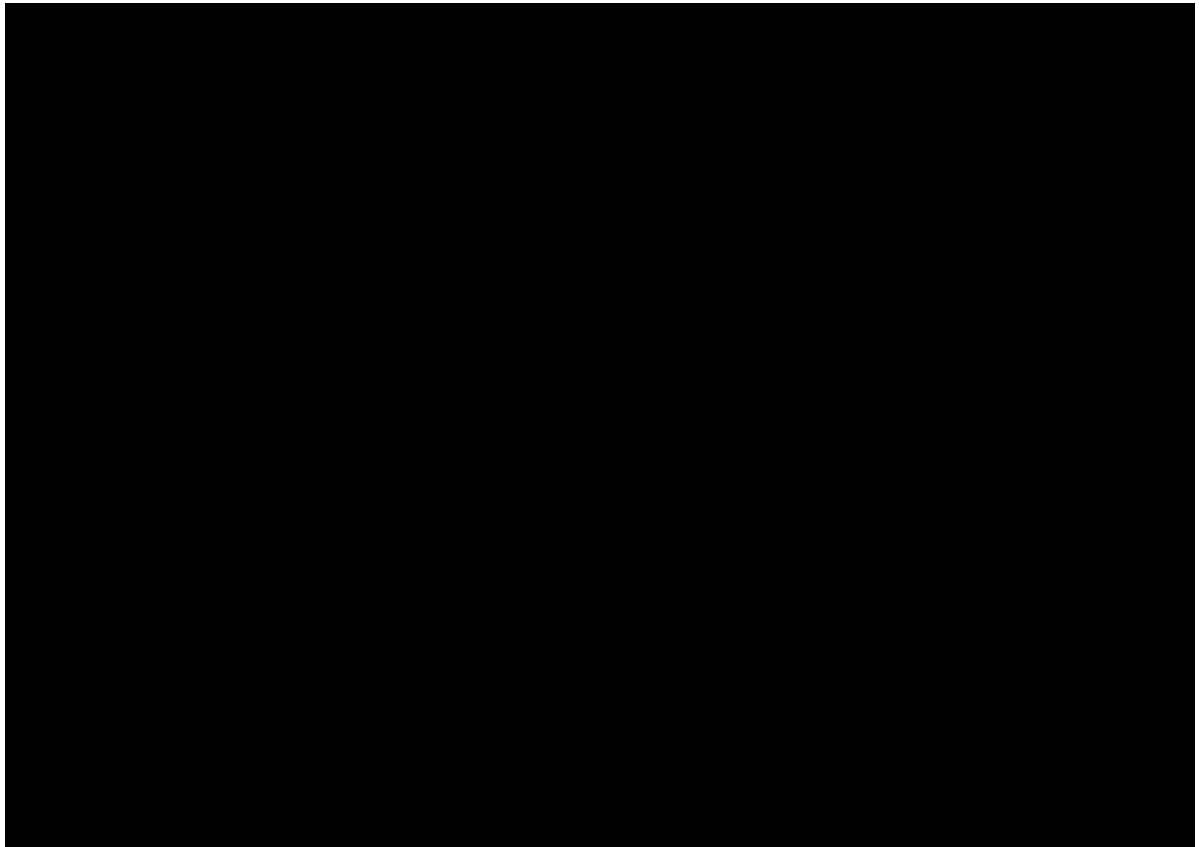


Figure 15 Historical aerial from 1982 (extract of Figure 22 from CHMP; Source: DELWP 2022)

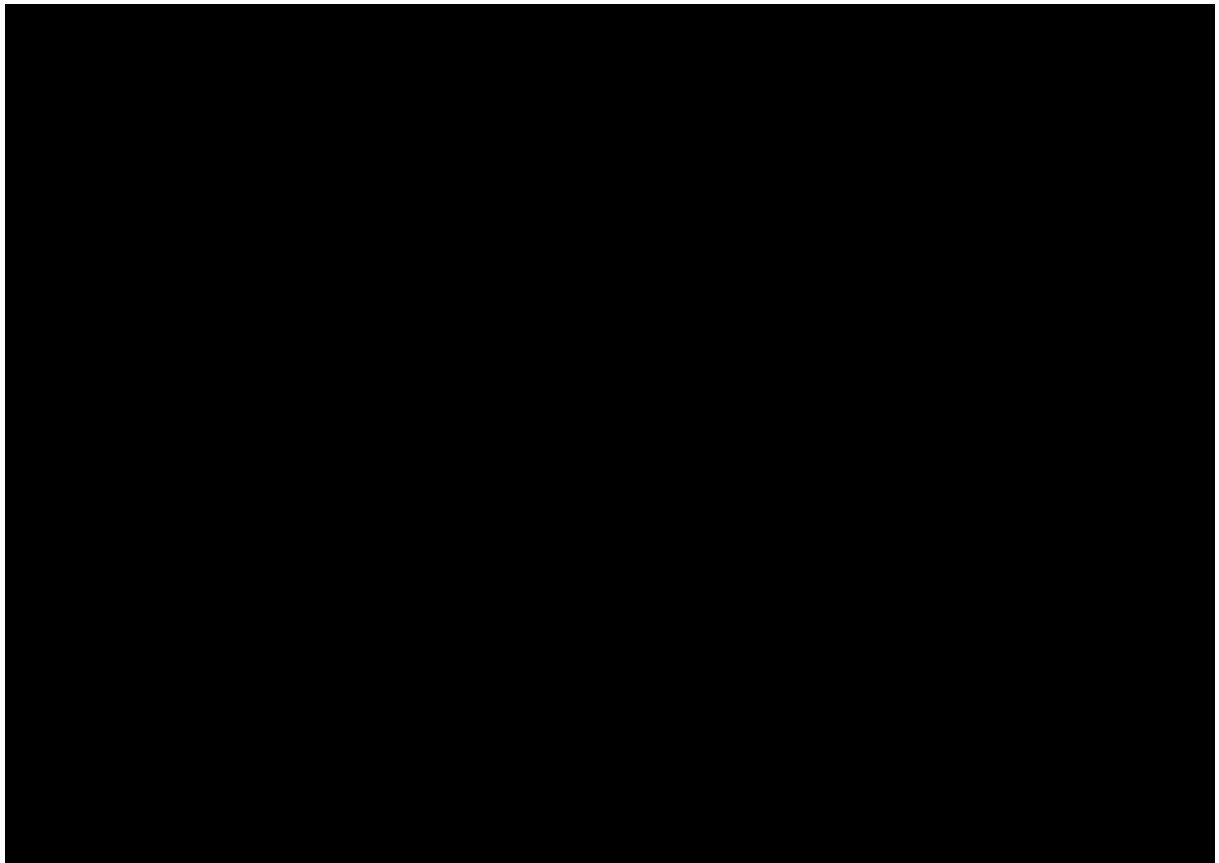


Figure 16 Historical aerial from 2010 (extract of Figure 22 from CHMP; Source: NearMap)



Figure 17 February 2021 (Source: Google Earth)



Figure 18 Banchory Grove Reserve (Google Earth 2021)



Plate 4 Highly degraded land from earth works associated with transmission line infrastructure and the thunder dome



Plate 5 Ausnet paddock with significant transmission line infrastructure and dominated by African box thorn and Artichoke Thistle

4.3 Landscape context

Landscape context mapping of suitable habitat and barriers to VGED movement were informed from the surveys undertaken in late 2023 and early 2024, and general and targeted ecological surveys from 2020 to 2023 as outlined in Section 3.1.

The construction footprint and Banchory Grove Reserve are located in a modified landscape with developed areas, infrastructure and inhospitable environments (infrastructure) that may influence the ability for the species to persist due to isolation (Figure 23). It is clear from aerial imagery and mapping (Figures 19 to 23) that any wildlife corridors (e.g. vegetated creeks, green wedges) are fragmented and would provide little cover and connectivity for a small reptile.

Banchory Grove Reserve is not connected directly to less disturbed remnant areas of potential habitat such as Organ Pipes National Park. The rail line, agricultural land, Calder Park Motorsport Complex and Calder Freeway dissect the landscape between the two reserves (Figure 23).

Areas to the north of Banchory Grove Reserve, although not developed, have been used for agriculture and rail and transmission line infrastructure including the Sydenham Terminal Station. Although private land to the west of Banchory Grove Reserve between Hillside residential area and the Calder Park Stabling Yards is undeveloped, it is unknown to what extent native grassland persists. The area immediately to the west of Banchory Grove Reserve was characterised by a dense sward of Serrated Tussock at the time of the habitat assessment, and aerial imagery suggests the area has been previously disturbed. Beyond that area further to the west may be an area referred to as Sydenham North Private (Grass PPMED12) biosite (EHP 2014). Banchory Grove Reserve is flanked by residential areas of Hillside to the south. Residential areas of Sydenham also occur to the east across Calder Park Drive.

Northern section of the construction footprint (Holden Road)

Figure 19 is a 2023 NearMap image of the Holden Road level crossing area showing disturbance to the paddocks that are now the site of the Calder Park Stabling Yard, the service station development on the Calder Freeway and the road and rail network. Furrows can be seen in remaining paddocks. All of these features contribute to the isolate and degradation of the area.



Figure 19 NearMap December 2023 – northern construction footprint (yellow line) (Holden Road)

Figure 20 is a NearMap image from December 2023 of the northern section of the construction footprint that shows the disturbed and isolated environment of the rail corridor between the Calder Freeway outbound service station and the Calder Park Stabling Yards and the disturbed environment of the remaining landscape.



Figure 20 Northern construction footprint (yellow line) (Holden Road) in December 2023 (source: NearMap)

Southern section of the construction footprint (Calder Park Drive)

Figure 21 is an April 2023 NearMap image that shows the management track dissecting the centre of Banchory Grove Reserve was in place. Signs of considerable earthworks to the west and north-west, the rail corridor and Calder Park Motorsport Complex to the north and north-west, rail corridor and Calder Park Drive sealed road to the east and residential areas to the south and west. The agricultural land to the east also appears to have been disturbed.

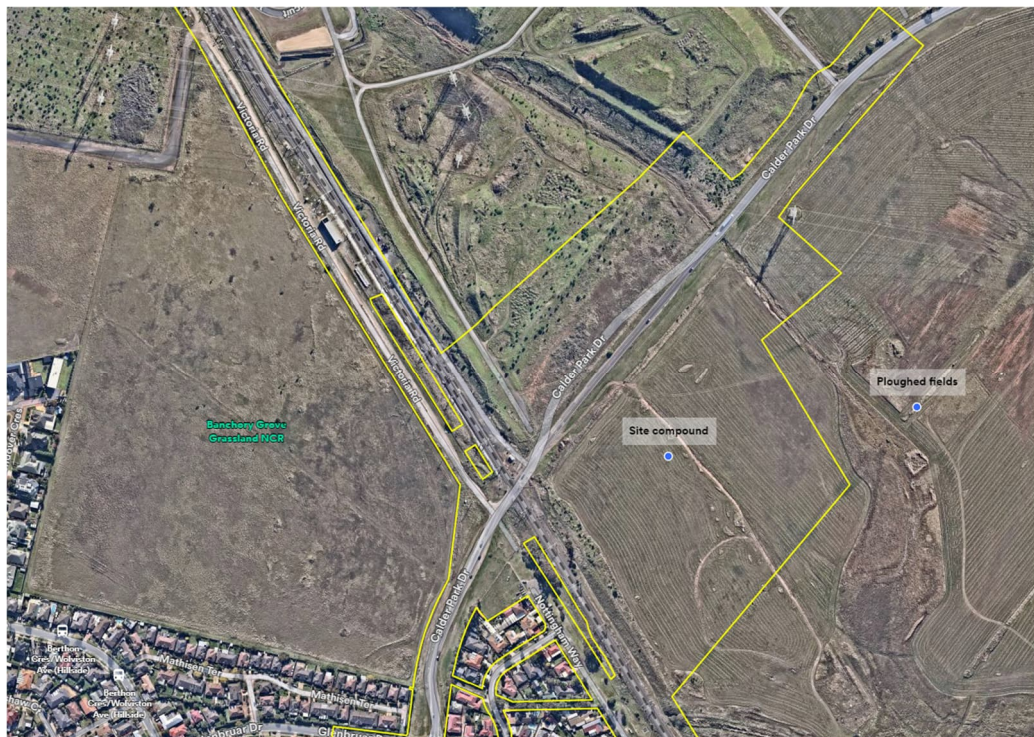


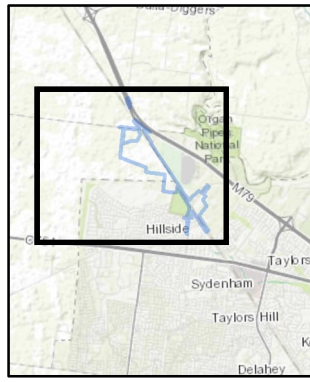
Figure 21 NearMap April 2023 - southern construction footprint (yellow line) (Calder Park Drive)

Figure 22 is a NearMap image from December 2023 of the southern section of the construction footprint shows the level of disturbance in the landscape. The slashed agricultural paddocks to the east of the rail and Calder Park Drive, the landfill and disturbed land associated with the Calder Park Motorsport Complex to the north of Calder Park Drive and the rail corridor, residential areas to the south, and the disturbed area in the east of Banchory Grove Reserve adjacent to the construction footprint.



Figure 22 Southern construction footprint (yellow line) (Calder Park Drive) in December 2023 (Source: NearMap)

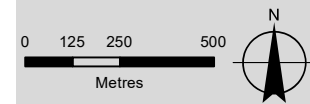
Figure 23 Barriers to Victorian Grassland Earless Dragon movement across the landscape and habitat suitability



- LEGEND**
- Level crossing site
 - Train Station
 - Organ Pipes National Park
 - Construction footprint
 - Habitat Suitability**
 - Less suitable
 - Likely unsuitable (no VGED quadrats)
 - Potential
 - Unsuitable
 - Barriers**
 - BP Service Station
 - Calder Park Motorsport Complex
 - Infrastructure
 - Railway and stabling
 - Residential
 - Roads and Highway
 - Substation

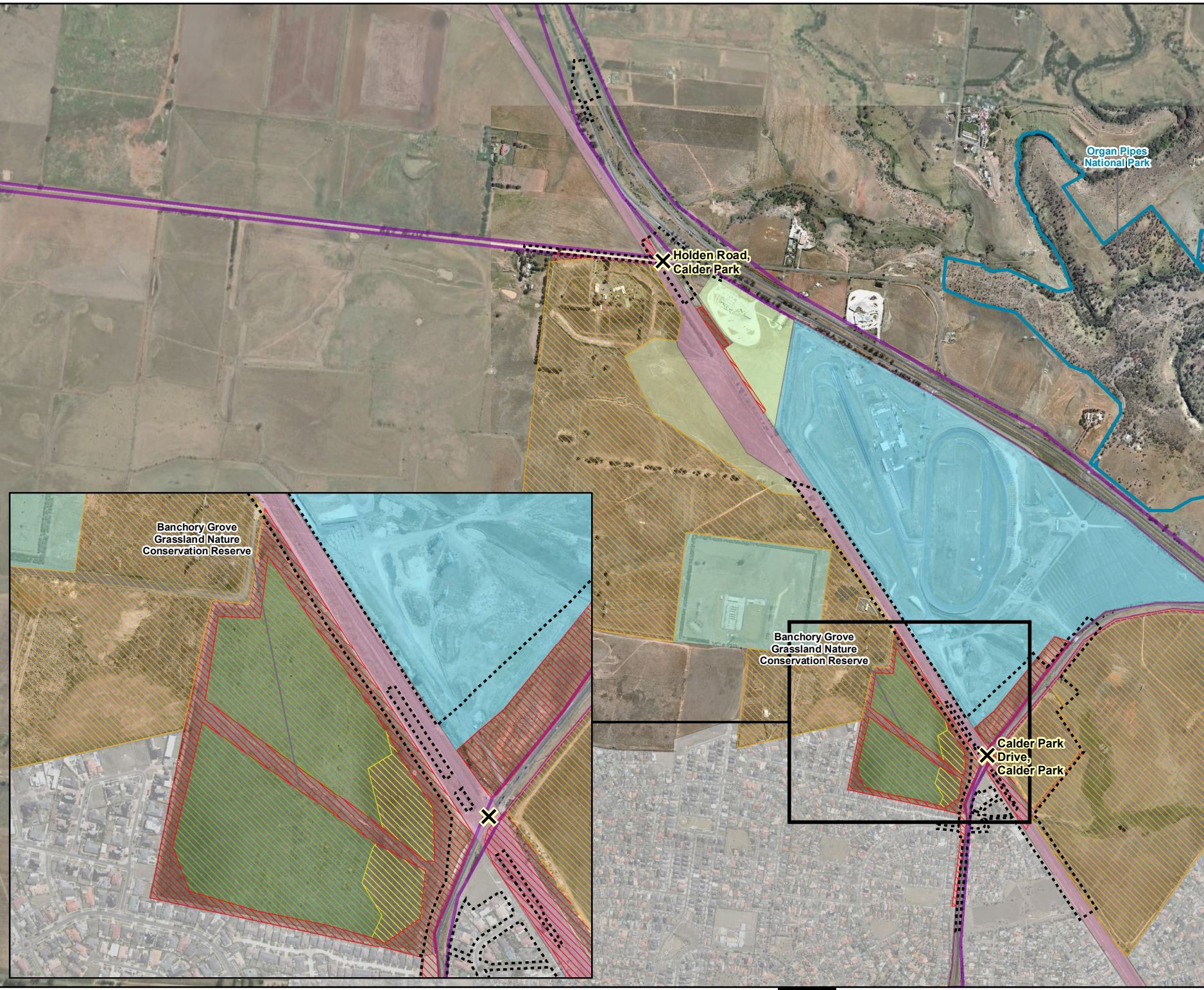
Victorian Grassland Earless Dragon barriers to landscape movement
Figure 23

Habitat Assessment



Paper Size A4
Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

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Data Source: LXP 2022, TA 2022, Vmap 2022, CIP 2021, ESRI/Basemap, Created by: crachi/kulkarni

4.4 Habitat features

4.4.1 Construction footprint

The construction footprint has been substantially modified through the construction of Calder Park Drive, Holden Road, rail and transmission line infrastructure, agricultural land use and the Calder Park Motorsport Complex and landfill.

