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Biodiversity Impact Assessment

William Hovell Drive Duplication

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Prepared for Infrastructure Delivery Partners on behalf of Transport Canberra and City Services

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Definitions and abbreviations

Abbreviation	Definition
ACT	Australian Capital Territory
BOM	Bureau of Meteorology
BGW	Yellow Box–Blakely's Red Gum Grassy Woodland and White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland
DBH	Diameter breast height
DNG	Derived Native Grasslands
EIS	Environmental Impact Statement
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
EPSDD	Environment, Planning and Sustainable Development Directorate
GIS	Geographic Information System
GPS	Global Positioning System
GSM	Golden Sun Moth
Ha	Hectares
IDP	Infrastructure Delivery Partners
KTP	Key Threatening Process
MNES	Matters of National Environmental Significance
NC Act	*Nature Conservation Act 2014*
P&D Act	*Planning and Development Act 2007*
PCT	Plant Community Type
PTWL	Pink-tailed Worm-lizard
TCCS	Transport Canberra and City Services Directorate
TEC	Threatened Ecological Community
TP Act	*Tree Protection Act 2005*
WHD	William Hovell Drive

Executive summary

SMEC has been engaged by Infrastructure Delivery Partners on behalf of Transport Canberra and City Services to undertake the detailed design of the duplication of a 4.5km portion of William Hovell Drive between Coppins Crossing Road (now known as John Gorton Drive) and Drake Brockman Drive. Infrastructure Delivery Partners are a part of Major Projects Canberra, the ACT Government directorate with the responsibility for directing and managing all aspects of major projects invested in by the ACT Government

This report presents an outline of the desktop and in-field ecological survey assessment methods, results, and values identified within the Project study area as well as an assessment of the likely impacts of the Project on biodiversity values.

Although the Project study area has been highly modified, the following biodiversity values of particular note were recorded:

- Patches of 'Box Gum Woodland' listed as the Critically Endangered Ecological Communities Yellow Box–Blakely's Red Gum Grassy Woodland under the *Nature Conservation Act 2014* (NC Act), and White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). This Threatened Ecological Community (TEC) was also recorded within the construction boundary
- *Leucochrysum albicans* var. *tricolor* (listed as Endangered under the EPBC Act) was observed in the study area and construction boundary.

Fourteen fauna species listed as threatened or migratory under the NC Act and/or EPBC Act were identified as having a moderate or higher likelihood of occurrence in the study area based on the availability of suitable habitat and recent nearby sightings. One species listed as vulnerable under the NC Act and EPBC Act was recorded during the survey period: Superb Parrot.

The Project will require clearing of up to 19.85 hectares of vegetation for construction, of which 6.49 hectares are considered to be consistent with remnant native vegetation, with 6.41 ha of this being consistent with Box Gum Woodland.

Impacts to Box Gum Woodland, and individuals or habitat for threatened species have been avoided and minimised, where possible, through early identification, preliminary design and consideration of alternatives construction methodologies through:

- Reducing the Project impact area extent in areas consistent with Box Gum Woodland
- Minimising impacts to patches of native trees and areas dominated by native groundcover vegetation through route alignment and placement of construction compounds.

A referral under the EPBC Act was lodged prior to final design based on the anticipated unavoidable clearing of Box Gum Woodland within the easement and the presence of habitat or likely occurrence of Matters of National Environmental Significance. The referral decision was a controlled action based on the level of potential impacts to threatened species and communities specifically including:

- Superb Parrot (*Polytelis swainsonii*) – vulnerable
- Swift Parrot (*Lathamus discolor*) – critically endangered
- Golden Sun Moth (*Synemon plana*) – critically endangered.

Since the preparation of the referral, targeted seasonal surveys were undertaken for the threatened flora species:

- *Lepidium ginninderrense*
- *Leucochrysum albicans var. tricolor*
- *Pomaderris pallida*
- *Rutidosis leptorrhynchoides*
- *Swainsona recta*
- *Thesium australe*.

Overall, even with the implementation of appropriate mitigation measures, the Project is considered likely to have a residual significant impact to the following threatened entities:

- Box Gum Woodland
- Hoary Sunray
- Superb Parrot
- Pink-tailed Worm-lizard
- Striped Legless Lizard.

Guidance has been prepared relating to offset obligations, preliminary Offset Strategy requirements and Offset Management Plan. An Offset Strategy will address the goal of maintaining or improving the likelihood of threatened flora, fauna and ecological communities of persisting in the ACT.

1 Project Introduction

1.1 Background to the Project

SMEC has been engaged by Infrastructure Delivery Partners (IDP) on behalf of Transport Canberra and City Services (TCCS) to undertake the detailed design of the duplication of William Hovell Drive between John Gorton Drive and Drake-Brockman Drive (the Project).

This Biodiversity Impact Assessment supports the Project's Environmental Impact Statement (EIS) that identifies potential environmental impacts as a result of the Project. The EIS in turn supports a development application made under the *Planning and Development Act 2007* (P&D Act).

The Project has been referred to the Australian Minister for the Commonwealth Department of Agriculture, Water and the Environment, and was determined to be a controlled action under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) on 28 July 2020. This EIS therefore includes an assessment of the matters required by the Commonwealth to enable the Project to be assessed under the bi-lateral agreement.

1.2 Project Need

The Project area is a 4.5 km section of William Hovell Drive between John Gorton Drive and Drake-Brockman Drive. It is the only remaining unduplicated section of William Hovell Drive, and is subject to traffic congestion, particularly during the AM and PM peaks. Congestion is anticipated to continue to increase as regions of Molonglo Valley, the estate of Ginninderry (West Belconnen) and the new suburbs of Strathnairn and Macnamara continue to be developed.

Based on the traffic counts undertaken for the Project from 13 to 19 February 2020, the road currently accommodates more than 20,000 vehicles per day which significantly exceeds the capacity of a single carriageway road. A review of crash history on the road has identified that the road is recording higher than average crash rates. Duplication of William Hovell Drive is critical to relieving AM and PM congestion from West Belconnen and addressing road safety issues.

The Project will also support active travel and sustainable transport. The Project retains the existing alignment of the Bicentennial National Trail and provides an off-road shared path for the length of the upgrade. Two additional on-road cycle paths will also be provided.

A feasibility study was undertaken by Calibre (2018). This study considered four upgrade options and it was determined that the current Project was the most feasible for the following reasons:

- Smallest overall footprint
- Smallest volume of fill required, thereby minimising hauling within the site
- Earthworks only required on one side of the carriageway overcoming the need to haul across William Hovell Drive
- Second lowest length of stormwater relocation and culvert extension
- Minimising impact on native vegetation and box gum woodland threatened ecological communities
- No impacts on the potential Molonglo 3 High Voltage alignment on the southern side of William Hovell Drive
- Easiest from a constructability perspective.

The overall objective of the Project as a whole is to increase its capacity to relieve the AM and PM traffic congestion from West Belconnen, whilst also improving road safety.

1.3 Purpose of this report

The purpose of this Biodiversity Assessment Report is to support the Environmental Impact Statement (EIS) which has been prepared for the Project and assess the potential construction and operational impacts to biodiversity associated with the Project. This report presents the desktop and ecological survey assessment methods, results, and the likely ecological impacts of the Project. The report also addresses mitigation of the impacts and offset requirements of the Project.

The (ACT) Environment, Planning and Sustainable Development Directorate (EPSDD) have provided the Scoping Document requirements for the EIS which specifically outlines the specialist study requirements of the EIS. The purpose of this report is to address the biodiversity specialist study requirements outlined in the scoping

document. Table 1-1 below outlines the specific requirements and where in this report these aspects are addressed.

Table 1-1 Relevant scoping document requirements

Flora and Fauna	
Scoping Document Requirements	**Section of this report where addressed**
Provide an Ecological Impact Assessment prepared by a suitably qualified consultant.	This report
Assess the direct impacts on flora and fauna in particular Golden Sun Moth, Pink-tailed Worm Lizard, Superb Parrot, Swift Parrot and any other threatened species and threatened ecological communities including Box Gum Woodland.	Section 6
Describe the impact of habitat fragmentation caused by the development, particularly the potential loss of wildlife movement corridors and habitat connections.	Section 6.1.1
Discuss the impact of night lighting and noise on nocturnal fauna and flora.	Section 6.2.7
Describe the impacts increased animal strikes and roadkill may have on threatened and nonthreatened species, particularly kangaroos and threatened fauna and methods to mitigate these.	Section 6.3
Discuss the potential impacts to the adjacent nature reserves, including impacts from altered hydrology patterns and spread of invasive plants.	Section 6
Outline mitigation arrangement and whether an offset is likely to be required and, if so, how they comply with the EPBC Act environmental offsets policy and whether an offset management plan is likely to be required.	Section 7.2 and Section 8
Consider whether ongoing management, monitoring or reporting regimes are required.	Section 7 and Section 8
Matters of National Environmental Significance (MNES)	
Describe the impact on Box Gum Woodland, Superb Parrot, Swift Parrot, Golden Sun Moth and any other MNES potentially impacted by the project.	Section 6
For any matters identified as potentially impacted provide a description of the relevant impacts of the action including: • a detailed discussion of known threats • a detailed assessment of direct and indirect impacts on areas of habitat and populations of listed threatened species during pre-construction, construction and operation • detailed information on the extent (in hectares) of known and potential habitat that occurs in the proposed site and surrounds which may potentially be impacted by the Project • a detailed assessment of the nature and extent of the likely short term and long term relevant impacts • a statement whether any relevant impacts are likely to be unknown, unpredictable or irreversible.	Section 6 and Appendix C
Outline how the Project is consistent with: • Australia's obligations under the Convention on Biological Diversity, the Convention on Conservation of Nature in the South Pacific (Apia Convention), or the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) • any relevant recovery plans or threat abatement plans • any relevant strategic assessment reports • any relevant Commonwealth recovery plans or threat abatement plans.	Section 5.5, Appendix B and Appendix C
If offsets are proposed to compensate for impacts on MNES, describe the proposed offsets and how they comply with the EPBC Act environmental offsets policy.	Section 8

1.4 Location of works

The Project is to be completely contained to the road reserve extending from John Gorton Drive to Drake-Brockman Drive. This Site is unleased Territory land, with TCCS - Roads ACT as the custodian. The land is zoned TSZ1 – Transport under the Territory Plan, and runs adjacent to parcels of leased rural land, nature reserves and existing and future urban areas. Figure 1-1 provides a map of the Project study area and identifies uses of surrounding land.

The Project study area crosses a hillside that sweeps to the south of The Pinnacle Extension Nature Reserve and to the north of the Kama Nature Reserve. From the intersection with John Gorton Drive, William Hovell Drive declines slightly and then steadily increases in gradient toward the Kama and Pinnacle Extension Nature Reserves. The road turns slightly to the north and continues to increase in gradient with the highest point located near the Old Weetangera Cemetery.

The Kama Nature Reserve is a 155 ha parcel of land, sharing its northern boundary with William Hovell Drive and extending from the western side of the new suburb of Whitlam. The Kama Nature Reserve was established as a nature reserve in 2008 and was listed on the ACT Heritage Register in 2012 for its natural heritage values. According to the Molonglo River Reserve: Kama Operational Plan 2014 (ACT Government) "Kama is part of a key corridor between the Molonglo River and the Belconnen Woodlands." Kama Nature Reserve is identified as an offset site under The Molonglo Valley Plan for the Protection of Matters of National Environmental Significance (2011; the NES Plan).

The Pinnacle Nature Reserve adjoins the rear of residential development in Hawker and Weetangera. The 2016 Pinnacle Extension (an offset area under the NES Plan) runs between the western boundary of The Pinnacle Nature Reserve and the eastern side of William Hovell Drive.

The western side of the Kama Nature Reserve adjoins rural property (Belconnen Block 1596 and 1593) which are provided with a heritage overlay. SMEC understands that these properties are leased to the Uniting Church and contain the Old Weetangera Cemetery and former location of the Weetangera Methodist Church.