Degraded native grassland now only persists in the MTM biosites in the rail corridor (outside the construction footprint) and as a few small discrete patches along the roadsides of Calder Park Drive and Holden Road.

Cracking in soil was minimal and not visible in many places due to high biomass (i.e., invasive species). Whereas cracking was high adjacent to the site compound possibly due to a long history of soil disturbance. A lot of rail ballast in the rail corridor indicates that these are not natural landforms. Large and small piles of rocks were artificial.

Surface rock was high in the construction footprint due to rock piles, rail ballast and road rubble encroaching from the edges.

Most areas within the construction footprint had high soil disturbance and/or compaction. Arthropod burrows seemed abandoned and old and were infrequently encountered.

The roadsides lack sheltering habitat features such as embedded and loose surface rock, soil cracks, inter-tussock spaces and Arthropod burrows, and dominance of high threat weeds (such as African Box Thorn, Artichoke Thistle, Serrated Tussock and Chilean Needle Grass). Other invasive species identified in the construction footprint were Windmill Grasses, Brome Grasses, Phalaris Grass and Ribwort Plantain. There is very little to no cover of native grasses, such as Kangaroo Grass. Exposure to threats would be high, given cat and fox scats were frequently observed and it appeared that some areas were mown or slashed. Rubbish was very common. For a full description of the habitat assessment see Appendix B.

Site compound

The site compound is in an area of agricultural land that has been subject to ploughing and slashing in the past. Quadrat surveys to the southeast of the site compound determined that although it appears to be a grassy area, it was a heavily ploughed mixture of Chilean Needle Grass and Serrated Tussock. Soil cracking and disturbance was high (e.g. furrows and vehicle tracks), no arthropod burrows and a high weed diversity. A few crickets and cabbage moths were seen and heard. It is assumed that soil cracking was due to repeated inundation and drying of the clay soil, but these cracks were often open and near other soil disturbance (Plates 8 to 11). Areas beyond the construction footprint (to southeast and northeast) had recently been mown or were in the process of being mown.



Plate 6 Former paddock north of Calder Park Drive and the site compound in the Calder Park Motorsport Complex property. Large earth bund and stockpiling of material can be seen. Area dominated high threat weeds.



Plate 7 Location of site compound south-east of Calder Park level crossing. Paddock recently slashed and contains minimal sheltering habitat such as cracks, embedded and surface rock. Large earth bund north of Calder Park Drive can be seen in the background.



Plate 8 Former paddock and heavily weeded area between site compound and railway (Feb 2024)



Plate 9 Former paddock southeast of site compound (Feb 2024)



Plate 10 Soil cracking in former paddock southeast of site compound (Feb 2024)



Plate 11 Vehicle tracks and other old and recent soil disturbance in former paddock southeast of site compound (Feb 2024)

Rail corridor

The rail corridor portion of the construction footprint has been substantially disturbed by rail construction works and ongoing maintenance. The corridor is narrow and dominated by weeds including introduced grasses and Artichoke thistle. Evidence of weed poisoning was observed during survey. The natural landform is disrupted by rock piles, rail ballast, earth piles, management tracks and illegally dumped rubbish alongside management tracks where accessible.



Plate 12 Past earth works within the rail corridor indicated by large rocks and weed infested earth bund



Plate 13 Material stock piling in the rail corridor

Road easements

Roadsides within the construction footprint are Holden Road and Calder Park Drive.

Calder Park Drive

Calder Park Drive is a major link to the Calder Highway from the residential areas south and east of the study area. The roadside is dominated by exotic grasses that are regularly mown (as seen in the plates below). Small patches of degraded native grassland have been previously recorded along the roadside, but those patches appear to have degraded to the point they no longer qualify as native vegetation and/or have been removed by preliminary works (Plates 16 to 19). A small cluster of Spiny Rice-flower persist in the Calder Park Drive roadside near the rail corridor.

Quadrat sampling during the species-specific habitat assessment noted that areas previously mapped as modified Plains Grassland south of Glenbruar Drive were not apparent at the time of survey (Plate 20). The quadrat survey was unable to sample sections of the Calder Park Drive roadside due to construction works and in February 2024 the entire verge being mown, however, sampling south of Glenbruar Drive in January 2024 indicates the roadside was dominated by *Bromus* sp. and *Chloris* sp. with only scattered tufts of Kangaroo Grass (*Themeda triandra*) (Plate 22, Plate 23). Kangaroo Grass was the only native species observed and within the quadrats most often constituted 1-5%, with maximum being 10%.



Plate 14 Roadside of Calder Park Drive contains minimal sheltering habitat such as cracks, embedded and surface rock



Plate 15 Roadside of Calder Park Drive south of Glenbruar Drive. Highly modified but retains required floristic cover for EVC Plains Grassland. Sheltering habitat such as cracks, embedded and surface rock absent.



Plate 16 Calder Park Drive roadside south of level crossing – HZ3 area of high weed cover (January 2024)



Plate 17 Calder Park Drive roadside south of level crossing – area of HZ14 highly disturbed (January 2024)



Plate 18 Calder Park Drive roadside south of level crossing – area of HZ14 highly disturbed (January 2024)



Plate 19 Calder Park Drive roadside south of level crossing – area of HZ14 highly disturbed (January 2024)



Plate 20 Calder Park Drive roadside south of Glenbuar Drive – HZ15 area of highly modified EVC Plains Grassland (January 2024)



Plate 21 Calder Park Drive roadside north-east of Calder Park Drive level crossing (December 2023)



Plate 22 Quadrat sampled on Calder Park Drive roadside south of Glenbuar Drive – HZ15 area of highly modified EVC Plains Grassland, *Chloris* sp. dominates and *Themeda triandra* 1-5% (January 2024)



Plate 23 Quadrat sampled on Calder Park Drive roadside south of Glenbuar Drive – HZ15 area of highly modified EVC Plains Grassland, *Chloris* sp. dominates and *Themeda triandra* 1-5% (January 2024)

Holden Road

Holden Road is unsealed and the roadside is narrow and appears to be less regularly slashed than Calder Park Drive. Most of the roadside is exotic grasses with some planted Sugar Gums. Some small patches of low-quality native grassland occur along the roadside (Plate 24). These areas are mostly re-colonised areas of Wallaby Grass and Spear Grass (*Austrostipa* spp). Quadrats in a patch identified during previous ecological assessments for the Project as potential Striped Legless Lizard habitat were dominated by Chilean Needle-grass and Serrated Tussock (*Nassella* spp.), rubbish and road rubble (Plate 25, Plate 26).



Plate 24 Low quality native grassland vegetation along Holden Road



Plate 25 Quadrat along Holden Road previously identified as potential Striped Legless Lizard habitat. *Nassella* spp. was the dominant grass with rubbish and road rubble evident, 1-5% *Themeda triandra* cover



Plate 26 Holden Road looking towards level crossing (Feb 2024)

Existing threats

Parts of the construction footprint are subject to ongoing maintenance of rail, track and other infrastructure. Ongoing maintenance includes access by vehicles, placement of stockpiles, slashing and likely also weed spraying. According to their website, MTM conduct maintenance of the rail reserve five times a year. Works include grass slashing, weed management, trackside weed spraying, and pruning of trees and other vegetation to maintain operation.

4.4.2 MTM biosites

Several MTM biosites occur in the larger Project Area originally assessed for the Project. The construction footprint avoids the majority of MTM biosites, with a small patch (0.025 ha Plains Grassland) to be lost immediately south of the Calder Park Drive level crossing from MTM biosite 3551. The remainder of biosite 3551 shares a boundary with the construction footprint.

MTM biosite 3551 is within the rail corridor immediately south of Calder Park Drive level crossing (Plates 27 to 29). This biosite is known to support a population of Spiny Rice-flower and some areas of Natural Temperate Grassland of the Victorian Volcanic Plain beyond the area within the construction footprint. Part of the biosite has planted Sugar Gums with an understory of Wallaby grass which may have recolonised following disturbance during rail and road construction and other areas of tree planting. Cracks were infrequent and many soils were damp, particularly in the low-lying areas with pooled water attracting breeding frogs. Construction rubble, including concrete, was found in this biosite and naturally occurring rocks were generally absent.

Another MTM biosite 8499 located away from the construction footprint was also assessed to provide more general context of the pockets of potential habitat in the area (Plate 30, Plate 31). The biosite is dominated by Kangaroo Grass although weeds were common including Catsear (*Hypochaeris radicata*), Quaking Grass (*Briza minor*), Common Onion Grass (*Romulea rosea*), Wild Oats (*Avena barbata*), Kikuyu (*Cenchrus clandestinus*), Common Wheat grass (*Elymus scaber*), Yorkshire Fog (*Holcus lanatus*), and Rye Grass (*Lolium* spp.). Cracks were infrequent, but also difficult to see due to dead matted grass creating a humid and damp environment. Rocks were largely absent from the biosites. However, it is possible that surface and embedded rock was not visible in the biosites due to the high biomass.

The biosites are degraded and are very small and isolated from other areas of native grassland. Arthropod burrows detected in the biosites assessed seemed abandoned and old, and many of these burrows were in very damp soil and probably inundated only a few days prior to the habitat assessment (due to a flooding event).

MTM biosites are probably also unsuitable for VGED given that the native species cover has created dense mats of biomass, there are few burrows and rocks, and much was waterlogged. The VGED habitat survey found that, on average, the biosites had the most biomass of the quadrats sampled, the lowest median vegetation cover and most burrows. There was evidence of widespread tussock collapse forming dead thatches. This suggests it has been a long time since the biosites had been burnt (Morgan and Lunt 1999).



Plate 27 Biosite 3551 within the the rail corridor south of Calder Park Drive with planted Sugar Gums (Feb 2024)



Plate 28 Pooled water in biosite 3551 near Calder Park Drive with tadpoles, Common Eastern Froglet (*Crinia signifera*) heard calling



Plate 29 Biosite 3551 within the the rail corridor south of Calder Park Drive with planted Sugar Gums (Source: Google maps)



Plate 30 Biosite 8499 within the the rail corridor dominated by Kangaroo Grass located in Project area approximately 150 m south of the construction footprint (Holden Road level crossing construction footprint)



Plate 31 Biosite 8499 within the the rail corridor opposite Service Station

4.4.3 Banchory Grove Reserve Grassland Nature Conservation Reserve

Banchory Grove Reserve has a total area of approximately 22 ha. Banchory Grove Reserve supports patches of Natural Temperate Grassland of the Victorian Volcanic Plain (NTGVVP) dominated by native grasses such as Kangaroo Grass (*Themeda triandra*) and Wallaby Grass (*Rytidosperma* sp.) with a diversity of native herbs and forbs (Plate 40, Plate 41). Native vegetation is not continuous throughout Banchory Grove Reserve with many areas dominated by non-native species (e.g. Chilean Needle-grass) and areas dominated by forbs and bare ground (Plates 36 to 38). The more extensive areas of native grassland were apparent on the upper slopes in the north and west of Banchory Grove Reserve. There were several large anthropogenic rock piles within Banchory Grove Reserve, and it is unclear whether these were from de-rocking Banchory Grove Reserve or brought from elsewhere.

Banchory Grove Reserve was recently created so some of the large rock piles may have been established while still agricultural land as it is believed that the area was used for agriculture prior to be gazetted. In the 1968 imagery of Banchory Grove Reserve, there are clear crop/grazing parcels and in the 1991 imagery there is a large structure encircled by tracks in the north-east corner that is now the T-junction of Victoria Road and Calder Park Drive (Figures 7 to 11). This structure is absent in 1985 and 2001 imagery. It is possible that the temporary structure is related to the construction of the residential development to the south as there are connecting tracks/roads (e.g. building/sale office). There is also a small structure or possibly a dam in the south-east corner (adjacent to now Calder Park Drive) in the 1985 and possibly in the 1974 imagery.

Sheltering habitat such as loose and embedded rock, grass tussocks with inter-tussock spaces, arthropod burrows and cracking soil occurs in Banchory Grove Reserve (Plate 33). Invertebrate activity was notably low within Banchory Grove Reserve when sampling quadrats and walking between areas. Several invertebrate burrows were documented (Plate 34, Plate 35), with very occasional crickets observed during and only one of the invertebrate burrows inspected with a scope was occupied by a wolf spider. Most burrows found in Banchory Grove Reserve were 20 to 25 mm wide. Grassland earless dragons use burrows between 15 to 130 mm, most commonly 16 to 20 mm (Stevens et al. 2010). McGrath (2015) determined that wolf spider burrows are of critical importance to grassland earless dragons in other states when associated with any sized embedded surface rocks. Burrows associated with rocks of any size can provide more shelter, particularly from trampling by livestock (McGrath 2015).

Quadrats in the west of Banchory Grove Reserve had vegetation and structural parameters that are suitable for Victorian Grassland Earless Dragon (Plate 32, Plate 33). The western portion of Banchory Grove Reserve had well maintained arthropod burrows, with most seemingly empty, dominated by a native tussock forming grass with moderate height and inter-tussock spaces, low weed coverage and scattered surface and embedded rock. These areas had some cover of apparently naturally embedded rock and cryptogams, and the least soil disturbance. Although soil moisture was not recorded, these areas appeared drier, and the soil appeared to be less disturbed.

The portion of Banchory Grove Reserve adjacent to the construction footprint and with potential to be indirectly affected by the Project appears to be the least favourable area of Banchory Grove Reserve. The eastern part of Banchory Grove Reserve is lower lying (see topography below) and more disturbed than the western, more elevated portion of Banchory Grove Reserve. Rock cover was generally absent with the exception of a few small areas, most of which appeared to be artificially placed rock.

The south-eastern corner of Banchory Grove Reserve is dominated by Needle-grass *Nassella* spp. and Canary-grass *Phalaris* sp. which is an indicator of more damp environments. There appears to have been some large rock artificially placed in the corner, whether that be by rock removal in Banchory Grove Reserve or stockpiling. A network of management tracks in the south-east further indicates disturbance of the surface (Figures 24 to 25 below and Figure 22 in Section 4.3). A small earth and rock bund follows the curve of the slashed area suggesting perhaps the area was scraped by a grader to form the maintenance strip. The maintenance strip is approximately 8.8 m wide and follows the boundary around Banchory Grove Reserve. The disturbance in the east of Banchory Grove Reserve is visible in the Google Earth image below from February 2021 (Figure 26).

Soil compaction was apparent due to frequent vehicular access (Plate 42, Plate 43). There were several clear vehicle paths, one used more recently along the fence and another approximately 10-15 m from the fence (Figure 24, Figure 25). It was clear that edge effects, specifically weeds, had encroached further into Banchory Grove Reserve than the maintenance strip and vehicle tracks. Quadrats surveyed near the eastern boundary fence, adjacent to Calder Park Drive were dominated by highly invasive species, Chilean Needle-grass or Serrated Tussock, had few cracks, highly invasive forb species and minimal coverage of cryptogams and rocks. Ribwort Plantain (an invasive forb) was common and could cover as much as 25% of a quadrat (Plate 45). Although Kangaroo Grass was present, its cover was often <1% and was more often absent.

Wheel ruts were clear within the strip/track, but a few arthropod burrows were found in the maintenance strip away from the ruts and one was occupied by a wolf spider (Plate 43). Part of the surveyed area had been previously mapped as NTGVVP during vegetation assessments for the Project, but the area no longer appears to support extensive cover of native species, inter-tussock spaces, arthropod burrows, soil cracks and rocks for the Victorian Grassland Earless Dragon. For a more detailed description of VGED habitat within Banchory Grove Reserve see Appendix C.



Figure 24 Aerial imagery of Banchory Grove Reserve with cleared area and vehicle tracks evident (NearMaps 2024)



Figure 25 Aerial imagery of Banchory Grove Reserve with vehicle tracks highlighted (ArcGIS 2024)



Figure 26 Google Earth (2021) clearly showing several maintenance tracks and cleared areas, vehicle ruts evident



Figure 27 Banchory Grove Reserve boundary with slashed maintenance strip visible (Source: Google streetview image captured July 2021 in SMEC 2023a)



Plate 32 Western section of Banchory Grove Reserve; much higher ground, good coverage of Kangaroo Grass, scattering of embedded rocks

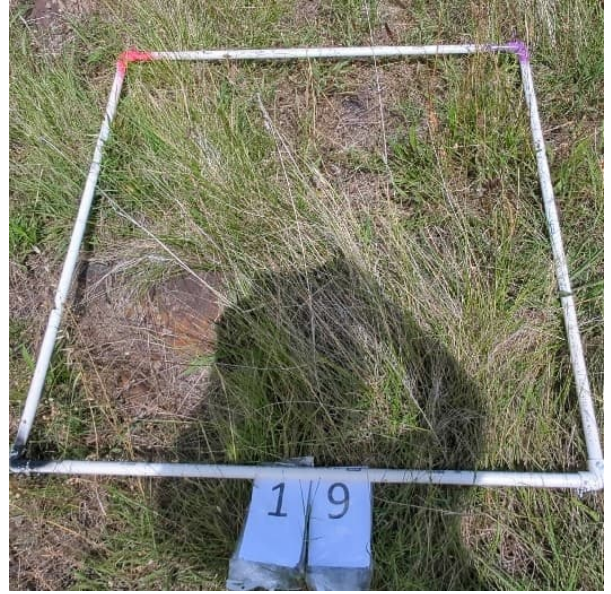


Plate 33 Western section of Banchory Grove Reserve with embedded rocks clear in lower left quadrant



Plate 34 Burrows beneath natural rock formation on higher ground west of Banchory Grove Reserve. Unoccupied.



Plate 35 Well-maintained burrow on the higher ground in the west of Banchory Grove Reserve. Scope did not detect any occupants.



Plate 36 Western area of Banchory Grove Reserve supports native grassland patches but also still open areas dominated by forbs (Dec 2023)



Plate 37 Western area of Banchory Grove Reserve supports more rock than the eastern area (Dec 2023)



Plate 38 Central area of Banchory Grove Reserve viewed east supports extensive open areas dominated by forbs (Dec 2023)



Plate 39 South central eastern area of Banchory Grove Reserve showing area dominated by Wallaby-grass with artificial rock pile (Dec 2023)



Plate 40 Banchory Grove Reserve native grassland patch in eastern area (2022)



Plate 41 Banchory Grove Reserve in eastern area (October 2023)



Plate 42 Vehicle track in slashed area near corner of Calder Park Drive and Victoria Road in Banchory Grove Reserve (December 2023)



Plate 43 Wolf spider in burrow in maintenance strip next to vehicle track on eastern boundary in Banchory Grove Reserve (December 2023)



Plate 44 Vehicle track in slashed maintenance strip in south of Banchory Grove Reserve view north along boundary (December 2023)



Plate 45 South-east of Banchory Grove Reserve showing forb and exotic grass dominate maintenance track and area of Phalaris suggesting damp soils. View south along boundary (December 2023).

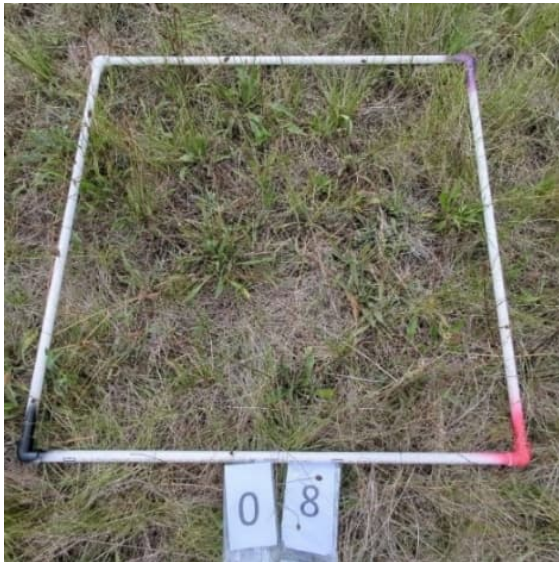


Plate 46 Quadrat surveyed along edge of eastern maintenance strip in Banchory Grove Reserve with high coverage of forb weeds, no burrows few cracks and no rocks and high dead grass cover (Dec 2023)



Plate 47 Vehicle track on northern boundary in Banchory Grove Reserve adjacent to Victoria Road and the rail corridor

Topography

Banchory Grove Reserve slopes from west to east with the lowest point of Banchory Grove Reserve adjacent to Calder Park Drive and therefore the study area. The cross sections in Figure 37 illustrate the slope at three locations across Banchory Grove Reserve with the highest elevation in the west and a fall of approximately 16 to 20 m from west to east. The landform of Banchory Grove Reserve is also apparent in the street view image in Plate 48.

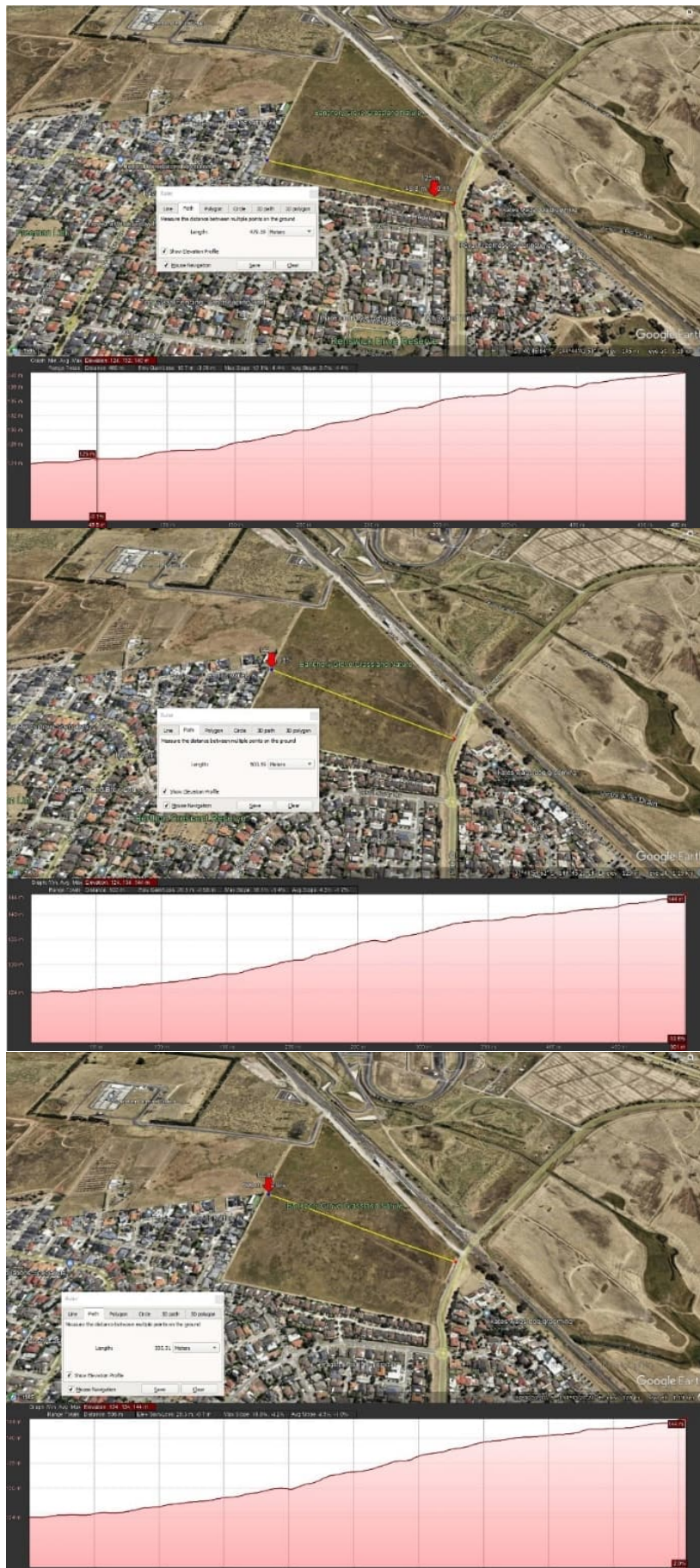


Figure 28 Terrain (elevation and slope) cross sections of Banchory Grove Reserve (Source: Google Earth)



Plate 48 View of Banchory Grove Reserve from south-east corner showing rising to the north-west (Source: Google Maps streetview)



Plate 49 View from within Banchory Grove Reserve from south-east corner showing rising to the north-west (Dec 2023)

Soil and hydrogeology

The geotechnical and hydrogeology assessment summarises the anticipated conditions at Calder Park Drive based on information obtained from boreholes. The area is New Volcanics Basalt with a variable depth to rock levels over short distances and potential for interbedded basalt and clay layers. Close to the rail there is one (1) m of overlying fill (AECOM-GHD JV 2022a). The residual clay derived from weathering of basalt rock is expansive/reactive prone to significant shrink-swell movements in response to seasonal moisture change (AECOM-GHD JV 2022a).

Hydrology

Topography grades to the south-east of the level crossing on Calder Park Drive with a local Council drainage network in the south (Figure 29). The drainage network in the south extends from the south-east corner of Banchory Grove Reserve and discharges to the Victoria Street Drain (AECOM-GHD JV 2022b).

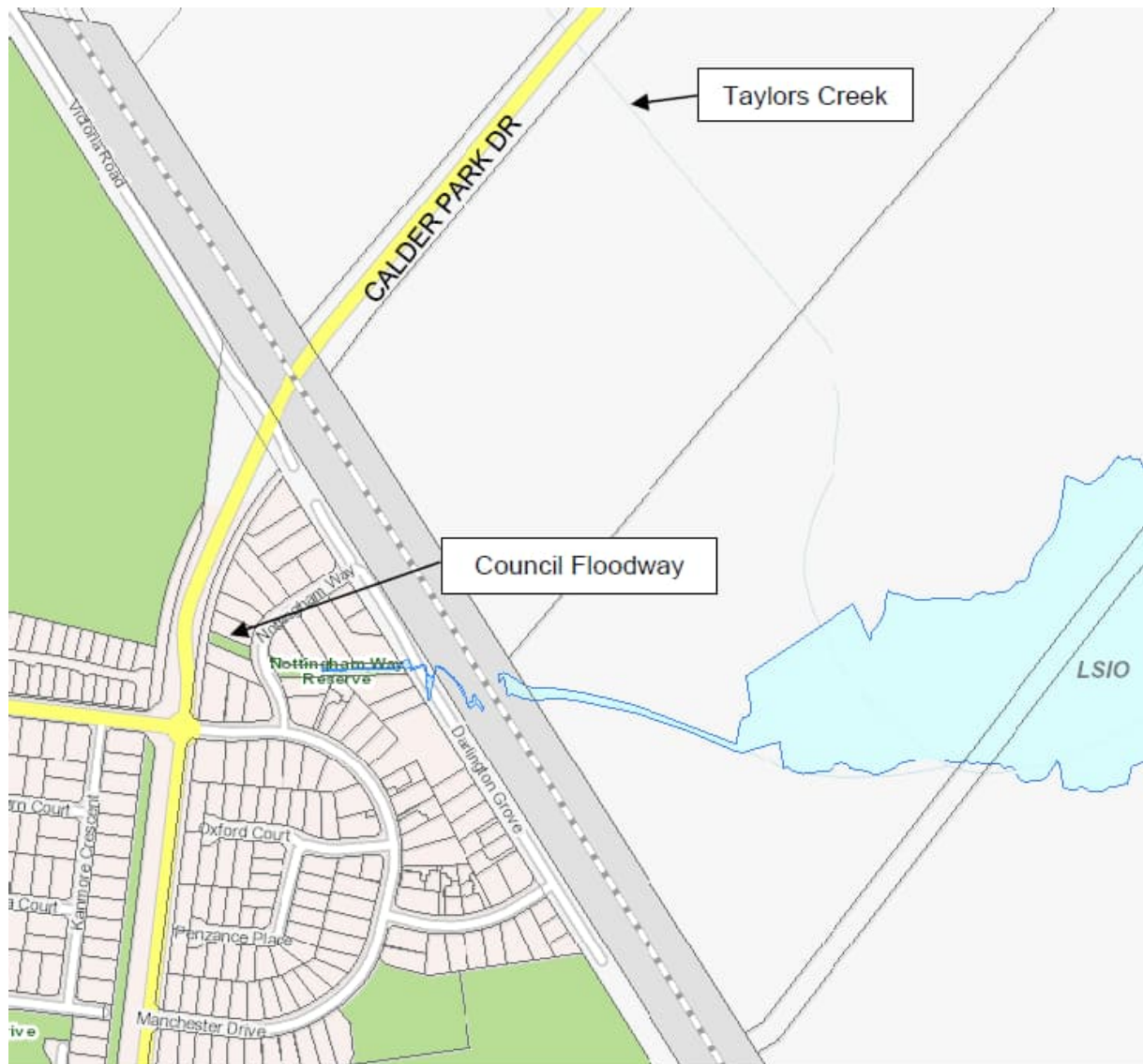


Figure 29 Drainage network



Figure 30 Existing flowpaths (Extract of Figure 3 from SMEC 2023b)

Flood modelling suggests the south-east area of the Banchory Grove Reserve is currently subject to inundation during a 100-year storm event (Figure 30) with above surface flood depths of <math>< 100</math> mm (50-100 mm) lasting for approximately 4 hours (not including subterranean features). The topography of most of Banchory Grove Reserve is more elevated than the south-eastern area (see topography above) and is expected to remain free draining. Both factors suggest the south-eastern portion is more likely to be temporarily or intermittently inundated with water in winter and spring.

Fire history

Banchory Grove Reserve has been managed by Parks Victoria using fire. The northern portion of Banchory Grove Reserve was burnt in 2022 (visible on GoogleMaps Figure 31) and the southern portion of Banchory Grove Reserve was scheduled for burning in December 2023, but as of mid-January had not occurred. Parks Victoria have indicated previously to LXR that routine fire management burns are conducted on an approximately 5-year cycle with the next planned burn for 2024.