Centrally through the alignment, the embankment on the south-western side of William Hovell Drive becomes relatively steep, with views from the road reserve over rural rolling hills toward development in the Molonglo Valley. Mounds of fill from the previous construction of William Hovell Drive are located along the north-eastern side of the alignment and generally obscure views from the road.

The Project is located entirely within the Murrumbateman Interim Biogeographic Regionalisation of Australia (IBRA) Subregion of the South Eastern Highlands IBRA Bioregion (IBRA v.7). The Murrumbateman IBRA Subregion covers an area of approximately 630,454 ha.



Figure 1-1: Locality Plan

1.5 Description of the Project

The duplication of William Hovell Drive will occur along the 4.5 km stretch of road between John Gorton Drive and Drake-Brockman Drive in the districts of Molonglo Valley and Belconnen, ACT. The Project comprises the following:

- Duplication of 4.5km of unduplicated road
- Provision of two onroad cycle paths and a dedicated offroad shared path
- A signalised intersection at Drake-Brockman Drive
- Tie in works to the existing road at both ends of the Project
- Upgrade of access road to Old Weetangera Cemetery from Drake-Brockman Drive
- Upgrade of underpass for the Bicentennial National Trail
- Upgrade of the vehicular access for Rangers to Kama Nature Reserve
- Retention and upgrade works at three existing underpasses
- Retaining wall structures
- Ancillary works such as batters, drainage and safety barriers
- Relocation of utilities such as water and sewer to accommodate new intersection at Drake-Brockman Drive
- Street lighting, median works and other road furniture
- Temporary construction set down areas, compounds and stockpiles
- Retention of 90km/h posted speed limit and 100km/h design speed.

The construction boundary is 28.46 ha, including 8.6 hectares of existing road infrastructure. No buffer has been applied to the Project footprint except for three ends of the road reserve that do not align with internal boundaries of the road cadastre. In the north of the site, generally around the existing Drake-Brockman Drive – William Hovell Drive roundabout, four areas of construction boundary totalling 0.2 hectares extend outside the road reserve. A general arrangement plan of the proposed road duplication is provided in Figure 1-2 below.



Figure 1-2: Project footprint and study area

2 Legislative context

2.1 Commonwealth legislation

2.1.1 Environment Protection and Biodiversity Conservation Act 1999

The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is the Australian Government's key piece of environmental legislation. Under the EPBC Act, approval is required for any proposed action likely to have a significant impact on a matter of national environmental significance (MNES) protected by the EPBC Act. Potentially significant impacts on any MNES trigger a referral process under the EPBC Act.

An EPBC referral was prepared and the office of the Minister for the Environment has determined that the proposed action is a controlled action given that it is likely to have a significant impact on listed threatened species and communities including:

- White Box-Yellow Box-Blakely's Red Gum Grassy Woodland
- Derived Native Grassland Ecological Community.

Assessment and approval under the EPBC Act will be through the bilateral agreement with the ACT.

The Department also considers that further information is required to determine whether the proposed action will have a significant impact on the following species:

- Superb Parrot (*Polytelis swainsonii*)
- Swift Parrot (*Lathamus discolor*)
- Golden Sun Moth (*Synemon plana*).

TCCS must not take an action that has, will have or is likely to have a significant impact on any MNES without approval from the Commonwealth Minister for the Environment. An action is a project, a development, an undertaking, an activity or a series of activities, or an alteration of any of these things.

2.2 ACT legislation

2.2.1 Planning and Development Act 2007

The *Planning and Development Act 2007* (P&D Act) is the chief determining act for impact assessment procedures in the ACT. The P&D Act also provides the basis for land use zoning under the ACT Territory Plan.

Schedule 4 of the P&D Act states that an impact assessment is required for certain development activities, areas and processes. Under Section 138AA of the P&D Act, in certain circumstances, if the extent of impact is not significant, a proponent can apply to the relevant agency for an Environmental Significance Opinion (ESO). If an opinion is given that the project is not likely to have a significant adverse impact, the Project can be taken out of the 'impact track' and placed in the 'merit track'.

2.2.2 Nature Conservation Act 2014

The *Nature Conservation Act 2014* (NC Act) establishes a formal process for the identification and protection of threatened species and ecological communities in the ACT. Section 73 provides the legislative background to key threatening processes, being those actions that may threaten the survival, abundance or evolutionary development of a native species or ecological community. Key threatening processes are then defined in the action plan or conservation advice for each listed species.

The NC Act defines 'native vegetation area' as present if:

- Trees or shrubs indigenous to the area have a canopy cover of 10% or greater in any stratum

or:

- No more than 60% of the ground layer vegetation cover is exotic annual; and
- Native plants indigenous to the area comprise 50% or more of the perennial ground layer vegetation cover (grasses, small shrubs, forbs, sedges etc.); and
- 10% or more of the area is covered with vegetation (whether dead or alive).

2.2.3 Tree Protection Act 2005

Trees that have been identified as being of exceptional value are protected under the ACT *Tree Protection Act 2005* (TP Act) across leased and unleased urban land. The ACT Tree Register includes all the trees protected by the TP Act. Approval is required for any activity that may damage a protected tree or to undertake prohibited ground works within a protection zone for a protected tree. A Tree Protection Zone is defined as:

- The area under the canopy of the tree;
- The two metres wide area surrounding the vertical projection of the canopy; and
- The four metres wide area surrounding the trunk as measured at one metre above natural ground level.

3 Methodology

3.1 Personnel

Table 3-1 provides details on the qualifications and experience of the personnel involved in the ecological surveys and the preparation of this report.

Table 3-1: Personnel involved in the biodiversity assessment

Personnel	Position on Project	Qualifications and experience
Larissa Abbott	Lead ecologist – Project management, ecological surveys and reporting	Bachelor of Science (Hons) 13 years' experience
Lachlan Laurie	Lead botanist – ecological surveys, habitat assessments and reporting	BAM Accredited Assessor 15+ years' experience
Rebecca Carman	Lead fauna ecologist – ecological surveys, habitat assessments and reporting Review of updated reporting	Master of Philosophy Bachelor of Science PG Diploma in Wildlife Management 8 years' experience
Gregg Goldin	Botanist – ecological surveys, habitat assessments and reporting	BAM Accredited Assessor Master of Science Bachelor of Science (Hons) 7 years' experience
Jessica Ward-Jones	Fauna ecologist – ecological surveys and habitat assessments	Master of Science (Adv) Bachelor of Science (Hons) 3 years' experience
Joel Callaghan	Botanist – ecological surveys, habitat assessments and reporting	Bachelor of Science (Hons) 3 years' experience
James Taylor	GIS analyst	Bachelor of Environmental Science 11 years' experience
Alison Rowell	Technical advice and review	Bachelor of Science (Hons) 28 years' experience
Anthony Moll	Report revisions	Bachelor of Science (Ecology) Bachelor of Engineering (Environmental) 4 years' experience
Jessica Miller	EIS lead and review of updated reporting	Advanced Diploma of Applied Environmental Management Bachelor of Arts/Laws 11 years' experience

3.2 Desktop assessment

The study area for this assessment is broadly the construction boundary and that extent of the road reserve between John Gorton Drive and Drake-Brockman Drive, and the reserve along the western extent of Kingsford Smith Drive between Drake-Brockman Drive and Belconnen Way as shown in Figure 1-2. The study area was determined to consider all predicted direct and indirect impacts to biodiversity.

SMEC undertook a review of relevant public databases and literature to identify species threatened under both the NC Act and EPBC Act, migratory species, endangered populations, threatened ecological communities (TECs) and their habitats that have previously been recorded within or in the vicinity of the study area. Threatened species, migratory species, endangered populations and TECs that have the potential to occur within the study area were also considered.

3.2.1 Literature review

The following reports and ecological assessments were reviewed during preparation of this report:

- Preliminary Environmental Assessment: William Hovell Drive Duplication (SMEC 2020a)
- Technical memo: William Hovell Drive Duplication (SMEC 2020b)
- William Hovell Drive Upgrade Feasibility Study Report (Calibre 2018).

A full list of references is provided in Section 10.

Other resources reviewed included:

- ACT Threatened Species and Ecological Communities website
- ACT Environmental offsets policy
- ACT threatened species factsheets and action plans
- Offset Management Plan for the extension of The Pinnacle Nature Reserve (Parks and Conservation Service 2016).

3.2.2 Database searches

A search of relevant databases was undertaken to obtain records of all threatened species, endangered populations and communities previously recorded within a 10-kilometre buffer around the study area. Database searches were also completed to obtain information on additional listed areas of ecological importance, key habitat features, vegetation communities, aquatic habitat and ACT registered trees. All current and preliminary listings under the NC Act and EPBC Act were considered. A list of databases, access dates and search areas are outlined in Table 3-2.

Table 3-2: Database searches including access dates and search areas

Database	Date accessed	Search area
EPBC Act Protected Matters Search Tool	10 March 2020, updated 25 November 2020	10 km buffer around study area
ACTmapi (2021) – Significant Species, Vegetation Communities and Registered Trees layer	10 March 2020, updated 13 January 2021	10 km buffer around study area
ACTmapi (2021) – Soil and Hydrogeological Landscapes	15 January 2021	10 km buffer around study area
ACT threatened species list	13 January 2021	N/A

3.2.3 Vegetation mapping methodologies

The vegetation communities mapped as occurring in the study area that were presented in the *Preliminary Environmental Assessment: William Hovell Drive Duplication* (SMEC 2020a) were ground-truthed and modified where required. The vegetation mapping methodology, ACT Vegetation Map 2018 (ACT Government 2018) was used as source mapping for the *Preliminary Environmental Assessment: William Hovell Drive Duplication*.

3.3 Likelihood of occurrence assessment

The likelihood of threatened and migratory species, populations and ecological communities occurring within the study area was assessed against the criteria outlined in Table 3-3. The likelihood of occurrence table is provided in Appendix B.

Table 3-3: Likelihood of occurrence criteria

Likelihood of occurrence	Criteria
Recorded	The species was observed in the study area during the survey process.
High	It is highly likely that a species inhabits the study area and is dependent on identified suitable habitat (i.e. for breeding or important life cycle periods such as winter flowering resources), has been recorded recently in the locality (10 kilometres) and is known or likely to maintain resident populations in the study area. Also includes species known or likely to visit the study area during regular seasonal movements or migration.
Moderate	Potential habitat is present in the study area. The likelihood can reflect a lack of ecological understanding and/or information on an entity. An example includes cryptic flowering flora species that were not seasonally targeted by surveys and that have not been recorded in the study area despite potential habitat occurring. Adequate field survey will likely determine if there is a 'high' or 'low' likelihood of occurrence for the species within the study area.

Low	It is unlikely that the species inhabits the study area and has not been recorded recently in the locality (within 10 kilometres). For fauna species, individuals may be an occasional visitor, but habitat similar to that occurring in the study area is widely distributed in the locality, meaning that the species is not dependent (i.e. for breeding or important life cycle periods such as winter flowering resources) on the impacted habitat.
None	Suitable habitat is absent from the study area.

3.4 Field survey

3.4.1 Vegetation communities

Further ground-truthing of the vegetation communities within the study area including the completion of plot and transect surveys was not part of the agreed scope of works for this assessment. The vegetation mapping effort conducted for the *Preliminary Environmental Assessment: William Hovell Drive Duplication* (SMEC 2020a) has been used as the core mapping to assess vegetation communities in this report. A description of the vegetation mapping effort conducted for the *Preliminary Environmental Assessment: William Hovell Drive Duplication* is as follows:

A detailed assessment of vegetation and broad habitat features was carried out over three days by two SMEC ecologists from 11 to 13 March 2020. This assessment included rapid data assessments of the occurring flora species and random meander surveys (as described by Cropper, 1993) through all vegetation within the study area. This assessment stratified the vegetation communities into polygons, through:

- Structural formation (such as grassland, woodland, cleared)
- Native or exotic dominated perennial vegetation cover
- Representative and dominant species abundance and cover matrix (common, uncommon or rare)
- Apparent origins and processes relating to ecological functioning and genesis (such as derived native grassland, planted, remnant, recruitment).