World Imagery from ArcGIS Pro (2022) shows that the north of the maintenance track has clearly been burnt in Banchory Grove Reserve (Figure 31). That area is visibly a different vegetation colour in the Google Street view image below, from 2021 (Figure 32).



Figure 31 Image of Banchory Grove Reserve from 2022 showing the burnt north section (ArcGIS WMTS Service 2022)



Figure 32 Google Street View 2021 of Banchory Grove Reserve, from Calder Park Drive, approaching level crossing

4.5 Existing threats

Introduced predators occur in the area. Scats of Red Fox (*Vulpes vulpes*) and Cats (*Felis catus*) were frequently observed, and a fox was seen in Banchory Grove Reserve.

Weed cover is high with the lowest cover was in the western portion of Banchory Grove Reserve. Invasive Serrated Tussock, Chilean Needle Grass, Windmill Grasses, Brome Grasses, Phalaris Grass and Ribwort Plantain were common. Other invasive weed species common and widespread, particularly in the footprint, eastern boundary of Banchory Grove Reserve and biosites were *Hypochaeris radicata* (Catsear), *Briza minor* (Quaking Grass), *Romulea rosea* (Common Onion Grass), *Avena barbata* (Wild Oats), *Cenchrus clandestinus* (Kikuyu), *Elymus scaber* (Common Wheat grass), *Holcus lanatus* (Yorkshire Fog), *Panicum* sp. and *Lolium* spp. (Rye Grass). Ribwort Plantain was present in nearly all quadrats (approx. 95%) and often the dominant life form in quadrats.

High intensity grazing was absent and although a small mob of Eastern Grey Kangaroos (*Macropus giganteus*) was observed in Banchory Grove Reserve and European Rabbit (*Oryctolagus cuniculus*) scats were observed, grazing intensity was low. Goat or possibly sheep scats were also observed in Banchory Grove Reserve. It is probably more likely that goats would be able to jump the fence. It appeared that the Calder Park Drive roadside is regularly mown.

Soil compaction has occurred in the maintenance strip around the edge of Banchory Grove Reserve. See Section 4.4.3 for more detailed description of this strip.

Current and historic soil disturbance is moderate to high. There is clear cropping and grazing in imagery post 1951, with a major residential development to the south and infrastructure encircling the area. It appears that Banchory Grove Reserve has been used for cropping and grazing (1951-1991), and as a potential residential development sales/construction office. It is likely that the rock piles were created when Banchory Grove Reserve was derocked for cropping and grazing. Although there is less soil disturbance in the majority of Banchory Grove Reserve at present, it has had at least 40-50 years of agricultural and construction activity.

MTM conduct maintenance five times a year. Works include rail reserve grass slashing, weed management, trackside weed spraying, pruning of trees and other vegetation to maintain operation. (MTM 2024).

These are all factors that suggest there are no dragons or there are unlikely to be dragons in the landscape according to the conceptual diagram of threats to Grassland Earless Dragon (extract of Figure 7 from DCCEE 2023b p. 30) presented in Figure 5 (Section 2.5).

5. Likelihood of Occurrence

5.1 Construction footprint

The construction footprint is not considered to provide habitat for VGED due to the degree of modification and disturbance. Arthropod burrows, soil cracks, native grass tussocks and low soil disturbance that are critical for the VGED were absent in the construction footprint.

5.2 MTM biosites

Some small patches of NTGVVP persist in the MTM biosites surrounding, but outside of, the construction footprint. Biomass in the biosites is high, inter-tussock space low, arthropod burrows minimal, invasive species high and there are minimal rocks and cracking. The biosites are very small, isolated and degraded and are therefore not considered to provide habitat for the VGED.

5.3 Banchory Grove Reserve Grassland Nature Conservation Reserve

Banchory Grove Reserve (outside, but adjacent to, the construction footprint) is potential habitat for VGED. Comparison of habitat survey findings with representative photos and descriptions from known sites provided in the draft National Recovery Plan (DCCEEW 2023b) suggest the suitability of the habitat cannot be discounted. Most of Banchory Grove Reserve has Kangaroo Grass tussocks, interspersed with invasive weeds. Banchory Grove Reserve has arthropod burrows and surface and embedded rocks.

However, it is understood Banchory Grove Reserve was ploughed and derocked prior to being protected in 1999s, and agricultural and construction activities are clear within imagery from 1968 to 1991 (Appendix B). Although Grassland Earless Dragons have been recorded in areas that have been historically ploughed, they require this lower quality habitat to be adjacent to high-quality habitat (Robertson and Evans 2009/2012). Banchory Grove Reserve is not directly connected to less disturbed remnant areas of potential habitat as described in landscape context (Section 4.3) above. The proximity of the residential areas is likely to increase the occurrence of predators (cats and foxes) in Banchory Grove Reserve.

It is unknown whether the area historically supported Victorian Grassland Earless Dragon and therefore whether the species could be persisting in the area. There are no previous known records of the species from Banchory Grove Reserve but given the general lack of records and the last valid record (prior to the 2023 rediscovery) was from 1969, this is not a reliable means of suggesting the species is not present.

Portion of reserve adjacent to the construction footprint

Habitat surveys suggest that this eastern portion of the reserve adjacent to the construction footprint is the unsuitable habitat for the VGED, particularly compared with the rest of Banchory Grove Reserve, because it contains:

- Little cover of native Kangaroo Grass tussocks with clear, moderate inter-tussock space
- High invasive weed cover and abundance of forbs. The area is dominated by Chilean Needle-grass and Serrated Tussock, two highly invasive species. Other weed species present included the widespread Ribwort Plantain and lesser coverage of Windmill Grasses, Brome Grasses, and Phalaris Grass.
- High soil disturbance, compaction due to vehicle movements as part of regular slashing and access for ongoing maintenance and management of Banchory Grove Reserve
- Low cover of sheltering rocks (embedded and surface)
- Sparse arthropod burrows - a few burrows were identified in areas not slashed or in wheel ruts

Undisturbed sites with abundant burrows, good rock cover, native grass tussocks and inter-tussock spaces are all crucial for VGED. Such features are limited or absent in the eastern edge of Banchory Grove Reserve. The eastern part of Banchory Grove Reserve adjacent to Calder Park Drive is the lowest point of the reserve and has been modelled as being subject to inundation during storm events.

Both factors suggest the south-eastern portion is more likely to be temporarily or intermittently inundated with water in winter and spring.

It appears likely the entire maintenance strip and edge beyond the maintenance strip (± 5 m) is unsuitable for VGEDs. A history of soil disturbance in the maintenance strip and beyond is evident in the aerial imagery (Figure 33) and there are several vehicle tracks that appear to be used regularly which adds to the disturbance experienced in the area.

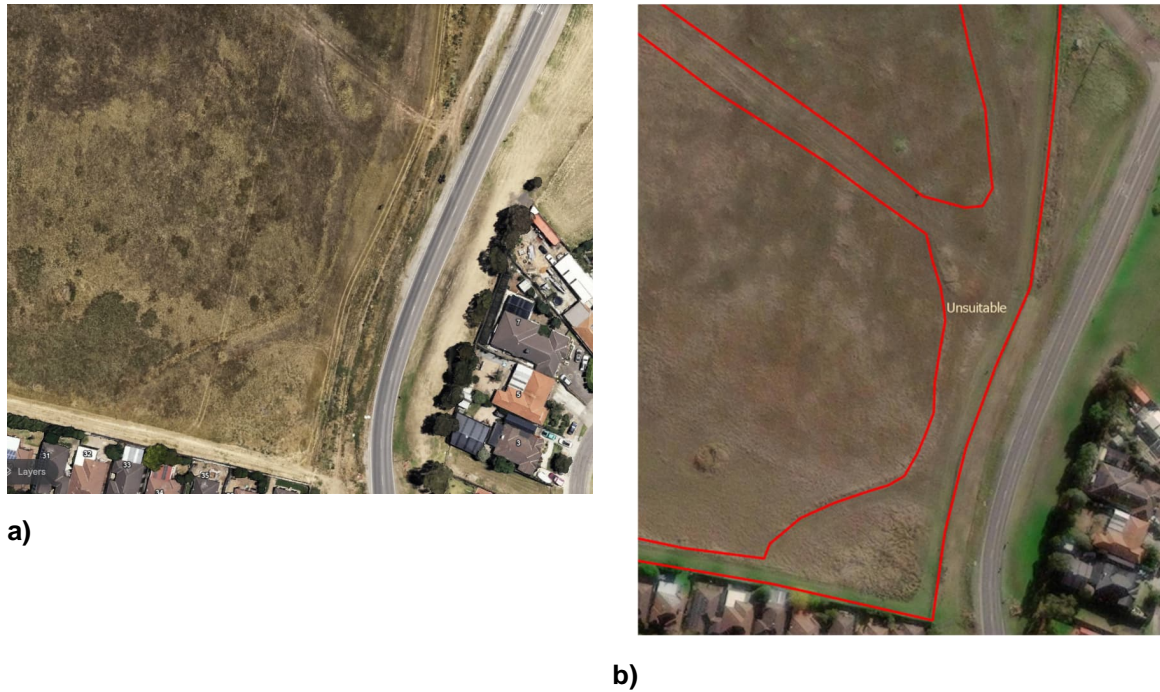


Figure 33 Several maintenance tracks and cleared areas, vehicle ruts evident resulting in disturbance to areas in Banchory Grove Reserve a) Google Earth (2021), b) marked up ArcGIS May (2023) as unsuitable (red polygon)

5.4 Home ranges and isolation

Home ranges of the closely related Canberra Grassland Earless Dragon (*T. lineata*) were found to be between 925 and 4,768 m² (Stevens et al. 2010) and most grassy areas within the construction footprint are therefore too thin and small, and surrounded by highly disturbed land. Although home ranges of Victorian Grassland Earless Dragons are unknown, it is highly unlikely that could utilise these small, highly disturbed, fragmented and isolated grassy areas. Canberra Grassland Earless Dragons centre these home ranges on one to two burrows (Stevens et al. 2010) and the western portion of Banchory Grove Reserve would probably be the only habitat in the area to provide sufficient size (approx. 14-18 ha excluding maintenance strip, vehicle tracks), burrow abundance and habitat structure and composition.

Canberra Grassland Earless Dragon populations are isolated by disturbance and Hoehn et al. (2013) found that human activities present significant barriers to dispersal, increasing genetic isolation and likelihood of a population crash. It is likely that Victorian Grassland Earless Dragon would also find human land use (e.g. railway, roads, buildings) a barrier to dispersal. There do not appear to be any grassland corridors connecting Banchory Grove Reserve and, for example, Organ Pipes National Park. See 4.3 for a more detailed discussion.

These major developments would have isolated any reptile populations and presented significant barriers to genetic exchange, particularly for the VGED if it was historically present in the area. The large residential development to the south would have further isolated any populations. It is likely that, if the VGED was present in the broader landscape, it would have been isolated to patches of the Land Use category “grazing in native vegetation” and reserves prior to the 1990s due to the massive expansion of residential development.

5.5 Summary

A summary of the factors that influence the occurrence of dragons depicted in Figure 4 (Section 2.4) and an indication of whether the construction footprint, MTM biosites and Banchory Grove Reserve meet those requirements is provided in Table 2. A likelihood of occurrence rating is given based on the sum of factors based on the following definitions:

- **Unlikely:** Unlikely to be dragons in areas that are overgrazed, lack fire management and native grazers, are slashed, ploughed/cropped, sown pasture/fertilisation, de-rocked, had herbicide/pesticide application, and low inter tussock spaces (high biomass).
- **Low:** Reduced potential for dragons in areas with predation pressure, reduced food and shelter resources, dominated by weeds with dense biomass.
- **Possible:** Potential occurrence where there is connectivity, food and shelter resources, open tussock structure not dominated by weeds and not regularly slashed and with some connectivity to other grassland.

Table 2 Summary of factors influencing dragon occurrence in the study area

Feature/factor	Sub-feature/factor	Construction footprint			MTM biosites	Banchory Grove Reserve	
		Rail corridor	Paddocks (site compound)	Roadsides		Area affected by afflux	Remainder of Banchory Grove Reserve
Habitat features							
Native grassland	Large patches	No	No	No	No	Minimal*	Yes
	Small patches	No	No	No	No	No	Yes
	Isolated	Yes	Yes	Yes	Yes	Yes	Yes
Grass structure		Closed	Closed (TBC)	Open, low (slashed)	Closed (high biomass)	Open, low (slashed)	Open
Weed cover		High	High	High	Moderate	High	Moderate
Forb cover		Moderate	TBC	Low	Moderate	Moderate	Moderate
Cryptogam cover		Low-Absent	Low	Low-Absent	Low-Absent	Low-Absent	Low
Native grazers		No	No	No	No	Yes	Yes

Feature/factor	Sub-feature/factor	Construction footprint			MTM biosites	Banchory Grove Reserve	
		Rail corridor	Paddocks (site compound)	Roadsides		Area affected by afflux	Remainder of Banchory Grove Reserve
Threats							
Soil disturbance	Ploughing	No	Yes	Some	Historic	Historic	Historic
	Rock removal	Unk	Yes	Yes	No	Yes	Historic
	Earthworks	Yes	No	Yes	No	Yes	No
	Compaction	Yes	Yes	Yes	No	Yes	No
Regular slashing		No	Yes	Yes	Unk	Yes	No
Weed spraying		Yes	No	Yes	Yes	Yes	Yes
Fire management		No	No	No	Unk	Yes	Yes
Predators		Yes	Yes	Yes	Yes	Yes	Yes
Overgrazing		No	No	No	No	No	No
Likelihood of occurrence							
Likelihood		Unlikely	Unlikely	Unlikely	Low	Unlikely	Possible

*It is noted that NTGVVP has been mapped in the location, but at the time of survey minimal patches of native grassland were observed

Note to table: Green = positive feature for VGED, Orange = feature that reduces potential, Red = feature likely to preclude occurrence

6. Potential Impact

Habitat surveys in December 2023 and January 2024 concluded that the construction footprint and the MTM biosites adjacent to the construction footprint are too small, isolated and modified to support the VGED. As such, construction works within the construction footprint are unlikely to impact on VGED.

Banchory Grove Reserve is outside the construction footprint and protected by a chain mesh boundary fence from construction works. The Project has also installed a fauna fence in accordance with the Native Vegetation and Threatened Species Management Plan (AECOM-GHD JV 2023c). However, surface water modelling identified changes to water levels (afflux) in a small portion of Banchory Grove Reserve during storm events due to a proposed access road along the eastern Banchory Grove Reserve boundary obstructing the natural overland flow. Afflux refers to the predicted change in flood levels (depth) between two scenarios, in this case existing (base) and design.

Habitat surveys in December 2023 and January 2024 identified the area affected by afflux is unlikely to be suitable for the VGED. The area of afflux overlaps with several maintenance tracks that have high soil compaction, high invasive cover and low cover of rocks and cracks, and despite a few arthropod burrows, its regular slashing and disturbance by vehicles suggest the part of the reserve affected by afflux is unlikely Banchory Grove Reserve to be inhabited by the species. As such, potential impacts on VGED associated with afflux are unlikely.

However, for completeness (and given the analysis had already been undertaken as part of the impact assessment), analysis of flood modelling is included in Appendix D and Figures 44 to 48 to outline how change in drainage associated with the Project may affect Banchory Grove Reserve.

To understand whether the Project has potential to impact on VGED in Banchory Grove Reserve, the following points are discussed/reiterated:

- The potential for VGED to occur in the area affected by afflux.
- The potential for the afflux to impact on eastern boundary of Banchory Grove Reserve.

Potential occurrence of VGED in the area of Banchory Grove Reserve affected by afflux

Habitat surveys suggest that the area affected by afflux is unsuitable for the VGED, particularly compared with the rest of Banchory Grove Reserve, based on habitat structure (high biomass where not slashed, high weed cover and abundance of forbs, limited to no cover of rocks and sparse arthropod burrows), high level soil disturbance in the past and ongoing due to vehicle movements as part of regular slashing and access for management which affects the availability of soil cracks and arthropod burrows. High weed cover, high biomass, slashing, de-rocking, and soil disturbance are all recognised as threats which limit or eliminate the potential for VGED to occur (see Section 2.5).

Banchory Grove Reserve

The south-east area of Banchory Grove Reserve is also currently subject to inundation during a 100-year storm event with above surface flood depths of <100 mm (50-100 mm) lasting for approximately 4 hours (not including subterranean features). The topography of most of Banchory Grove Reserve is more elevated than the area affected by afflux and is expected to remain free draining. Both factors suggest the south-eastern portion is more likely to be temporarily or intermittently inundated with water in winter and spring. This assertion is supported by observations of an increasing dominance of Phalaris outside the area of mapped native grassland. Phalaris is an exotic grass that is typically indicative of more moist soil conditions. Soils were damp across the survey site and although it had rained in the previous week, the soil within habitat surveyed in the western section of Banchory Grove Reserve was dry.

Low-lying areas that become waterlogged in winter and continue to be wet in spring and summer are likely to be avoided as overwintering sites (Stevens et al. 2010) by the VGED even though the species is known to occur in association with basaltic clays that are naturally highly reactive and undergo large shrink/swell movements in response to moisture (DCCEEW 2023c). Although literature discussing the specific tolerances of VGED to inundation is lacking, it is considered less likely that the species would favour habitat along the lower lying eastern edge of Banchory Grove Reserve that is subject to inundation with surface water (i.e. 50-100 mm above surface) and does not provide critical habitat components necessary for its survival and reproduction.

Given the habitat appears to be unsuitable (lack of suitable features and frequent inundation) it is unlikely the VGED occurs in the area of Banchory Grove Reserve affected by afflux. It is unknown if the species occurs in the interior of Banchory Grove Reserve where there is more suitable habitat present and drier conditions for the reptile to utilise.

Potential for afflux to impact on the eastern boundary of Banchory Grove Reserve

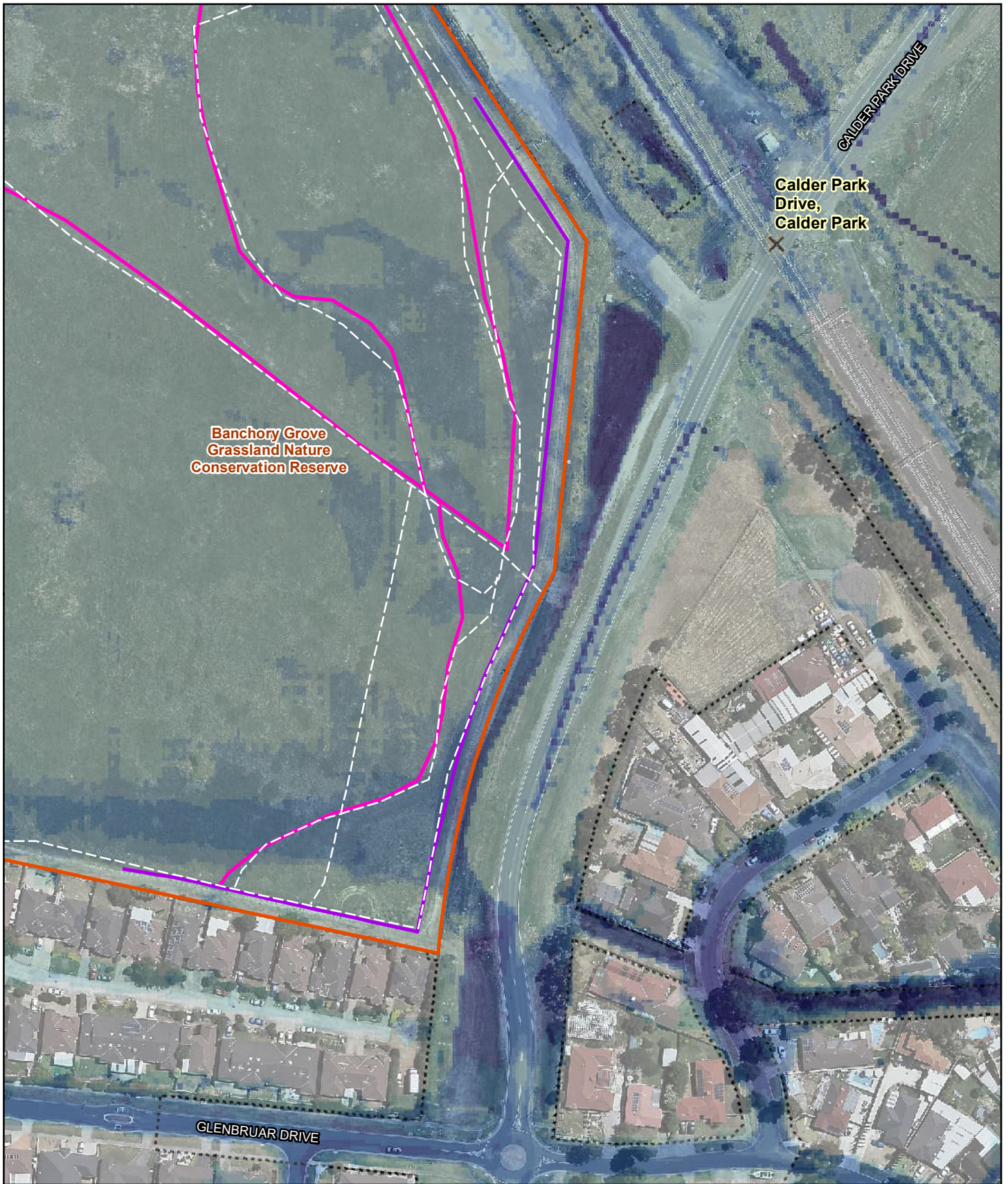
While the area affected by afflux is unlikely to support VGED, the assessment still considered a scenario where, if this were not the case, would afflux represent a material change to habitat in that area. Flood modelling suggests that this is unlikely.

The area affected by afflux is already subject to inundation during storm events. The afflux modelled for the Project represents a change in existing above surface water depths by 65 mm during a 1 in 100-year event, however changes to the duration of inundation are not expected as the design does not increase the flow rate. Velocity does not exceed 1.5 m/s and shear-stress does not exceed 20 N/m² therefore there is no risk of erosion or scour under design conditions (SMEC, pers. comm.).

Whilst this change represents a change in the peak flood level it is a continuation of the existing conditions experienced along the eastern boundary (i.e., inundated, unsuitable habitat). The afflux area appears to be entirely within the maintenance and vehicle track or adjacent areas subject to previous soil disturbance and scalping based on aerial imagery (Figure 47, Figure 48).

Given the lack in change to flood duration and minor changes in extent of inundation (to areas already surrounded by inundation) the changes to peak inundation levels during 1 in 100-year events are not expected to result in a material difference to VGED habitat suitability (i.e. the area is already disturbed and unsuitable for VGED).

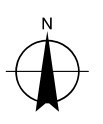
Figure 34 Banchory Grove conditions and showing 1% AEP Short Duration Flood



Data source: Data Custodian, Data Set Name/Title, Version/Date, Created by/prachi.kulkarni

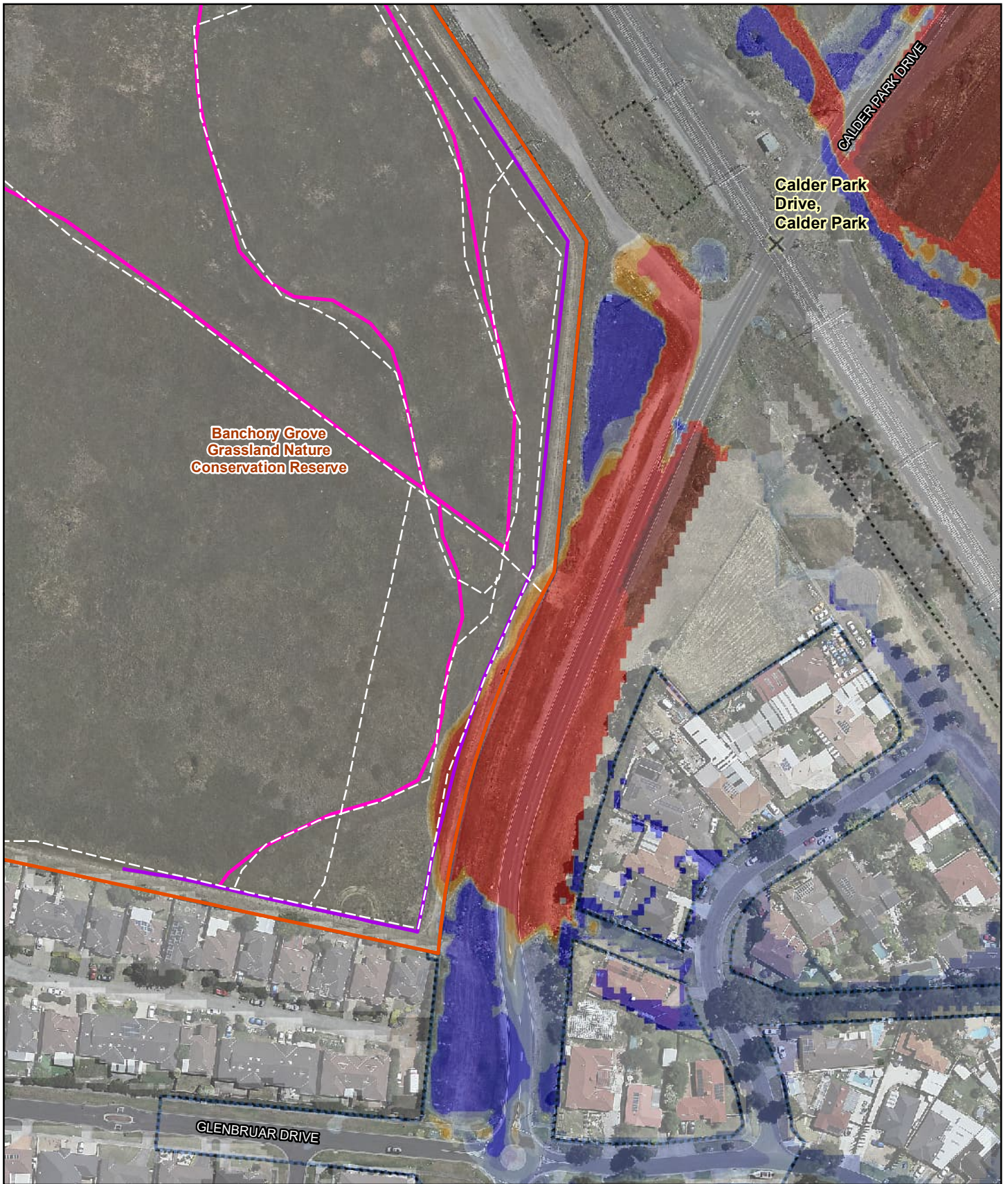
LEGEND	Level crossing site	Regularly slashed strip	Represents low mound of scraped up soil and rock	Construction footprint	Design 1% AEP Short Duration Flood Depth (m)	≤ 0.025	
	Management racks					0.025 - 0.05	

Paper Size A4
 0 12.5 25 50
 Metres
 Map Projection: Transverse Mercator
 Horizontal Datum: GDA 1994
 Grid: GDA 1994 MGA Zone 55



Calder Park Drive and Holden Road
 Design Condition
 1% AEP Short Duration
 Figure 34

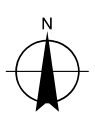
Figure 35 Banchory Grove conditions and showing AEP 1% Afflux



Data source: Data Custodian, Data Set Name/Title, Version/Date, Created by/prachi.kulkarni

LEGEND	Level crossing site	Management racks	Regularly slashed strip	Represents low mound of scraped up soil and rock	Construction footprint	Project area	Afflux (mm)		
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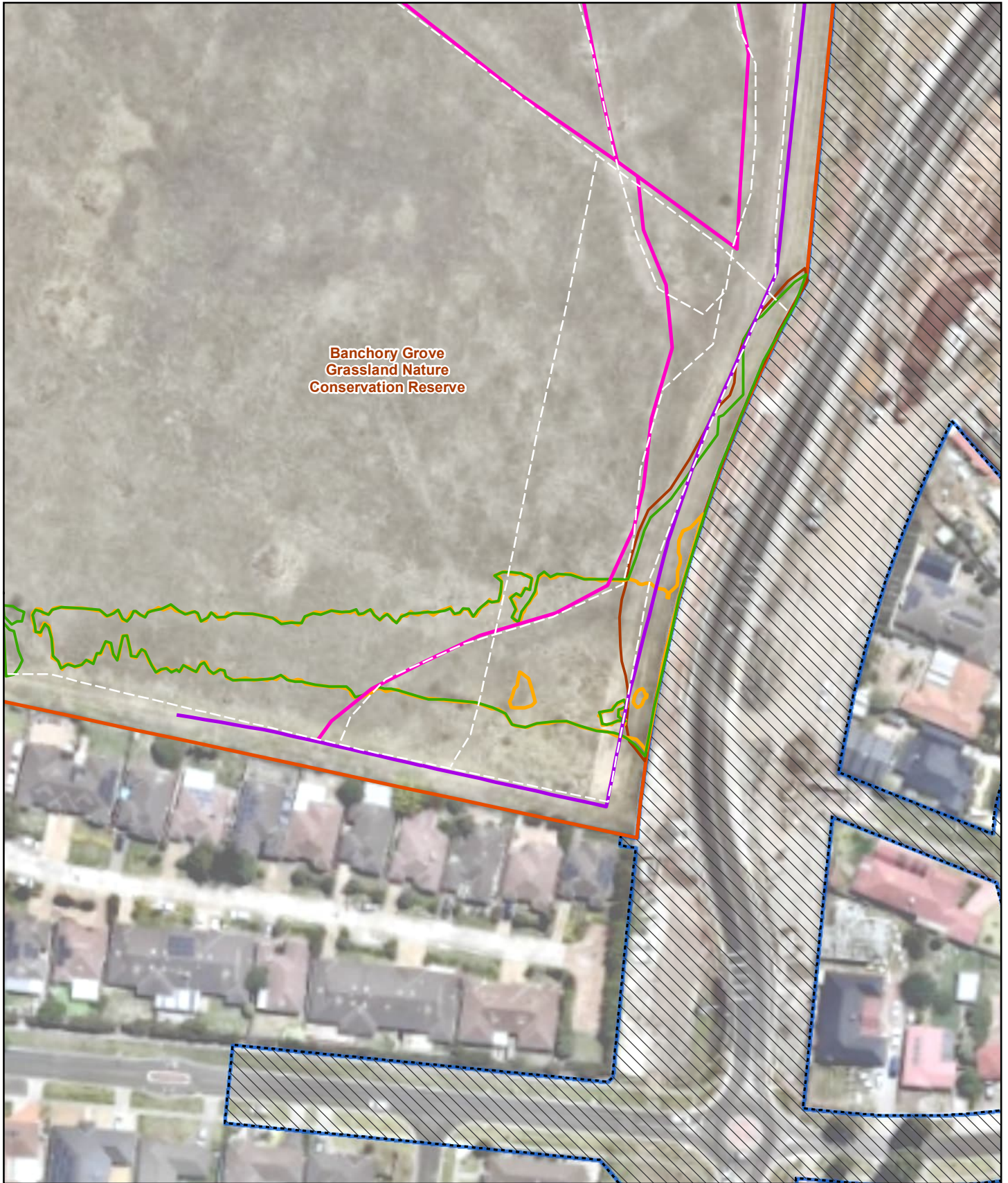
Paper Size A4
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 Map Projection: Transverse Mercator
 Horizontal Datum: GDA 1994
 Grid: GDA 1994 MGA Zone 55



Calder Park Drive and Holden Road
 AEP1% Afflux Short Duration
 Figure 35

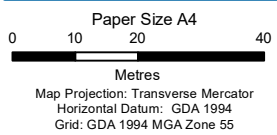
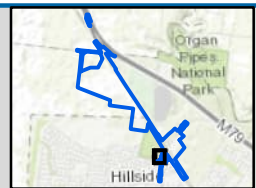
Figure 36 Banchory Grove conditions and showing flood study overlay

**Banchory Grove
Grassland Nature
Conservation Reserve**



Data source: Data Custodian, Data Set Name/Title, Version/Date, Created by/prachi.kulkarni

- LEGEND**
- Level crossing site
 - Management racks
 - Regularly slashed strip
 - Represents low mound of scraped up soil and rock
 - Base 1% AEP Short Duration Flood Depth (>100m)
 - Design 1% AEP Short Duration Flood Depth (>100m)
 - Modelled Afflux
 - Construction footprint
 - Project area



Calder Park Drive and
Holden Road
Simplified Flood
Study
Figure 36

7. Conclusion

The construction footprint for the Project is not considered to provide habitat for the VGED due to the degree of modification and disturbance. As such, works within the construction footprint are unlikely to impact on VGED.