Other characteristics such as disturbance, landforms and soil type were also noted. Data relating to specific habitats for candidate threatened fauna species was collected, specifically grassland floristics, structure, extent, aspect and slope as important habitat for Golden Sun Moth, *Synemon plana*, and floristics, rocky outcrops, partially buried rocks, rock weathering, slope, aspect and leaf litter cover for Pink-tailed Worm-lizard, *Aprasia parapulchella*.

Native vegetation zones were stratified by vegetation type and condition and assessed using the ACT Environmental Offsets Calculator (EOC) Assessment Methodology. Plots and transects were performed collecting the ten attributes required for the Calculator using the methods summarised in Table 3-4.

Table 3-4: Methods used to assess vegetation conditions.

Variable	Plot or transect type	Method
Native plant species richness	20m x 20m plot	Systematically walk the plot counting the number of native plant species for all vascular plants. Although not required for the calculator, a complete species list of both native and exotic species present were collected.
Native over- storey cover	At 10 points along 50m transects	At 10 points along the 50m transect (i.e. every 5m) estimate per cent foliage cover of native species directly overhead.
Native mid- storey cover	At 10 points along 50m transects	At 10 points along the 50m transect (i.e. every 5m) estimate per cent foliage cover in the mid-store, i.e. locally native shrubs between the overstorey stratum and 1m in height.
Native ground cover (grasses)	At 50 points along 50m transects	The ground stratum contains all native vegetation below 1m in height and includes all species native to the ACT (is not confined to species indigenous to the area). The ground stratum (grasses) refers to native grasses (i.e. plants belonging to the family Poaceae). At 50 points along the 50m transect (i.e. every 1m) record whether native grass intersects that point.
Native ground cover (shrubs)	At 50 points along 50 m transects	The ground stratum (shrubs) refers to native woody vegetation <1m. It is measured in the same way as for native ground cover (grasses) (see above).
Native ground cover (other)	At 50 points along 50m transects	The ground stratum (other) refers to non-woody native vegetation (vascular plants only) <1m that is not grass (e.g. herbs, ferns). It is measured in the same way as for native ground cover (grasses) (see above).

Variable	Plot or transect type	Method
Exotic plant cover	At 50 points along 50m transects	Exotic plants are vascular plants not native to Australia. Exotic cover is measured as a % of total standing ground cover vegetation (not ground litter).
Number of large trees	50m x 20m plot	This is a count of the number of living and dead trees within a 50mx20m plot which have a circumference of 150cm, at 1m above ground height.
Over-storey regeneration	Entire zone	Regeneration is measured as the proportion of over storey species present at the site that are regenerating (i.e. with dbh < 5cm).
Total length of fallen logs	50m x 20m plot	The total length of logs at least 10cm diameter and at least 0.5m long. The diameter is estimated with a measuring tape (or callipers if available) held horizontally. Only those parts of logs lying within the plot are measured.

A survey was undertaken in the study area for the presence of two potential threatened ecological communities listed under the NC Act, Natural Temperate Grassland and Yellow Box/Red Gum Grassy Woodland, both used criteria given in the NC Act, which has adopted the criteria for the corresponding communities (Natural Temperate Grassland of the South Eastern Highlands, and White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland), listed under the EPBC Act in both cases. Details on the criteria in relation to the site's vegetation is therefore covered under Matters of National Environmental Significance in Section 5.4.

3.4.2 Flora

Targeted threatened flora surveys were conducted for species listed as threatened under the EPBC and/or NC Acts and assessed with a moderate or higher likelihood of occurring in the study area (Table 3-5). Threatened flora surveys were conducted using the *NSW survey guide for the Biodiversity Assessment Method – Surveying threatened plants and their habitats* (DPIE 2020) as a guide. Surveys incorporated the use of transects to search for target species in areas of potential habitat. Specifically, transects were spaced approximately 10 metres apart, with more detailed sweeps performed in areas showing better native resilience. Survey tracks were recorded using a handheld GPS and are shown on Figure 3-1. Opportunistic observations were also included from surveys for vegetation condition and habitat assessments.

Surveys were conducted for all threatened flora species in areas mapped as having an associated plant community and other habitat preferences as outlined in the Conservation Advice or Strategy for each species under the NC Act. Potential habitat for the threatened species is shown in Table 3-5. Surveys were also performed in suitable habitat in 'planted vegetation' and 'exotic grassland' as some species - particularly *Lepdium ginniderrense* - may be present in disturbed areas.

Table 3-5: Species targeted for survey

Scientific Name	Common Name	Survey period	Habitat
Lepidium ginninderrense	Ginninderra Peppercress	Flowers winter to spring (returns to root stock after flowering so need to survey when flowering)	Low open structured native grassland, exotic grassland, typically prone to winter inundation.
Leucochrysum albicans var. *tricolor*	Hoary Sunray	September-April	Native grassland and grassy woodlands.
Pomaderris pallida	Pale Pomaderris	All year	Dry open forests and shrub communities.
Rutidosis leptorrhynchoides	Button Wrinklewort	All year (flowers in summer)	Natural temperate grassland and on the margins of stands of grassy woodland
Swainsona recta	Small Purple Pea	September-November	Open woodland with a grassy understorey that occasionally may have a low shrub component and groundcover that includes a wide range of native forbs.
Thesium australe	Austral Toadflax	November-February	Grassland, grassy woodland and grassy heath

Targeted surveys were conducted from 25 November to 27 November and from 30 November to 4 December 2020. These surveys all occurred within the prescribed survey windows identified within the NSW Threatened Biodiversity Profile Data Collection (https://www.environment.nsw.gov.au/AtlasApp). A limited area of lower quality habitat consisting of exotic grassland and planted natives, was also surveyed during the first two days of December, with attention given to spotting the maturing seed pods of *Lepidium* or *Swainsona* which persist on stems later in the season. An additional area of clearing became apparent from design refinement in early 2021. These areas along Drake-Brockman Drive consisted of mown lawn and planted trees were surveyed during the first week of February 2021.

3.4.2.1 *Dianella amoena*

SMEC understands that in preliminary discussions with TCCS, the ACT Conservator of Flora and Fauna requested consideration of the occurrence of the EPBC listed endangered plant species *Dianella amoena* within the road reserve, despite the species not being considered as a candidate through the likelihood of occurrence assessment. *Dianella* species incidentally encountered were recorded by handheld GPS and sampled.

3.4.3 Fauna

Species with a moderate or higher likelihood of occurrence in the study area (Appendix B) based on recent records and the availability of suitable habitat within the study area were targeted during the fauna survey period.

The total survey effort for threatened fauna species is provided in Table 3-6. Details of each survey method utilised are provided below. Survey methods and effort were generally based on the following guidelines:

- Survey guidelines for Australia's threatened bats: Guidelines for detecting bats listed as threatened under the EPBC Act (DEWHA 2010a)
- Survey guidelines for Australia's threatened birds: Guidelines for detecting birds listed as threatened under the EPBC Act (DEWHA 2010b).

Other survey guidelines are referenced where relevant. Survey locations were recorded with a handheld GPS and are shown in Figure 3-1.

Table 3-6: Summary of fauna survey effort

Survey	Target species	Total effort
Diurnal bird surveys	Regent Honeyeater Fork-tailed Swift Brown Treecreeper Varied Sittella Grey Falcon Painted Honeyeater Little Eagle White-throated Needletail White-winged Triller Hooded Robin Scarlet Robin Superb Parrot	8-11 December 2020 15 surveys of 5 transects TOTAL: 15 hours (2 observers)
Vantage point surveys		8-10 December 2020 4 surveys of 2 locations TOTAL: 2 hours 40 minutes (2 observers)
Ultrasonic detection	Large-eared Pied Bat	27 November – 1 December 2020 2 locations TOTAL: 8 nights
Habitat assessment	Golden Sun Moth Pink-tailed Worm Lizard Striped Legless Lizard Swift Parrot Grassland Earless Dragon	4-5 February 2021 2 surveyors along the study area TOTAL: 8 hours

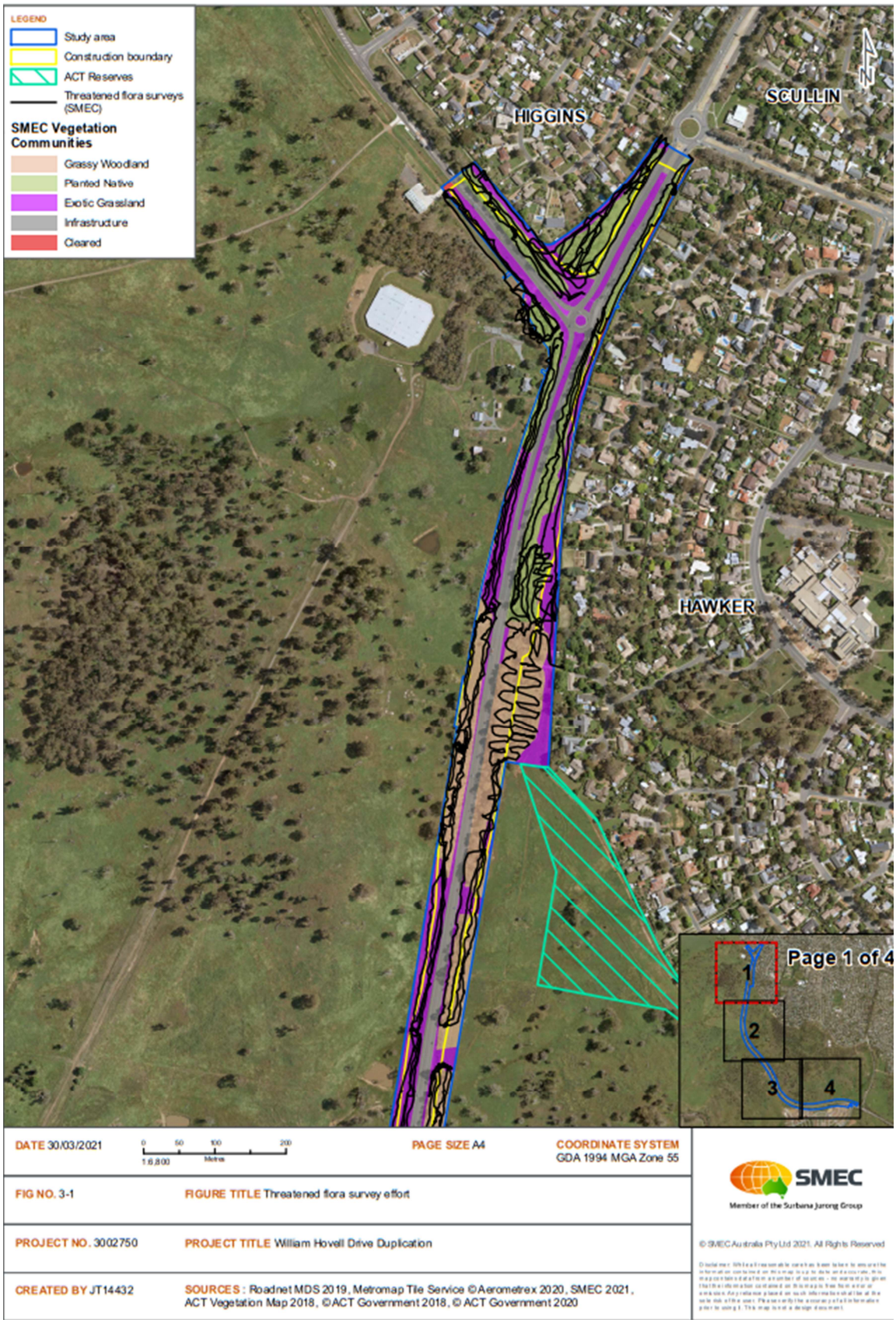
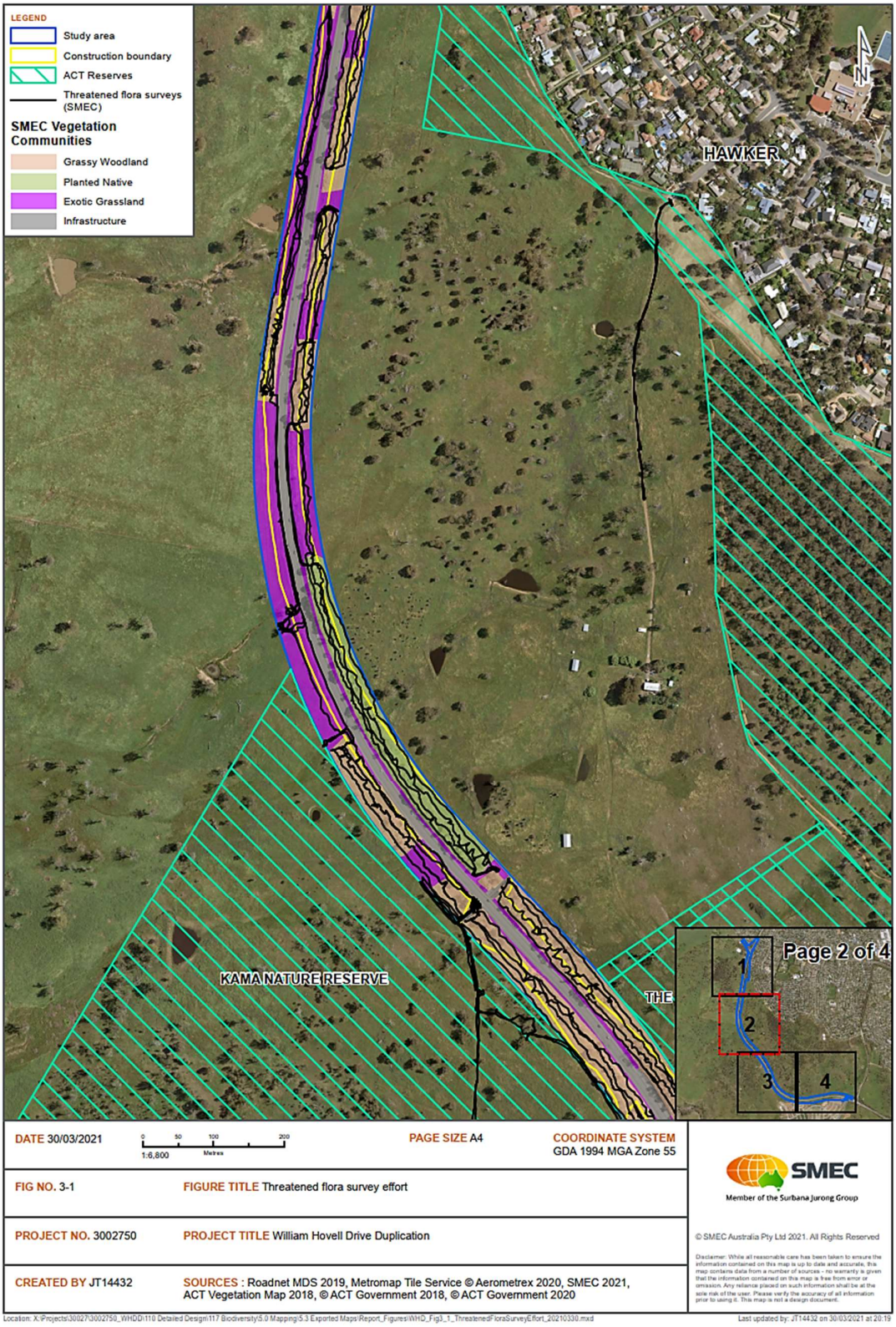
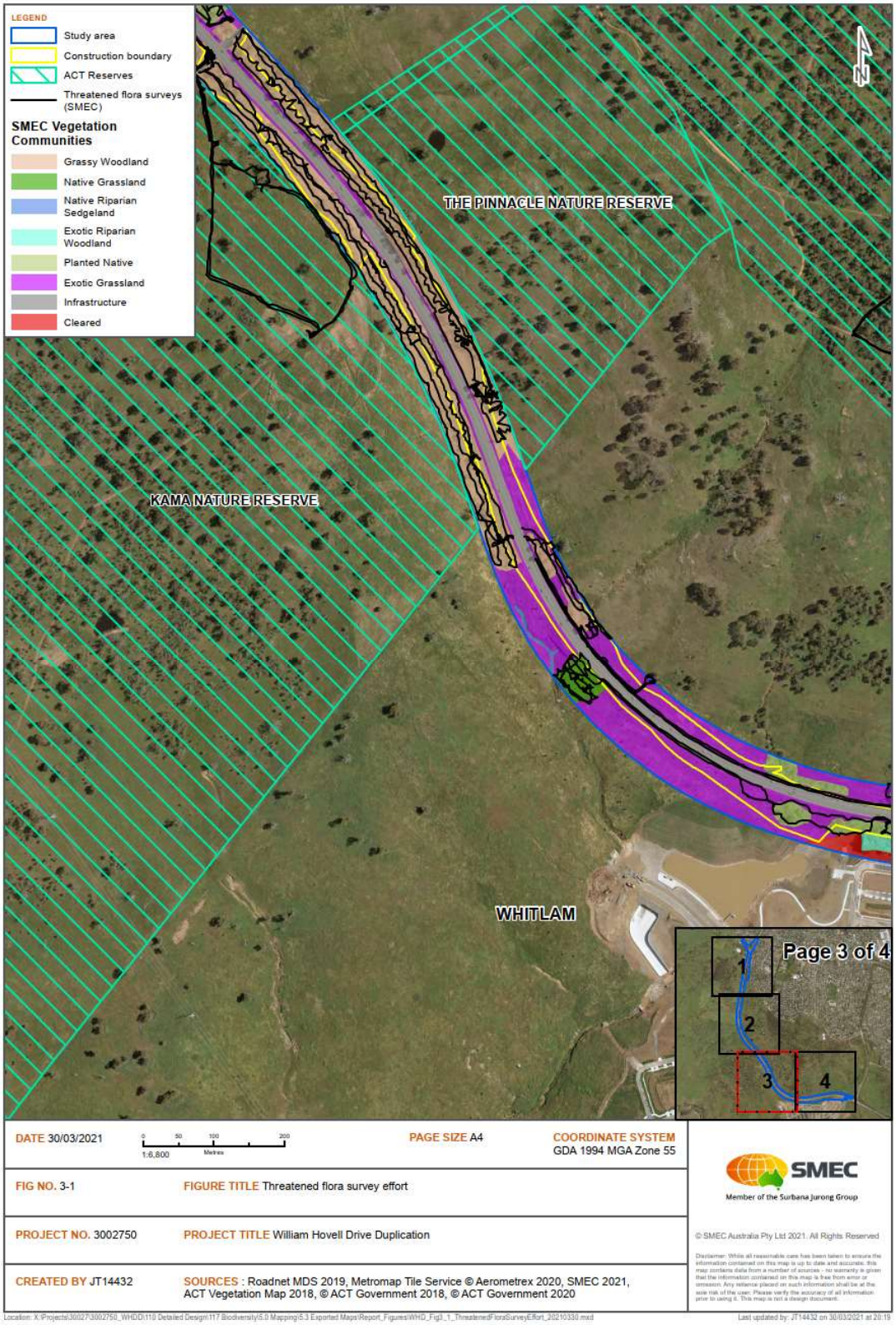
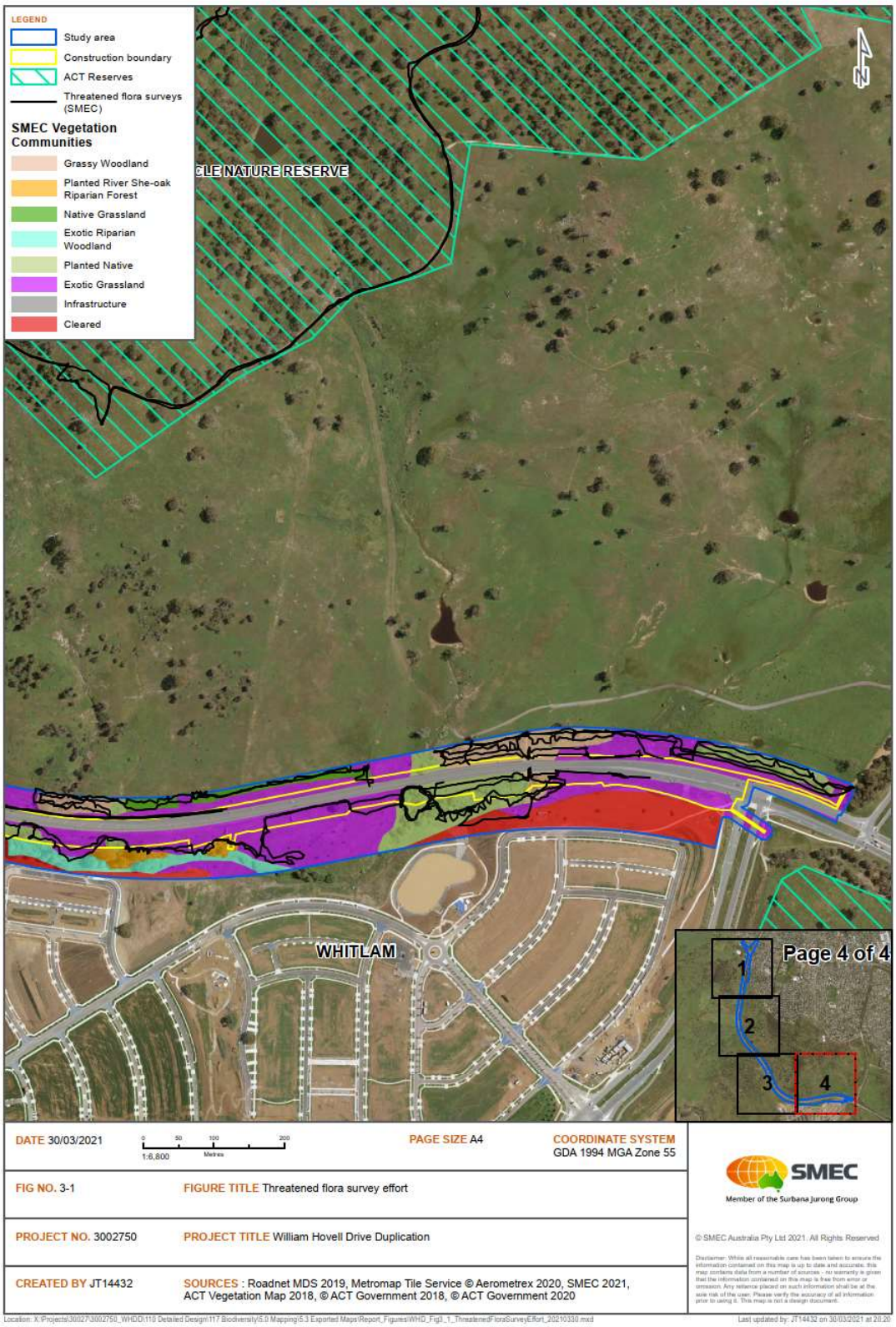