Banchory Grove Reserve is potential habitat for the VGED. Occurrence of VGED is likely to be influenced by whether the species previously occurred in Banchory Grove Reserve and could therefore be persisting (no previous records but there are records from 1990 from Holden Flora Reserve approximately 7 km north of the Banchory Grove Reserve), the ability for the species to move to the Banchory Grove Reserve from surrounding areas (landscape context where there are several barriers to movement and substantial inhospitable areas) and proximity of residential areas increasing the occurrence of predators in Banchory Grove Reserve. Comparison of habitat survey findings with representative photos and descriptions from known sites provided in the draft National Recovery Plan (DCCEEW 2023b) suggest the suitability of the habitat and therefore occurrence of VGED cannot be discounted.

Banchory Grove Reserve is outside of the construction footprint and protected by a chain mesh boundary fence from construction works. The Project has also installed a fauna fence in accordance with the Native Vegetation and Threatened Species Management Plan (AECOM-GHD JV 2023c). However, surface water modelling identified changes to water levels (afflux) in a small portion of Banchory Grove Reserve during storm events due to a proposed access road along the eastern Banchory Grove Reserve boundary obstructing the natural overland flow. This will result in an increase in depth of surface water and surface water affecting a slightly larger area of Banchory Grove Reserve during a 1 in 100-year flood event. The duration of inundation does not change.

Habitat assessments determined that the area affected by afflux is unsuitable Banchory Grove Reserve for the VGED. The unsuitability of the habitat in the area affected by afflux is due to high weed cover and soil disturbance, regular slashing, and vehicle access, and minimal/general absence of key sheltering and burrowing sites (burrows and rocks). While it is possible that the VGED occurs in the interior of Banchory Grove Reserve, the limited resources in the afflux area means the reptile already likely avoids the eastern boundary, especially when it is inundated.

While the area affected by afflux is unlikely to support VGED, the assessment still considered a scenario where, if this were not the case, would afflux represent a material change to habitat in that area. Flood modelling suggests that this is unlikely.

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Appendices

Appendix A – Photos of Known Habitat

Source: DCCEEW 2023b p 59

Photograph 7. Examples of Canberra GED habitat with open and heterogenous grassland structure, bare ground, and low grass height, including during both high biomass (top left) and drought (top right) conditions.



Photographed and supplied by Emma Carlson (top left and top right) and Rob Armstrong (bottom).

Plate 50 Examples of Canberra GED habitat (Extracts from DCCEEW (2023b) for reference)

Photograph 8. Examples of optimal habitat condition for the Canberra GED at Canberra airport (Top left and bottom) and at Majura West (top right).



Photographed and supplied by Alison Rowell.

Plate 51 Examples of optimal habitat condition for Canberra GED (Extracts from DCCEEW (2023b) for reference)

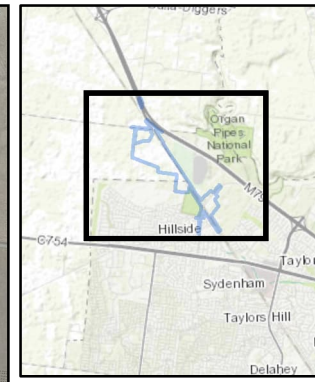
Photograph 9. Examples of Monaro GED habitat with open and heterogenous grassland structure, low grass height and abundant surface rock, including during high biomass conditions (top right).



Photographed and supplied by Tim McGrath (top left and top right) and Matt Clancy (Bottom).

Plate 52 Examples of Monaro GED habitat (Extracts from DCCEEW (2023b) for reference)

Appendix B – Land Use Time Series

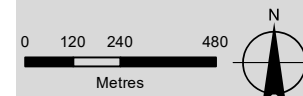


LEGEND

- Level crossing site
- Construction footprint
- Project area

Calder Park Drive
 Historic Aerial Imagery
 Year: 1951
 Figure 1

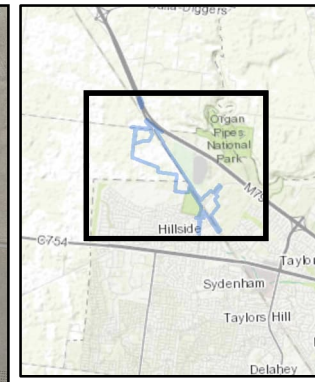
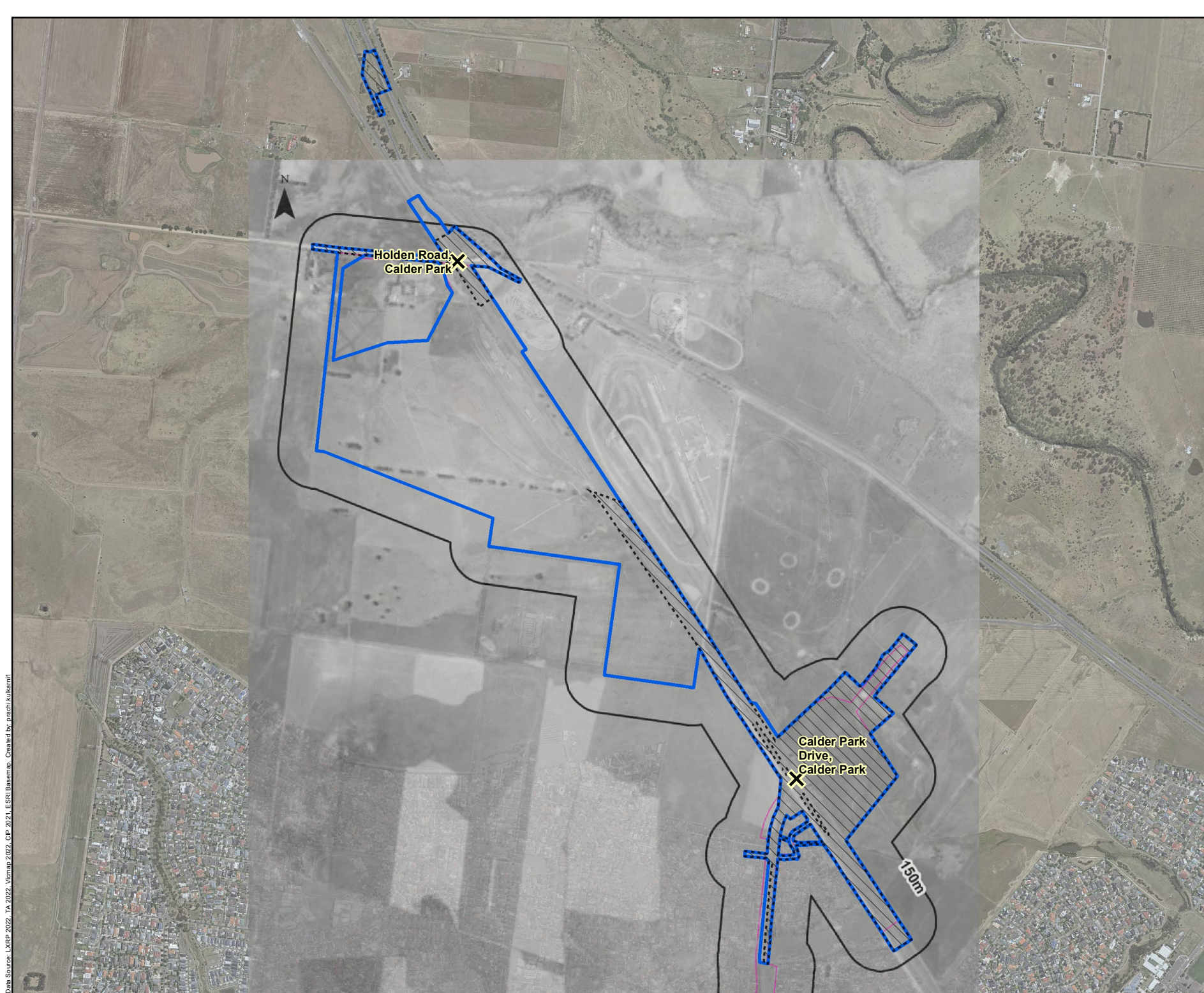
Landuse and Disturbance



Paper Size A4
 Map Projection: Transverse Mercator
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 Grid: GDA 1994 MGA Zone 55

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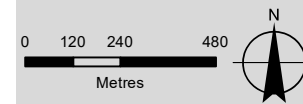
- LEGEND**
- Level crossing site
 - Construction footprint
 - Project area

**Calder Park Drive
Historic Aerial Imagery
Year: 1968
Figure 1**

Landuse and Disturbance

LEVEL CROSSING REMOVAL PROJECT

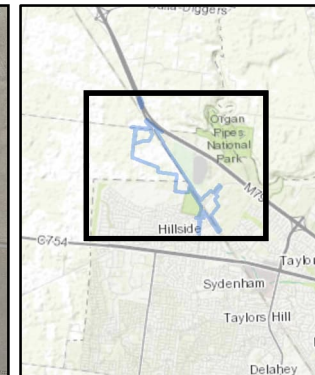
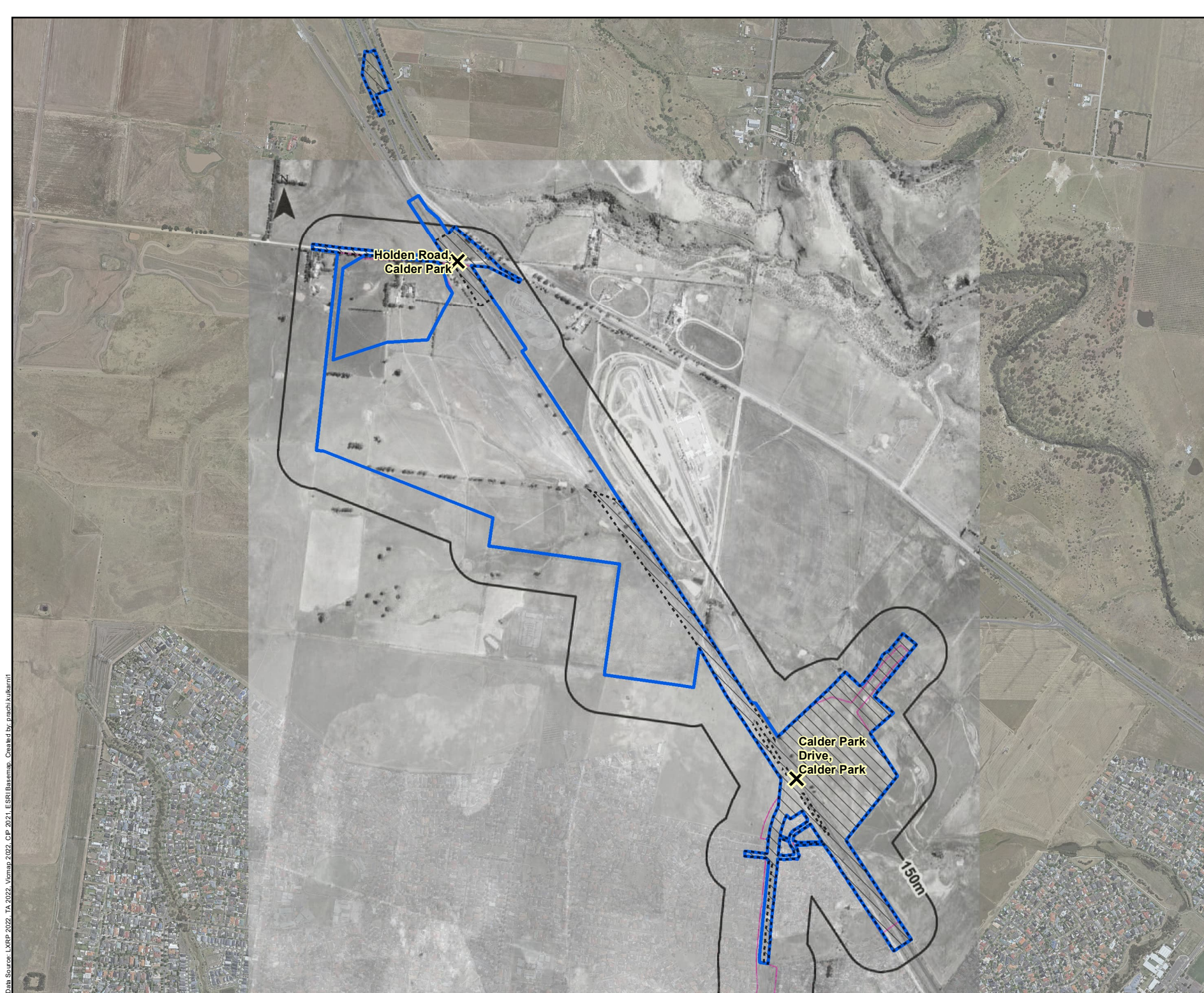
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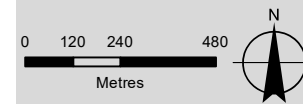
Data Source: LXR 2022, TA 2022, Vmap 2022, CIP 2021, ESRI/BasicMap, Created by: crachukukam1



- LEGEND**
- Level crossing site
 - Construction footprint
 - Project area

**Calder Park Drive
Historic Aerial Imagery
Year: 1974
Figure 1**

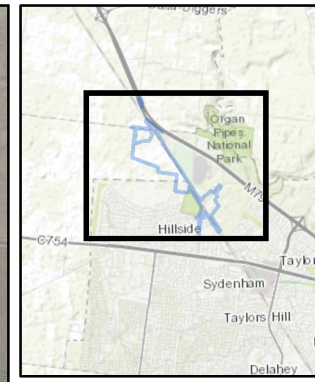
Landuse and Disturbance



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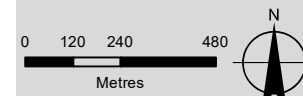
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- LEGEND**
- Level crossing site
 - Construction footprint
 - Project area