Figure 3-1: Threatened fauna survey locations


LEGEND
Study area
Construction boundary
ACT Reserves
Threatened flora surveys (SMEC)
SMEC Vegetation Communities
Grassy Woodland
Planted Native
Exotic Grassland
Infrastructure
HAWKER
KAMA NATURE RESERVE
THE
Page 2 of 4
1
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4
DATE 30/03/2021
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PAGE SIZE A4
COORDINATE SYSTEM GDA 1994 MGA Zone 55
FIG NO. 3-1
FIGURE TITLE Threatened flora survey effort
PROJECT NO. 3002750
PROJECT TITLE William Hovell Drive Duplication
CREATED BY JT14432
SOURCES : Roadnet MDS 2019, Metromap Tile Service © Aerometrex 2020, SMEC 2021, ACT Vegetation Map 2018, © ACT Government 2018, © ACT Government 2020
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LEGEND
Study area
Construction boundary
ACT Reserves
Threatened flora surveys (SMEC)
SMEC Vegetation Communities
Grassy Woodland
Native Grassland
Native Riparian Sedgeland
Exotic Riparian Woodland
Planted Native
Exotic Grassland
Infrastructure
Cleared
THE PINNACLE NATURE RESERVE
KAMA NATURE RESERVE
WHITLAM
Page 3 of 4
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DATE 30/03/2021
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PAGE SIZE A4
COORDINATE SYSTEM GDA 1994 MGA Zone 55
FIG NO. 3-1
FIGURE TITLE Threatened flora survey effort
PROJECT NO. 3002750
PROJECT TITLE William Hovell Drive Duplication
CREATED BY JT14432
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LEGEND
Study area
Construction boundary
ACT Reserves
Threatened flora surveys (SMEC)
SMEC Vegetation Communities
Grassy Woodland
Planted River She-oak Riparian Forest
Native Grassland
Exotic Riparian Woodland
Planted Native
Exotic Grassland
Infrastructure
Cleared
CLE NATURE RESERVE
WHITLAM
Page 4 of 4
1
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DATE 30/03/2021
1:6,800
PAGE SIZE A4
COORDINATE SYSTEM GDA 1994 MGA Zone 55
FIG NO. 3-1
FIGURE TITLE Threatened flora survey effort
PROJECT NO. 3002750
PROJECT TITLE William Hovell Drive Duplication
CREATED BY JT14432
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3.4.3.1 **Diurnal bird surveys**

Dawn and dusk surveys for diurnal birds were carried out by two observers within three hours of sunrise or sunset for a period of one hour. Surveys were carried out along five transects 650-1250 metres in length. Locations are shown in Figure 3-1. Each transect was surveyed twice at dawn and once at dusk between 8 and 11 December 2020. Birds were identified visually or aurally through their vocalisations using Morcombe's Birds of Australia (Version 1.7.1, mydigitalearth.com, 2020) as a reference guide.

3.4.3.2 **Vantage point surveys**

Vantage point surveys were undertaken at two locations within the study area (Figure 3-1). Surveys were undertaken for 40 minutes by two observers. Each location was surveyed twice between 8 and 10 December 2020. Birds were identified visually or aurally through their vocalisations using Morcombe's Birds of Australia (Version 1.7.1, mydigitalearth.com, 2020) as a reference guide.

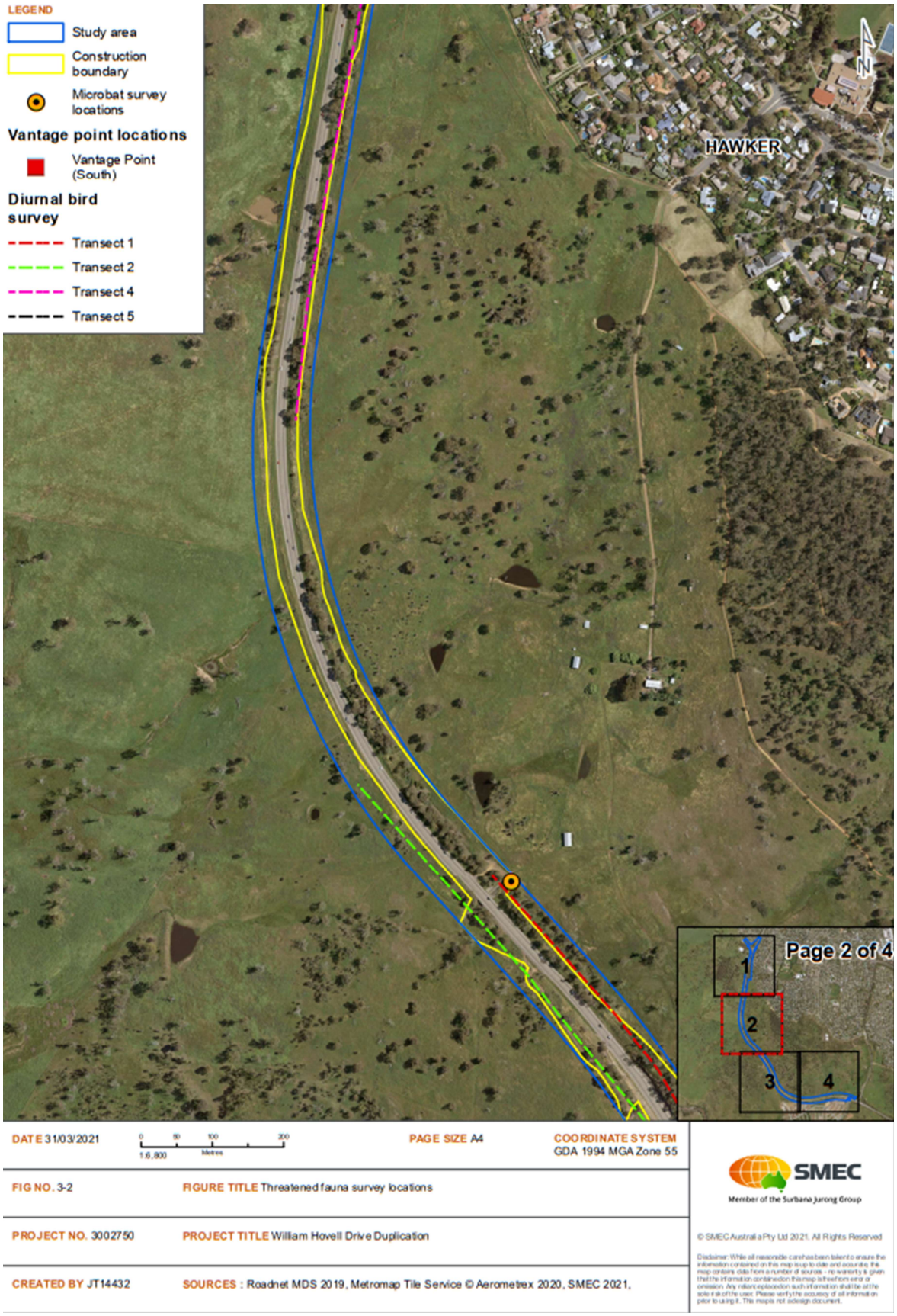
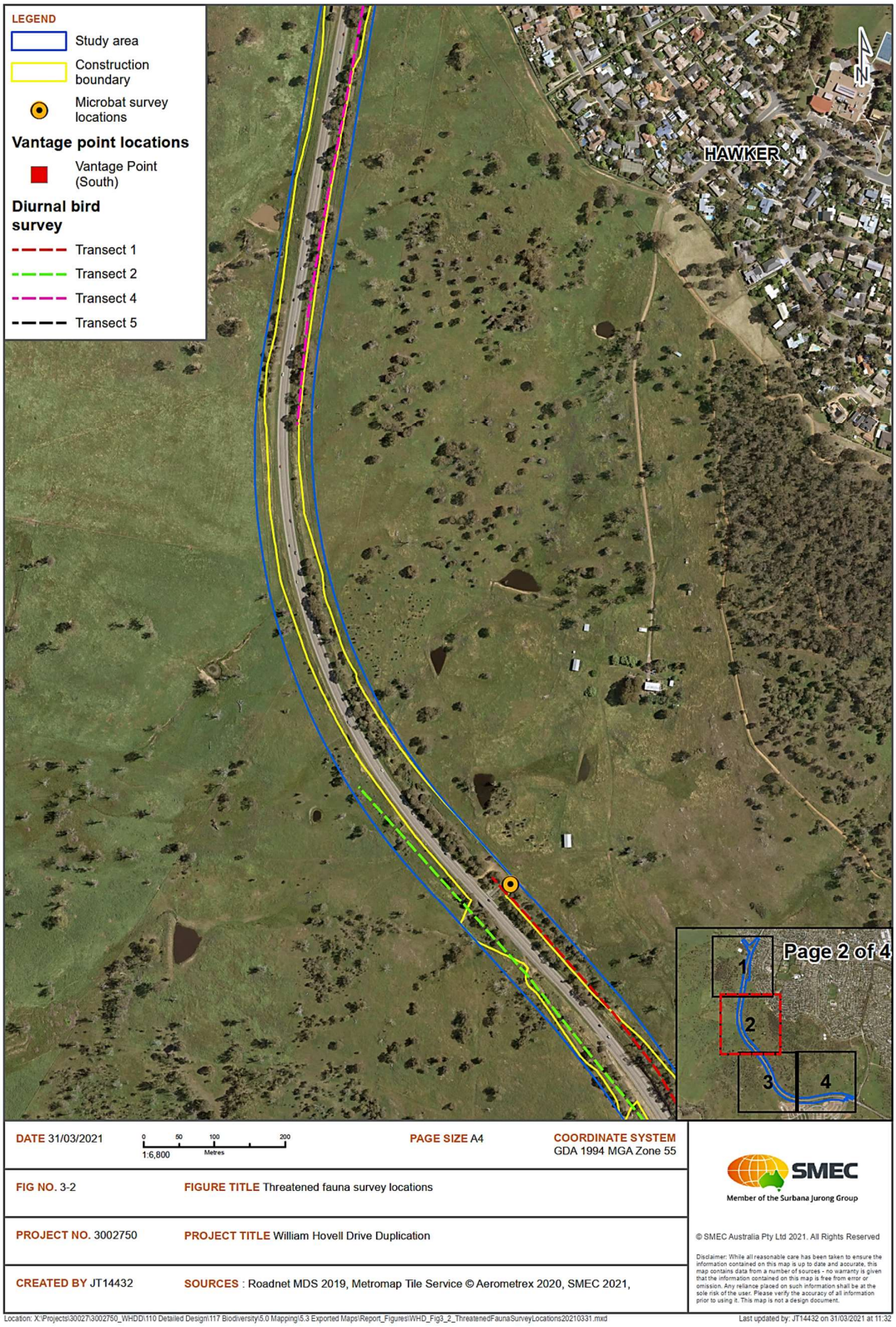
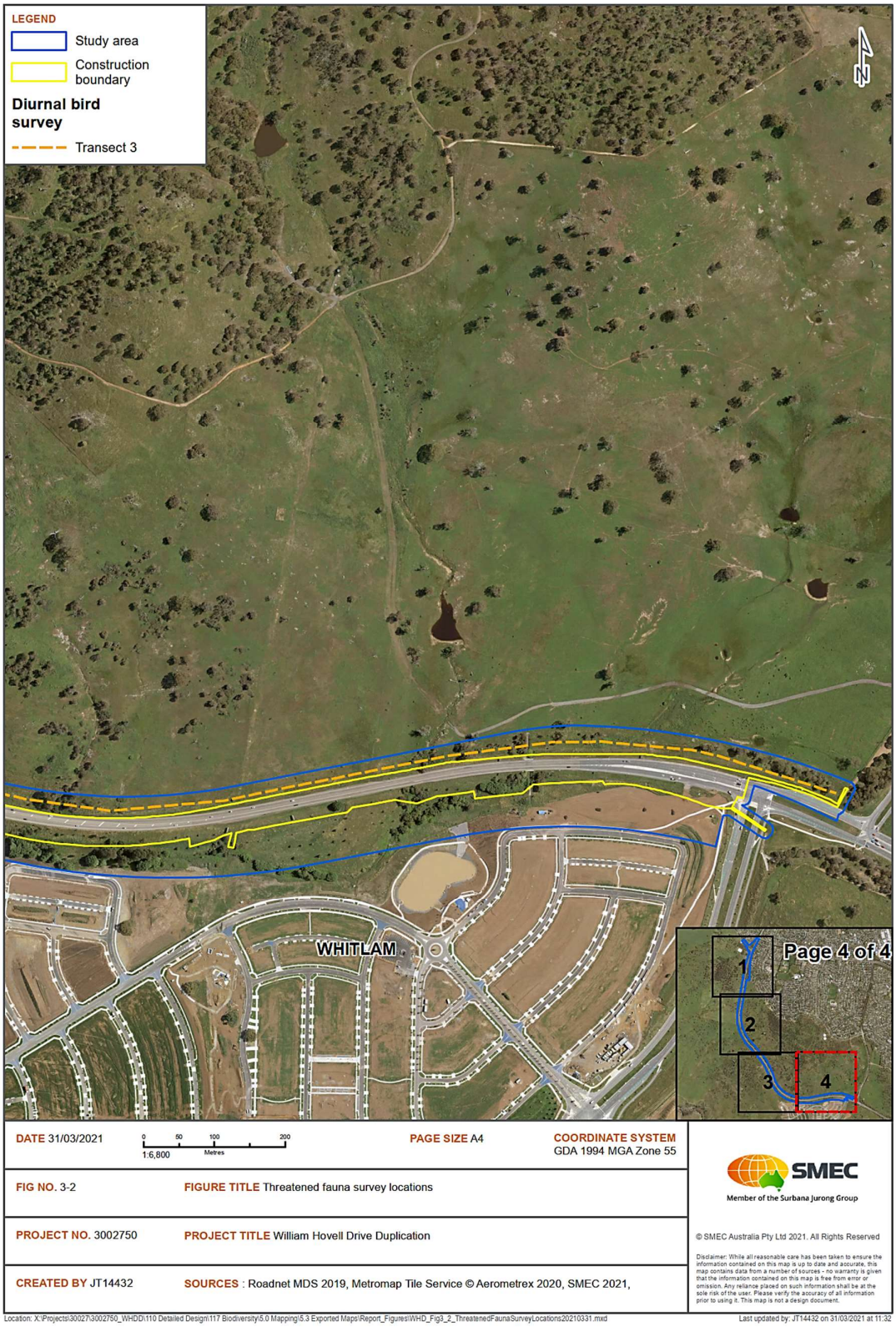


Figure 3-2: Threatened fauna survey locations


LEGEND
Study area
Construction boundary
Microbat survey locations
Vantage point locations
Vantage Point (South)
Diurnal bird survey
Transect 1
Transect 2
Transect 4
Transect 5
HAWKER
N
Page 2 of 4
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DATE 31/03/2021
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Metres
PAGE SIZE A4
COORDINATE SYSTEM
GDA 1994 MGA Zone 55
FIG NO. 3-2
FIGURE TITLE Threatened fauna survey locations
PROJECT NO. 3002750
PROJECT TITLE William Hovell Drive Duplication
CREATED BY JT14432
SOURCES : Roadnet MDS 2019, Metromap Tile Service © Aerometrex 2020, SMEC 2021,
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Location: X:\Projects\30027\3002750_WHDD\110 Detailed Design\117 Biodiversity\5.0 Mapping\5.3 Exported Maps\Report_Figures\WHD_Fig3_2_ThreatenedFaunaSurveyLocations20210331.mxd
Last updated by: JT14432 on 31/03/2021 at 11:32


LEGEND
Study area
Construction boundary
Microbat survey locations
Vantage point locations
Vantage Point (South)
Diurnal bird survey
Transect 1
Transect 2
Transect 3
Vantage Point (South)
WHITLAM
Page 3 of 4
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DATE 31/03/2021
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Metres
PAGE SIZE A4
COORDINATE SYSTEM
GDA 1994 MGA Zone 55
FIG NO. 3-2
FIGURE TITLE Threatened fauna survey locations
PROJECT NO. 3002750
PROJECT TITLE William Hovell Drive Duplication
CREATED BY JT14432
SOURCES : Roadnet MDS 2019, Metromap Tile Service © Aerometrex 2020, SMEC 2021,
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Location: X:\Projects\30027\3002750_WHDD\110 Detailed Design\117 Biodiversity\5.0 Mapping\5.3 Exported Maps\Report_Figures\WHD_Fig3_2_ThreatenedFaunaSurveyLocations20210331.mxd
Last updated by: JT14432 on 31/03/2021 at 11:32


LEGEND
Study area
Construction boundary
Diurnal bird survey
Transect 3
WHITLAM
Page 4 of 4
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DATE 31/03/2021
0 50 100 200
1:6,800
Metres
PAGE SIZE A4
COORDINATE SYSTEM
GDA 1994 MGA Zone 55
FIG NO. 3-2
FIGURE TITLE Threatened fauna survey locations
PROJECT NO. 3002750
PROJECT TITLE William Hovell Drive Duplication
CREATED BY JT14432
SOURCES : Roadnet MDS 2019, Metromap Tile Service © Aerometrex 2020, SMEC 2021,
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Location: X:\Projects\30027\3002750_WHDD\110 Detailed Design\117 Biodiversity\5.0 Mapping\5.3 Exported Maps\Report_Figures\WHD_Fig3_2_ThreatenedFaunaSurveyLocations20210331.mxd
Last updated by: JT14432 on 31/03/2021 at 11:32

3.4.3.3 Ultrasonic detection

Ultrasonic bat call detectors (Songmeter SM4BAT FS, Wildlife Acoustics Inc., USA) were utilised for four full nights (from 27 November to 1 December 2020) at each of the two locations shown in Figure 3-1. Calls were downloaded and converted to Zero-Crossing (ZC) files and sorted using Kaleidoscope (Version 5.3.9, 2020, Wildlife Acoustics Inc, USA). Identification of species was carried out by viewing calls in AnalookW (Version 4.2g, 2016, Chris Corben, www.hoarybat.com) and comparing recordings to regional reference calls and published descriptions (Pennay *et al.*, 2004). Calls with fewer than three pulses were excluded from analysis as call identification accuracy is reduced under this threshold. Calls were assigned to three categories, depending on the confidence of the identification; definite, probable or possible.

3.4.3.4 Habitat mapping and hollow-bearing tree surveys

Surveys for threatened fauna habitat and hollow-bearing trees were conducted on 3-4 November 2020 and 4-5 February 2021. Species considered were those listed in the Project's likelihood of occurrence table (Appendix B), specifically Golden Sun Moth, Pink-tailed Worm Lizard, Striped Legless Lizard, Grassland Earless Dragon and Perunga Grasshopper as well as several woodland bird species. Pink-tailed Worm Lizard habitat mapping (ACTmapi, 2021) that was in the study area was ground-truthed and modified where required. The vegetation mapping, land use and broad vegetation type and condition of the adjoining land was taken into consideration when assessing the potential habitat suitability of the study area for threatened species.

Hollow-bearing trees throughout the study area were marked with a GPS. The following data was collected on each tree with hollows:

- Tree species
- Diameter at breast height (DBH)
- Estimated number and size of each hollow: Small = <5cm, Medium = 5-10cm, Large = 10-20cm, X-Large = 20+cm
- Additional habitat features such as presence of mistletoe
- Photo of the tree.

Binoculars were used to assist in positive identification of the presence and size of hollows.

3.4.3.5 Opportunistic sightings

Opportunistic sightings of fauna were recorded during other field activities and while moving between surveys sites. Evidence of animal activity such as scats, diggings, scratch marks, nests/dreys or burrows were also noted.

3.4.4 Weather conditions

After a period of drought, the ACT experienced a wetter than usual spring, with most areas receiving 50% above their normal spring rainfall, the highest since 2010. The wet conditions resulted in prolific growth of groundcover vegetation across the site. Minimal rainfall fell during the survey periods (Table 3-7).

The weather was also warmer than average, especially overnight. Maximum daytime temperatures ranged from 19 to 35 degrees Celsius across the survey period (BOM 2020).

Weather conditions were considered suitable for the survey of the target threatened flora and fauna species.

Table 3-7: Weather conditions during survey

Date	Sunrise	Sunset	Min. temp (°C)	Max temp (°C)	Rainfall (mm)	Max. wind gust (km/hr)	Wind gust direction
27/11/20	5:42 AM	7:59 PM	13.3	31.4	0	44	NW
28/11/20	5:42 AM	8:00 PM	14.9	35.3	0	76	SW
29/11/20	5:42 AM	8:01 PM	16.8	27.8	3.4	72	NW
30/11/20	5:42 AM	8:02 PM	13.6	23.2	0	41	E
1/12/20	5:42 AM	8:00 PM	11.9	33.1	0	70	NW
2/12/20	5:41 AM	8:04 PM	13.9	26.2	2.6	46	E
3/12/20	5:41 AM	8:05 PM	12.3	25.3	0	35	NNW
4/12/20	5:41 AM	8:05 PM	6	28.8	0	54	W

Date	Sunrise	Sunset	Min. temp (°C)	Max temp (°C)	Rainfall (mm)	Max. wind gust (km/hr)	Wind gust direction
5/12/20	5:41 AM	8:06 PM	8.4	28.4	0	72	NW
6/12/20	5:41 AM	8:07 PM	12.8	19.5	12	61	NNW
7/12/20	5:41 AM	8:08 PM	10.4	21.3	0	59	WNW
8/12/20	5:41 AM	8:09 PM	3.9	20.7	0.4	44	NNW
9/12/20	5:41 AM	8:10 PM	4.9	24.6	0.2	39	NNW
10/12/20	5:41 AM	8:10 PM	8.7	25.4	0	46	E
11/12/20	5:42 AM	8:11 PM	9	19.9	0.8	41	ESE
12/12/20	5:42 AM	8:12 PM	7.1	19.4	0	37	ESE
13/12/20	5:42 AM	8:13 PM	11.2	23.8	0.8	39	E
14/12/20	5:42 AM	8:13 PM	12.3	26	0	37	NE

Weather conditions recorded at Canberra Airport (BOM station 070351)

3.5 Limitations

The long periods of prolonged precipitation in the weeks and months prior to the threatened flora surveys facilitated the rapid growth and spread of non-native grasses. The most common non-native grasses were *Phalaris aquatica, Festuca arundinacea*, *Dactylis glomerata* and *Avena* species. These grasses formed thick stands throughout the study area – often reaching head-height – potentially out-competing the threatened flora targeted in the surveys. The prevalence of these non-native grasses also obstructed the view of the surveying ecologists making detection of the targeted species less likely.

Despite not detecting most of the targeted threatened flora species, this does not necessarily mean that they do not occur in the study area. As stated by Rehwinkel (2015): 'As a general rule, natural and secondary grasslands should only be assessed using this method when the diversity is likely to be most evident.' It was noted by surveyors that the more immediately post-drought species assemblages observed by SMEC (2020) broadly showed more evidence of structural dominance of perennial natives (compared to perennial exotics) than the surveys of the current study. While the surveys for SMEC (2020) were limited to rapid data assessment to identify broad vegetation types and the likely presence of TECs, the data they collected relating to perennial native dominance has been used here to be inform the assessment of whether vegetation is mapped as native or exotic.

Threatened fauna surveys were limited to those targeting diurnal birds and microbats. Surveys were conducted during suitable weather conditions and time of day to optimise detection of the target species. Additional species not detected during surveys or not present at the time of survey have been assessed considering the availability and condition of suitable habitat and recent reliable records of occurrence within or nearby the study area. Where necessary, a precautionary approach was used to assess impacts to threatened species.

4 Results

4.1 Vegetation communities

The following seven broad vegetation communities have been mapped by the current study within the study area:

- Grassy Woodland
- Native Grassland
- Native Riparian Sedgeland
- Planted River She-oak Riparian Forest
- Planted Native
- Exotic Riparian Woodland
- Exotic Grassland.

These communities have been mapped to stratify vegetation structure types, dominance of native versus exotic, and dominant plant group when particularly relevant.

The extent of each vegetation community within the study area and their conformity to threatened ecological communities and ACTmapi vegetation communities is summarised in Table 4-1. A map of the delineated vegetation communities within the study area is provided in Figure 4-1.