Calder Park Drive
 Historic Aerial Imagery
 Year: 1982
 Figure 1

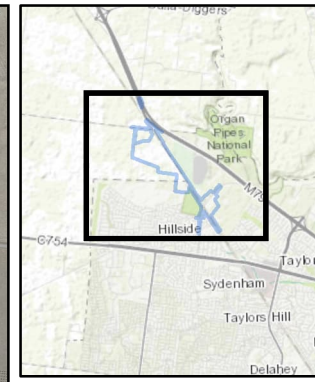
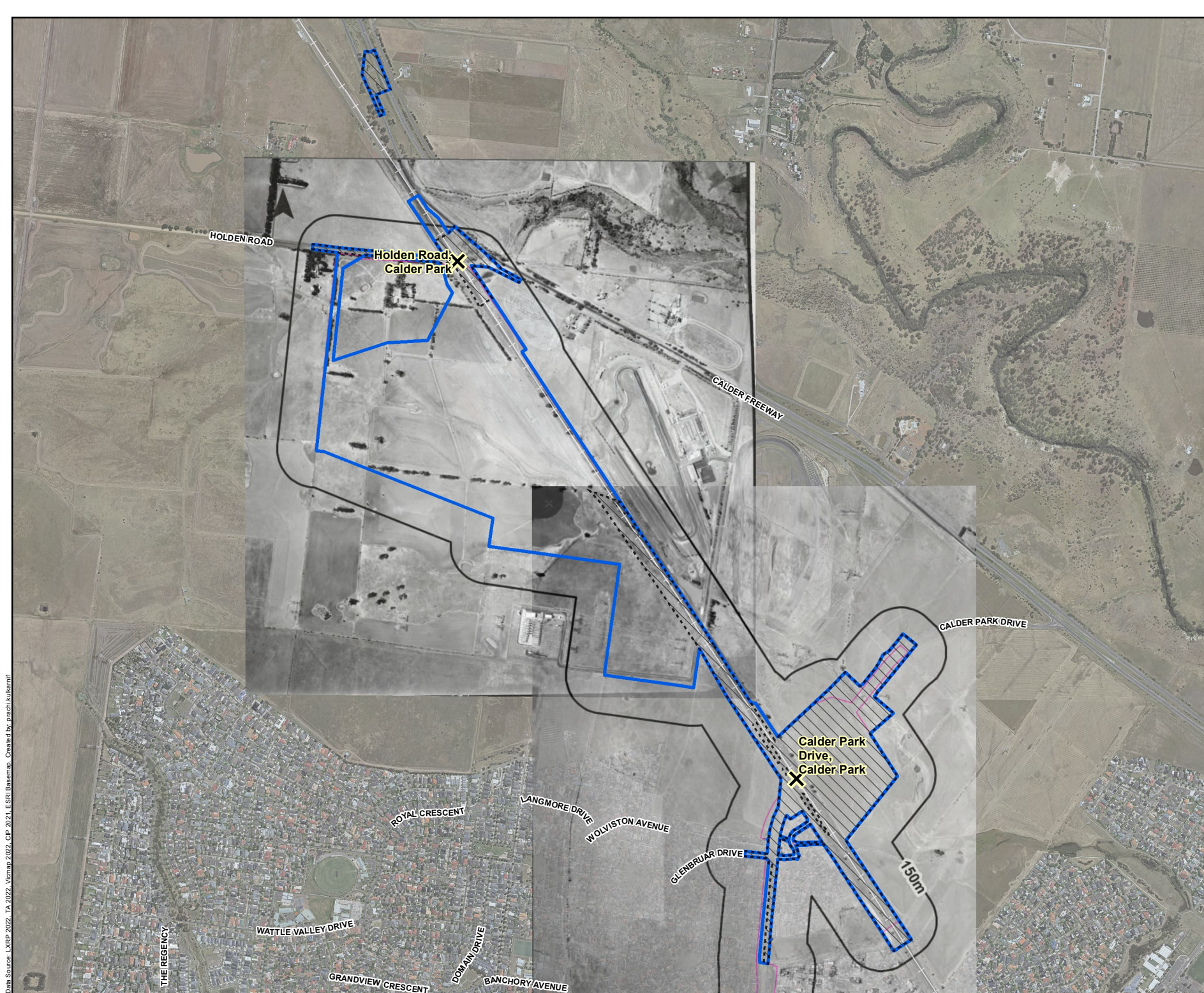
Landuse and Disturbance



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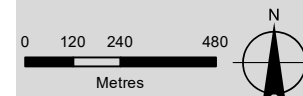
Data Source: LXRP 2022, TA 2022, Wombar 2022, CIP 2021, ESRI/Basemap, Created by: crachuk/kukam1



- LEGEND**
- Level crossing site
 - Construction footprint
 - Project area

Calder Park Drive
 Historic Aerial Imagery
 Year: 1985
 Figure 1

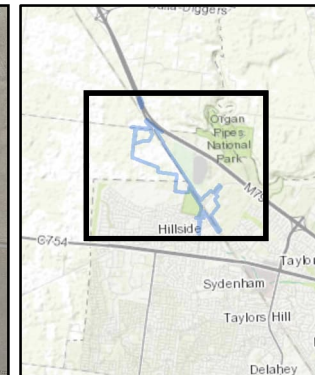
Landuse and Disturbance



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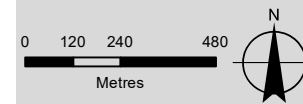
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- LEGEND**
- Level crossing site
 - Construction footprint
 - Project area

Calder Park Drive
 Historic Aerial Imagery
 Year: 1991
 Figure 1

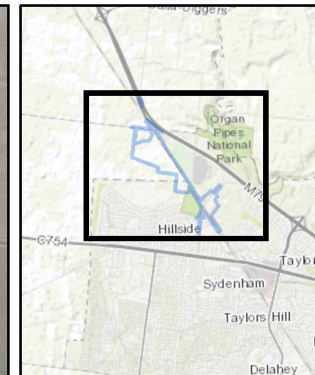
Landuse and Disturbance



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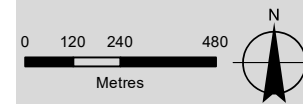
- LEGEND**
- Level crossing site
 - Construction footprint
 - Project area

Calder Park Drive
 Historic Aerial Imagery
 Year: 2001
 Figure 1

Landuse and Disturbance

LEVEL CROSSING REMOVAL PROJECT

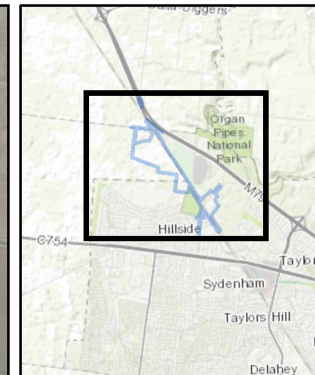
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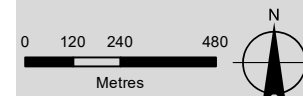
- LEGEND**
- Level crossing site
 - Construction footprint
 - Project area

Calder Park Drive
 Historic Aerial Imagery
 Year: 2009
 Figure 1

Landuse and Disturbance

LEVEL CROSSING REMOVAL PROJECT

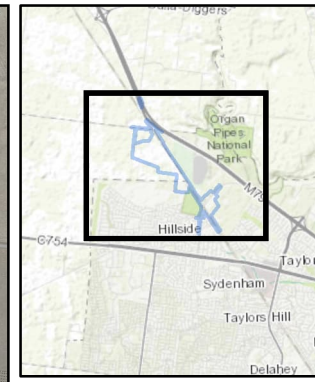
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LEGEND

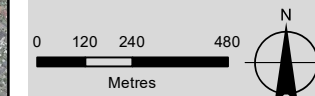
- Level crossing site
- Construction footprint
- Project area

Calder Park Drive
 Historic Aerial Imagery
 Year: 2010
 Figure 1

Landuse and Disturbance

LEVEL CROSSING REMOVAL PROJECT

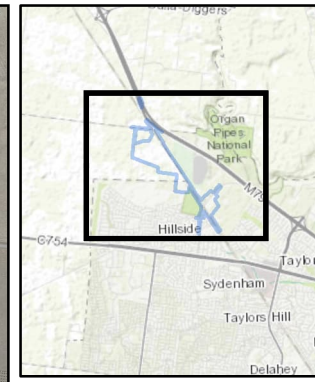
AECOM GHD JOINT VENTURE



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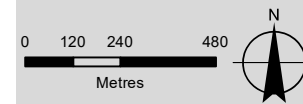
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- LEGEND**
- Level crossing site
 - Construction footprint
 - Project area

Calder Park Drive
 Historic Aerial Imagery
 Year: 2016
 Figure 1

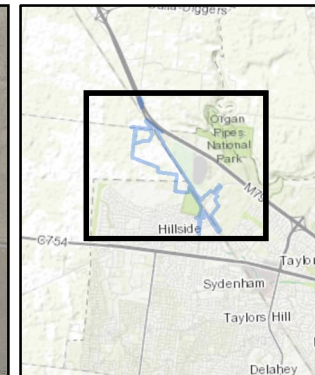
Landuse and Disturbance



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 Grid: GDA 1994 MGA Zone 55

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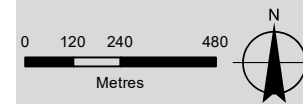
- LEGEND**
- Level crossing site
 - Construction footprint
 - Project area

Calder Park Drive
 Historic Aerial Imagery
 Year: 2021
 Figure 1

Landuse and Disturbance

LEVEL CROSSING
REMOVAL
PROJECT

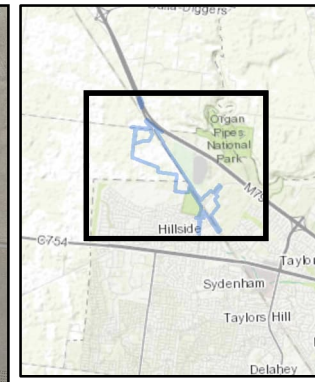
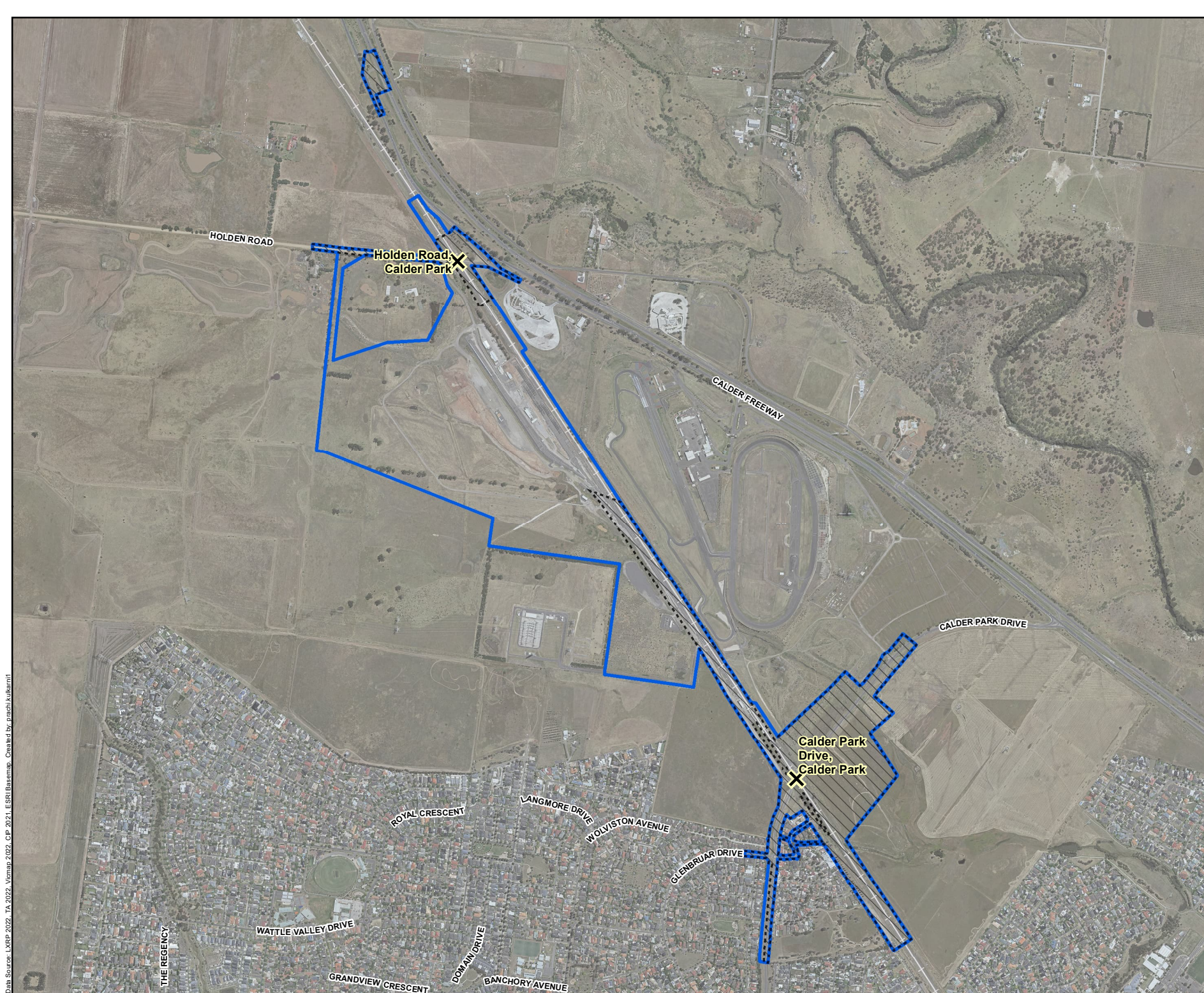
AECOM GHD
JOINT VENTURE



Paper Size A4
 Map Projection: Transverse Mercator
 Horizontal Datum: GDA 1994
 Grid: GDA 1994 MGA Zone 55

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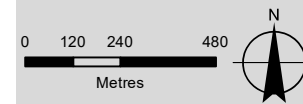
Data Source: LXRP 2022, TA 2022, Vicmap 2022, CIP 2021, ESRI/Basemap, Created by: arashi.kulkarni



- LEGEND**
- Level crossing site
 - Construction footprint
 - Project area

Calder Park Drive
 Historic Aerial Imagery
 Year: 2022
 Figure 1

Landuse and Disturbance



Paper Size A4
 Map Projection: Transverse Mercator
 Horizontal Datum: GDA 1994
 Grid: GDA 1994 MGA Zone 55

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Data Source: LXRP 2022, TA 2022, Vcmabp 2022, CIP 2021, ESRI/EsriMap, Created by: crachukulkam1

Appendix C – VGED Habitat Survey (LXRP-LX14-000-0-00-PA-RPT-0006)

Refer to [LXRP-LX14-000-0-00-PA-RPT-0006](#)

Appendix D – Flood Modelling Impact Analysis

Following is a summary of the information on flood modelling provided in the impact assessment report and the potential implications for the Victorian Grassland Earless Dragon that was completed prior to understanding the suitability (or otherwise) of habitat in Banchory Grove Reserve.

Flood modelling analysis

According to the SMEC flood modelling to inform impact assessment for Banchory Grove Reserve (SMEC 2023a), identified the greatest risk to Banchory Grove Reserve is posed by more frequent flood events such as 5-year Average Recurrence Interval (ARI) events. While rarer flood events, such as a 100-year ARI, may have a greater overall zone of influence compared to more frequent events, the infrequent nature of the events means the impacts may be less permanent and therefore a lower risk of ecological damage (SMEC 2023a). However, in keeping with a precautionary approach, a 'worst case' scenario for extent and depth of flooding (i.e. the 100-year ARI or 1% AEP) should be considered irrespective of the potential frequency of the event. As such, the 100-year ARI storm event and 1% AEP flood risk were considered in relation to potential impacts on the Banchory Grove Reserve.

Average Recurrence Interval (ARI) represents the probability of a flooding event occurring as:

the average time between floods of a certain size. Annual Exceedance Probability (AEP) presents the probability of a flooding event expressed as a per cent chance of the event occurring in any one year. A 5-year ARI event is therefore also known as a 1 in 5 year or 20% AEP flood, and a 100-year event is also known as a 1 in 100 year or 1% AEP flood.

SMEC (2023a) concluded that the 'likely' hydrology impacts on the Banchory Grove Reserve associated with flooding are:

- **Peak depth:** On average, average peak depth does not increase (increase of ~0 mm from ~20 mm) in a 5-year ARI flood scenario, though does increase by ~65 mm in 100-year ARI flood scenario.
- **Zone of influence (area subject to the increase in flood depth):** The zone of influence is contained to the estimated 8.8 m wide mown maintenance strip inside the perimeter of the Banchory Grove Reserve boundary fence in a 5-year ARI event (average ~ 0 m²). In a less frequent 100-year ARI event the change in flood depth extends further into Banchory Grove Reserve (average 570 m² – with 45 m² of the 570 m² extending beyond the maintenance strip (SMEC 2023a)).
- **Duration:** No impact to average duration of inundation because the area remains free draining in the design case (post-construction). In both pre- and post-construction scenarios, inundation following a storm event lasts on average ~3 hr (5-year ARI) and ~4 hr (100-year ARI). The design does not increase the flow rate. Velocity does not exceed 1.5 m/s and shear-stress does not exceed 20 N/m² therefore there is no risk of erosion or scour under design conditions (SMEC, pers. comm.).