Table 4-1: Vegetation communities in the study area

SMEC vegetation community	ACT Vegetation Type (Act Government 2021	General ACTmapi vegetation community spatial correlation as mapped in study area (ACTmapi 2021)	Relationship to NC Act TEC	Relationship to EPBC Act TEC	Area within study area	
Grassy Woodland	ACT16: *Eucalyptus melliodora – E. blakelyi* Tableland Grassy Woodland	u19: Blakely's Red Gum – Yellow Box tall grassy woodland	Yellow Box–Blakely's Red Gum Grassy Woodland (critically endangered) - Moderate condition only	White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (critically endangered) - Moderate condition only	Low condition: 0.14 (Not TEC) Moderate condition: 12.60 (TEC)	Total: 12.74 (TEC and non-TEC)
Native Grassland	ACT[tba]: Derived Native Grasslands	NG: Native Grasslands	Yellow Box–Blakely's Red Gum Grassy Woodland (critically endangered)	White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (critically endangered)	0.82	
Native Riparian Sedgeland	N/A	AFV - Aquatic Fringing Vegetation	N/A	N/A	0.07	
Planted River She-oak Riparian Forest	N/A	P32d River She-oak Riparian Forest	N/A	N/A	0.27	
Planted Native	ACT25: Eucalyptus macrorhyncha Tableland Grass / Shrub Forest	Amenity planting native	N/A	N/A	7.06	
Exotic Riparian Woodland	NA	EXW: Exotic Woodlands	N/A	N/A	0.63	
Exotic Grassland	N/A	Exotic Grassland	N/A	N/A	18.52	

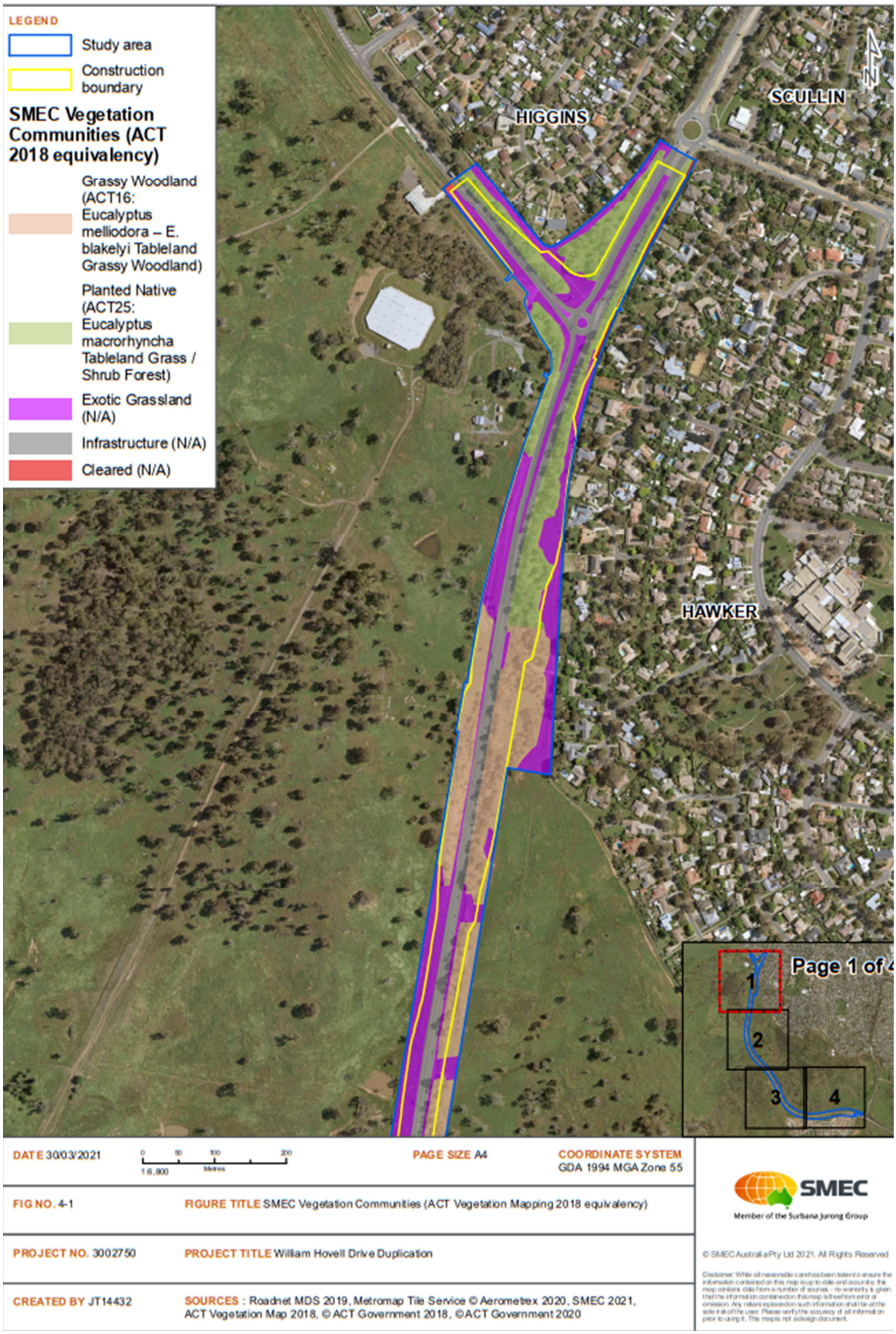
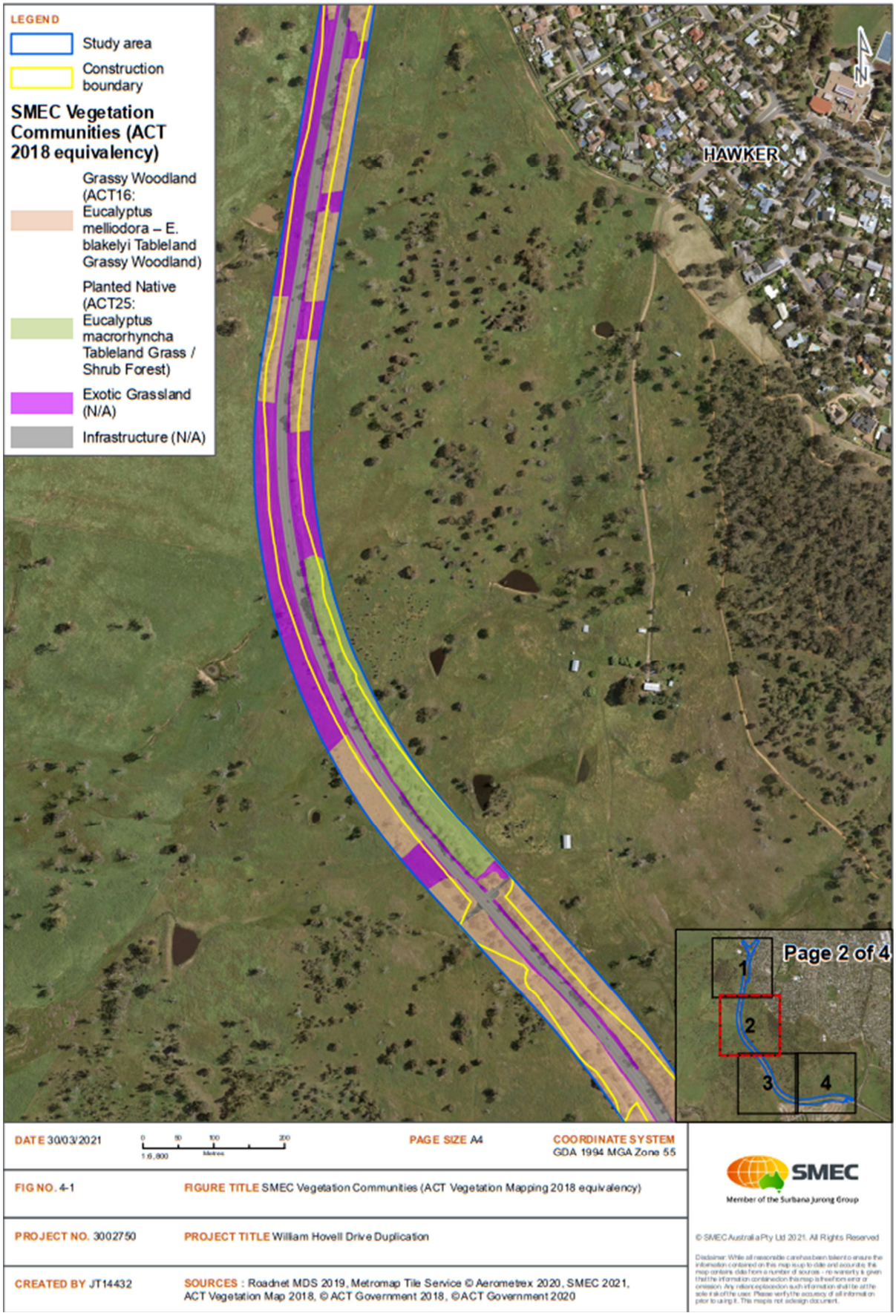
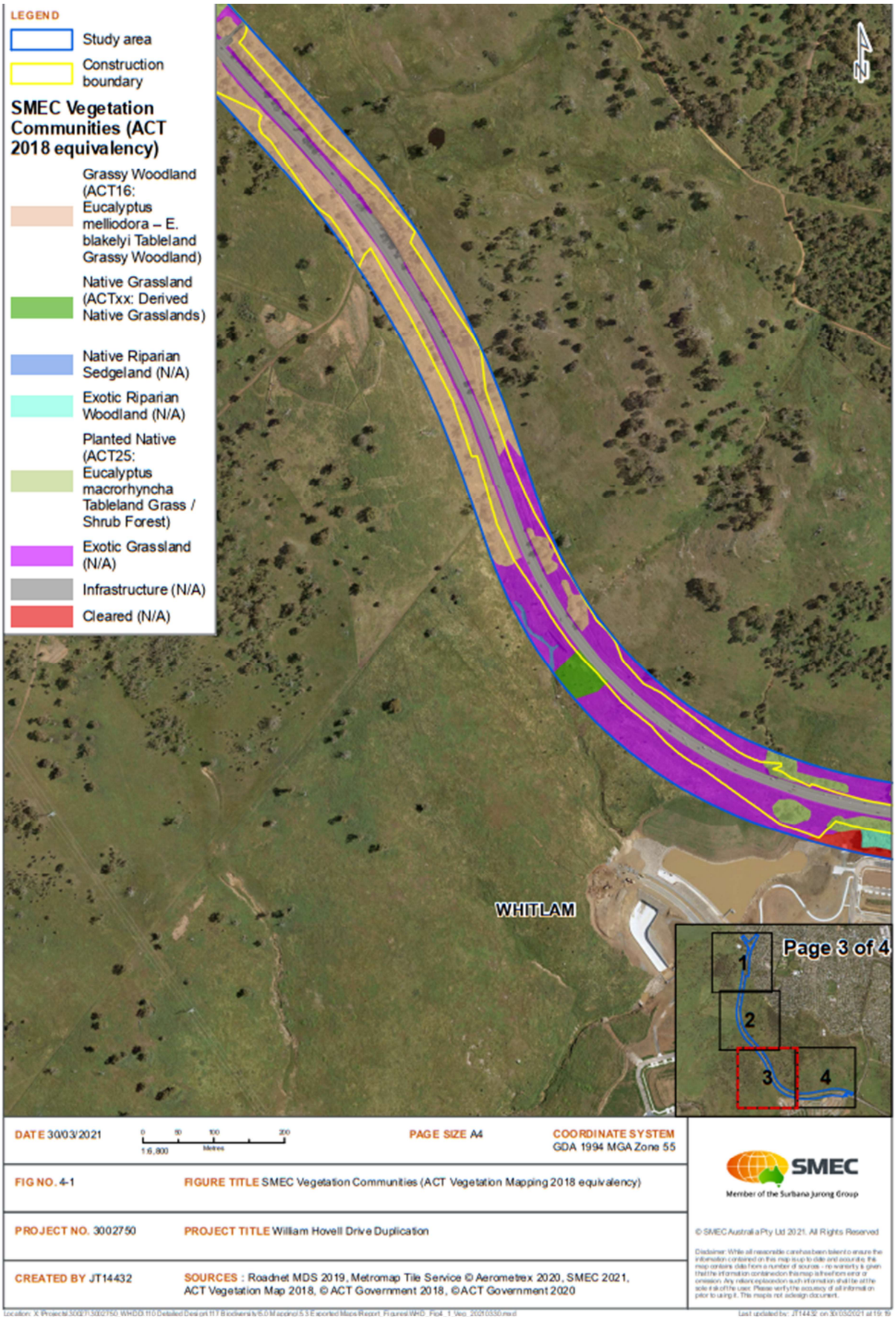
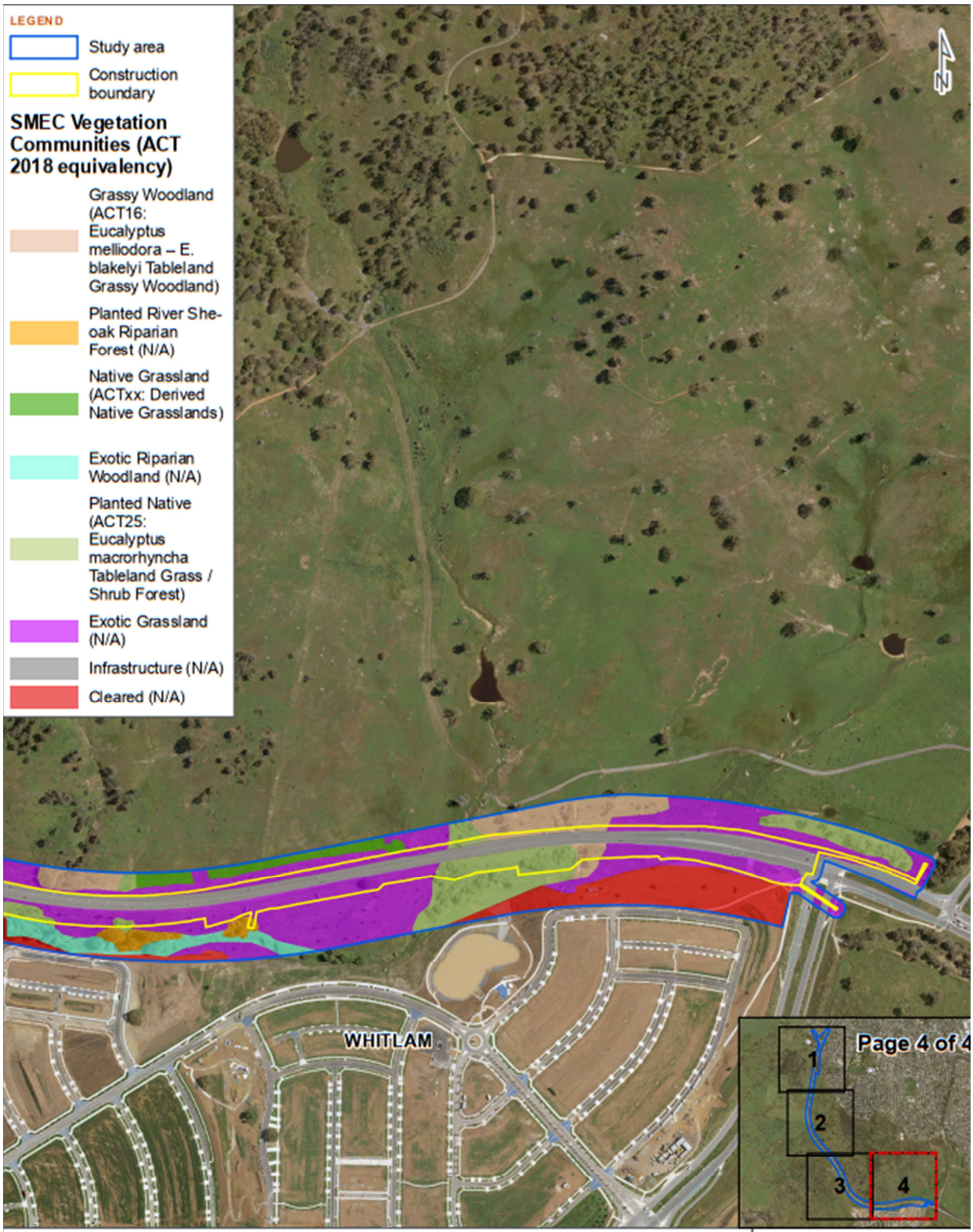