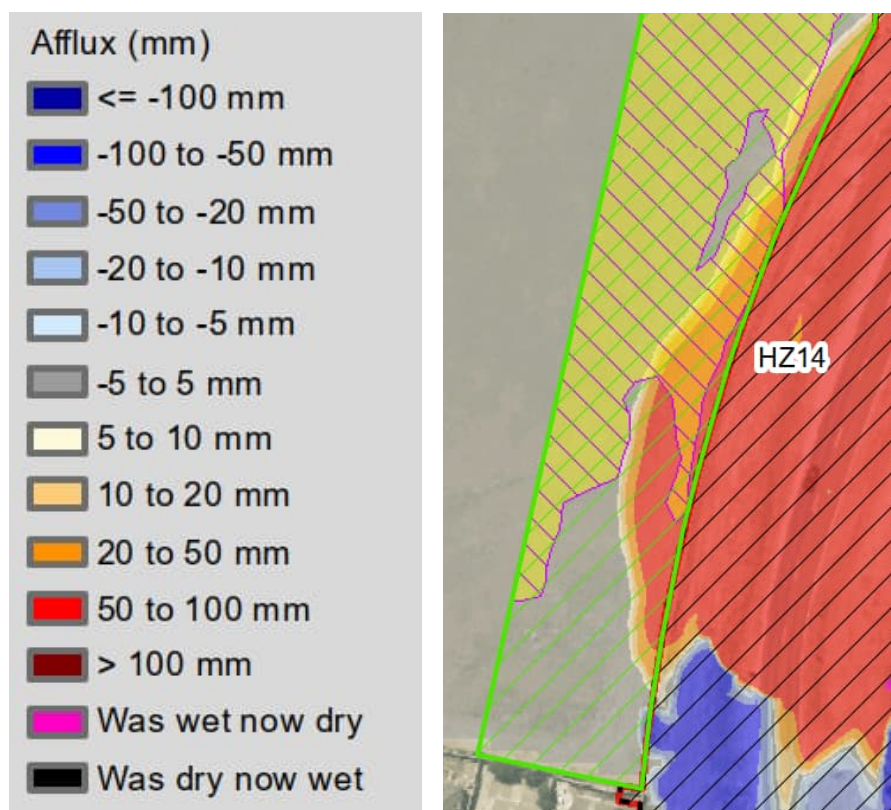
Average peak depth, area and duration are based on the average between the short duration (20 minute) and long duration (360 minute) flood event scenarios.

Table 3 provides a calculation of the area of NTGVVP that occurs within the modelled afflux.

Table 3 Modelled afflux area calculations in Banchory Grove Reserve

Flood Scenario	Area of Banchory Grove Reserve affected by afflux (ha)	Area of native vegetation / NTGVVP affected by afflux (ha)
20% AEP 360 min	0.009	0.001
20% AEP 20 min	0.004	0.001
1% AEP 360 min	0.037	0.018
1% AEP 20 min	0.095	0.038

Afflux modelling indicates an increase in flood depth by 50-100 mm then tapering off further into Banchory Grove Reserve (Figure 37). SMEC (2023a) identified the increase in average depth as ~65 mm in 100-year ARI flood scenario which in simplistic terms would represent an average flood depth of 165 mm if the base is assumed to be 100 mm (and not less than).



Yellow hatched polygon represents native grassland (NTGVVP)
Green hatched polygon represents area assessed for the Project.

Figure 37 Afflux (mm) in 100 year ARI short duration scenario

Afflux is based on flood depth during a 1% AEP short duration event (worst-case scenario) modelled to be:

- Existing conditions (base) - <math><0.1\text{ m}</math> (<math><100\text{ mm}</math>) depth
- Design –0.2-0.5 m (200-500 mm) depth tapering to 0.1-0.2 m (100-200 mm) and back to <math><0.1</math>, (<math><100\text{ mm}</math> depth) (Figure 38).

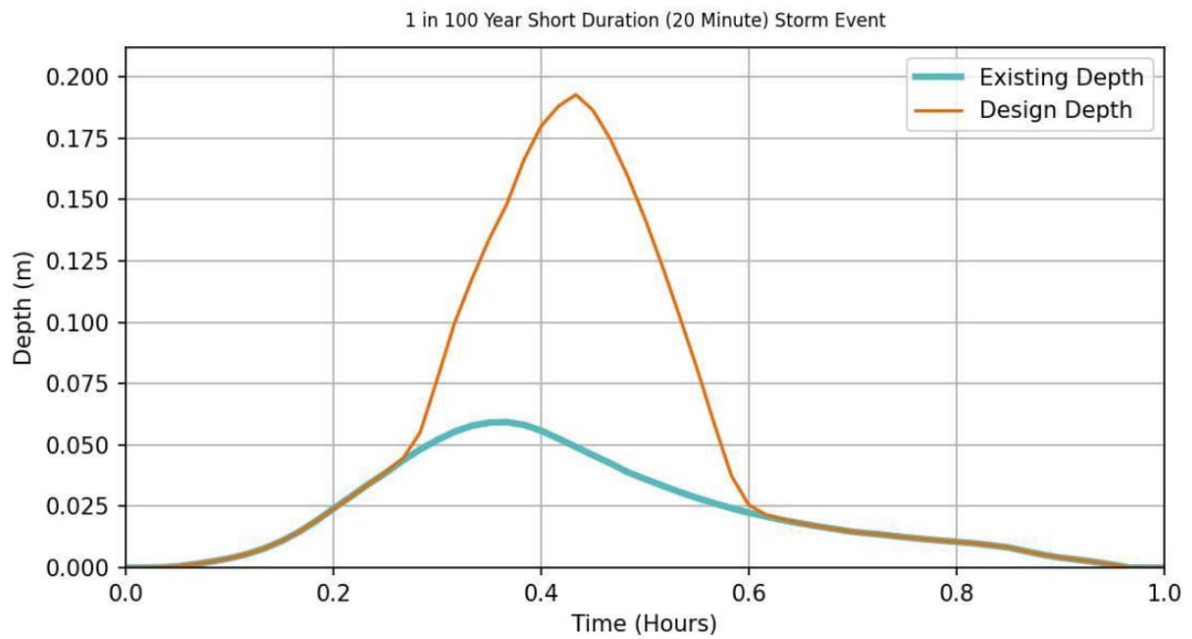


Figure 40 ARI short duration (20 minute) event existing and design condition (Source: Figure 22 in SMEC 2023a)

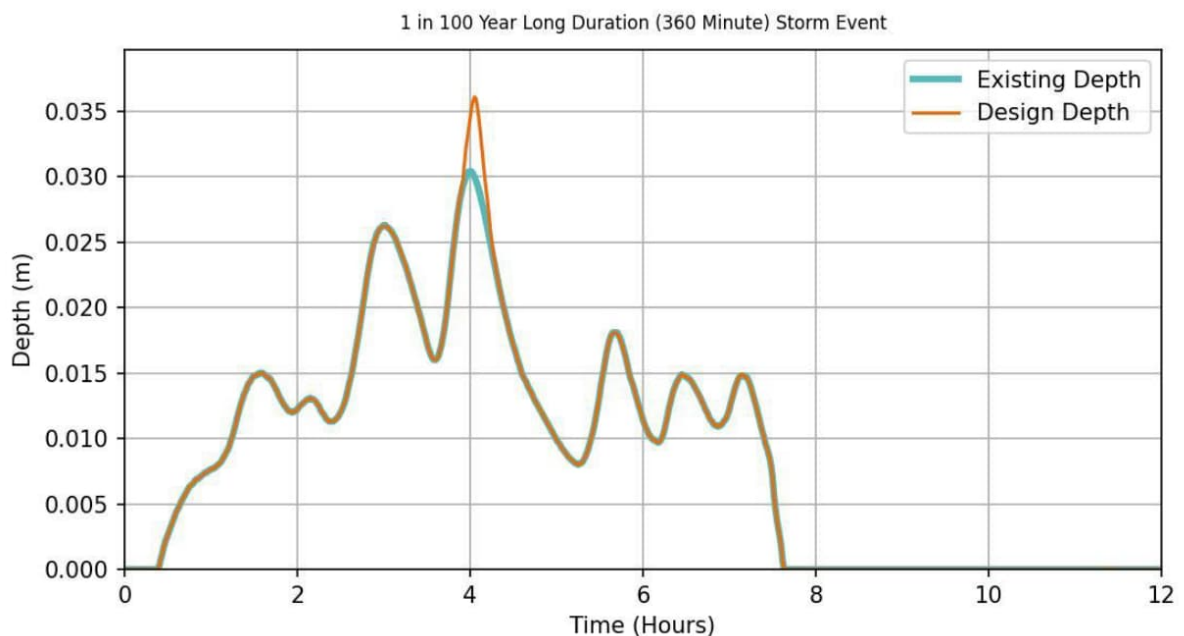


Figure 41 ARI long duration (360 minute) event existing and design condition (Source: Figure 26 in SMEC 2023a)

The cross section presented in Figure 42 for the long duration (360 minute) event suggests the maximum lineal distance afflux will affect is approximately 10 m inside the Banchory Grove Reserve boundary. Noting that this does not then represent the average area affected by afflux mentioned above.

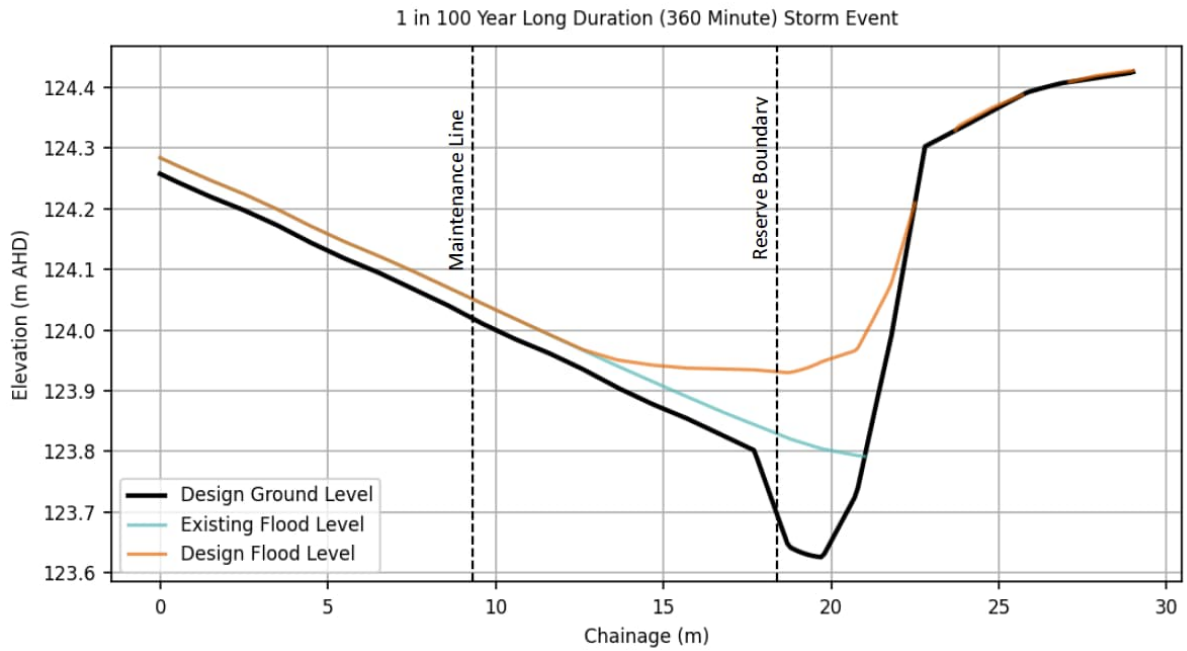


Figure 42 ARI long duration (360 minute) event existing and design condition by distance (Source: Figure 16 in SMEC 2023a)

In summary, during a 100 year ARI event the Project will increase peak flood levels in the area of Banchory Grove Reserve affected by afflux by ~65 mm from an assumed <100 mm to 165 mm. Afflux does not change average duration of inundation from approximately 4 hours (as illustrated in Figure 41). Afflux affects an area that is already subject to inundation during a 1 in 100-year event.



Figure 43 Area affected by afflux in the eastern area of Banchory Grove Reserve (Dec 2023)

Appendix E – Impact Figures

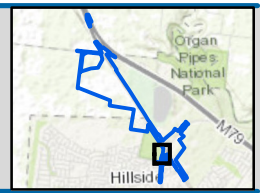
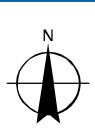
Figure 44 Calder Park Drive and Holden Road Base Condition 1% AEP Short Duration



Data source: Data Custodian: Data Set Name/Title, Version/Date. Created by: prachi.kulkarni

LEGEND Level crossing site Construction footprint Project area	Base 1% AEP Short Duration Flood Depth (m) 	

Paper Size A4
0 12.5 25 50
Metres
Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55



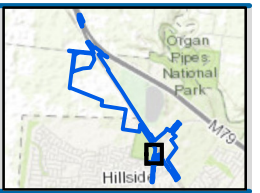
Calder Park Drive and Holden Road
Base Condition
1% AEP Short Duration
Figure 44

Figure 45 Calder Park Drive and Holden Road Base Condition 1% AEP Long Duration

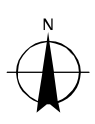


Data source: Data Custodian: Data Set Name/Title, Version/Date. Created by: prachi.kulkarni

LEGEND			
Level crossing site	Base 1% AEP Long Duration Flood Depth (m)	0.025 - 0.05	> 0.5
Construction footprint		0.05 - 0.1	0.1 - 0.25
Project area		0.25 - 0.5	<=0.025



Paper Size A4
 0 12.5 25 50
 Metres
 Map Projection: Transverse Mercator
 Horizontal Datum: GDA 1994
 Grid: GDA 1994 MGA Zone 55



Calder Park Drive and Holden Road
 Base Condition
 1% AEP Long Duration
 Figure 45

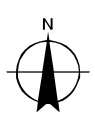
Figure 46 Calder Park Drive and Holden Road Design Condition 1% AEP Short Duration



Data source: Data Custodian: Data Set Name/Tile, Version/Date, Created By/prachi.kulkarni

LEGEND Level crossing site Construction footprint	Design 1% AEP Short Duration Flood Depth (m) <= 0.025 0.025 - 0.05 0.05 - 0.1 0.1 - 0.25 0.25 - 0.5 > 0.5	
--	--	--

Paper Size A4
 0 12.5 25 50
 Metres
 Map Projection: Transverse Mercator
 Horizontal Datum: GDA 1994
 Grid: GDA 1994 MGA Zone 55



Calder Park Drive and Holden Road
 Design Condition
 1% AEP Short Duration
 Figure 46

Figure 47 Calder Park Drive and Holden Road Design Condition 1% AEP Long Duration

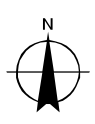


Data source: Data Custodian: Data Set Name/Title, Version/Date, Created By/prachi.kulkarni

LEGEND			
Level crossing site	Design 1% AEP Long Duration Flood Depth (m)	<= 0.025	> 0.5
Construction footprint		0.025 - 0.05	0.05 - 0.1
Project area		0.1 - 0.25	0.25 - 0.5



Paper Size A4
0 12.5 25 50
Metres
Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55



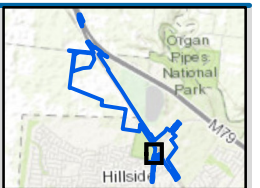
Calder Park Drive and Holden Road
Design Condition
1% AEP Long Duration
Figure 47

Figure 48 Calder Park Drive and Holden Road AEP1% Afflux Short Duration

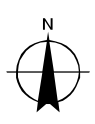


Data sources: Data Custodian: Data Set Name/Title, Version/Date. Created by:prachi.kulkarni

LEGEND						
		Afflux (mm)				



Paper Size A4
0 12.5 25 50
Metres
Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55



LEVEL CROSSING REMOVAL PROJECT

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Calder Park Drive and
Holden Road
AEP1% Afflux
Short Duration
Figure 48

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