Figure 4-1: Vegetation communities in the study area


LEGEND
Study area
Construction boundary
SMEC Vegetation Communities (ACT 2018 equivalency)
Grassy Woodland (ACT16: Eucalyptus melliodora – E. blakelyi Tableland Grassy Woodland)
Planted Native (ACT25: Eucalyptus macrorhyncha Tableland Grass / Shrub Forest)
Exotic Grassland (N/A)
Infrastructure (N/A)
N
HAWKER
Page 2 of 4
1
2
3
4
DATE 30/03/2021
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PAGE SIZE A4
COORDINATE SYSTEM GDA 1994 MGA Zone 55
FIG NO. 4-1
FIGURE TITLE SMEC Vegetation Communities (ACT Vegetation Mapping 2018 equivalency)
PROJECT NO. 3002750
PROJECT TITLE William Hovell Drive Duplication
CREATED BY JT14432
SOURCES : Roadnet MDS 2019, Metromap Tile Service © Aerometrex 2020, SMEC 2021, ACT Vegetation Map 2018, © ACT Government 2018, © ACT Government 2020
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LEGEND
Study area
Construction boundary
SMEC Vegetation Communities (ACT 2018 equivalency)
Grassy Woodland (ACT16: Eucalyptus melliodora – E. blakelyi Tableland Grassy Woodland)
Planted River She-oak Riparian Forest (N/A)
Native Grassland (ACTxx: Derived Native Grasslands)
Exotic Riparian Woodland (N/A)
Planted Native (ACT25: Eucalyptus macrorhyncha Tableland Grass / Shrub Forest)
Exotic Grassland (N/A)
Infrastructure (N/A)
Cleared (N/A)
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Page 4 of 4
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DATE 30/03/2021
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1:6,800
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PAGE SIZE A4
COORDINATE SYSTEM GDA 1994 MGA Zone 55
FIG NO. 4-1
FIGURE TITLE SMEC Vegetation Communities (ACT Vegetation Mapping 2018 equivalency)
PROJECT NO. 3002750
PROJECT TITLE William Hovell Drive Duplication
CREATED BY JT14432
SOURCES : Roadnet MDS 2019, Metromap Tile Service © Aerometrex 2020, SMEC 2021, ACT Vegetation Map 2018, © ACT Government 2018, ©ACT Government 2020
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Disclaimer: While all reasonable care has been taken to ensure the information contained on this map is up to date and accurate, this map contains data from a number of sources - no warranty is given that the information contained on this map is free from error or omission. Any reliance placed on such information shall be at the sole risk of the user. Please verify the accuracy of all information prior to using it. This map is not a design document.

4.1.1 Grassy Woodland

This vegetation community occurred as a grassy woodland of native trees, dominated by *Eucalyptus blakelyi*, *E. bridgesiana* and *E. melliodora* (Photograph 4-1). Occasional to rare individuals of *E. mannifera*, *E. viminalis*, and *E. macrorhyncha* were sub-dominant. The sub-canopy was typically sparse or absent with *Acacia dealbata* and *A. implexa* being the dominant species. The shrub-layer was similarly typically scant with *Bursaria spinosa*, *Acacia rubida*, *Cassinia quinquifaria*., *Dodonaea viscosa* subsp. *angustissima*, *Hibbertia riparia (sensu lato)*, *H. obtusifolia* and *Solanum americanum*. The ground-layer was comparatively diverse, supporting a mixed and patchy assemblage of native and non-native grasses, herbs and forbs. Native grasses commonly include *Rytidosperma* spp., *Austrostipa bigeniculata, Austrostipa scabra*, *Themeda triandra*, *Bothriochloa macra*, *Microlaena stipoides*, *Dichelachne* spp., *Sorghum leiocladum* and *Panicum effusum*. Native forbs commonly included *Tricoryne elatior*, *Cheilanthes* spp., *Einadia hastata*, *Hackelia suaveolens*, *Geranium solanderi*., *Acaena ovina*, *Rumex brownii*, *Glycine* spp., *Oxalis exilis*, and *Wahlenbergia* spp.. Grassy Woodland was the second most extensive community within the study area, and the most extensive native community covering 12.74 hectares, or approximately 24% of the study area.

Grassy Woodland was differentiated from the Planted Native vegetation community by the presence of recruiting of ground-layer species, occasional canopy species recruitment and a higher diversity of native species across a number of different growth forms. There was evidence of soil disturbance within the study area, including two extents of a linear fill mound in the northern and central parts of the alignment. While much of this mound has been mapped as planted, significant extents are mapped as Yellow Box–Blakely's Red Gum Grassy Woodland and White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (together referred to as BGW), owing to the observed floristic assemblage and apparent ecological processes. It is presumed that at least these extents of fill mound supporting mapped BGW are constructed from local soil.

Most extents of Grassy Woodland (and all areas of Native Grassland) have been assessed as components of the critically endangered communities (BGW TECs) Yellow Box–Blakely's Red Gum Grassy Woodland (critically endangered under the NC Act) and White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (critically endangered under the EPBC Act). Section 5.1 further discusses how extents of Grassy Woodland meet the thresholds of BGW TECs.



Photograph 4-1 Example of Grassy Woodland

4.1.2 Native Grassland

Approximately 0.7 hectares of discontinuous native grassland occurs within the study area (about 1.5% of the study area) as three small patches of native grassland (0.13 hectares, 0.30 hectares and 0.33 hectares). These three extents of native grassland did not share a boundary with any other native vegetation communities in the road reserve, so were not considered as components of any other contiguous vegetation communities. They may, however, form contiguous extents of native vegetation, and even native grassland, outside the road reserve. This community was composed of a diverse assemblage of native grasses, herbs and forbs such as *Themeda triandra*, *Rytidosperma* spp., *Austrostipa* spp., *Tricoryne elatior*, *Cheilanthes sieberi*. and *Eryngium ovinum* (Photograph 4-2). While there are other smaller areas of grassland in the study area, these have been mapped as components of broader, contiguous patches of Grassy Woodland, effectively assessed as comparatively smaller extents of treeless areas as part of the woodland structure.

Native grasses can also be components of exotic grassland, however in an exotic grassland, the native component is typically less than 1% by cover, occasionally up to 5%, and rarely up to 25% in very limited extents. Where native grassland is mapped, it has obvious boundaries and tussock grasses often show some spacing between them. The most northerly linear extent of this community appears to be associated with an anthropogenically constructed drainage channel.

All native grassland across the study area was considered secondary (derived) grasslands, cleared of woody vegetation from original extents of Grassy Woodland. This is discussed below in Section 5.1.



Photograph 4-2 Example of native grassland

4.1.3 Native Riparian Sedgeland

A small area of native sedgeland is found in a drainage line that leads into Deep creek from the west. This vegetation dominated by the native sedge *Schoenoplectus validus*. The low diversity of species does not match any of the ACT's wetland communities other than Native Aquatic Fringing Vegetation, a community distinguished by the ACT Conservation Planning and Research for areas surrounding waterbodies or in creeks. Native Riparian Sedgeland was not mapped within the construction footprint for the Project.



Photograph 4-3 Native Riparian Sedgeland

4.1.4 Planted River She-oak Riparian Forest.

Casuarina cunninghamiana dominated sections of Deep Creek have been considered as River-Oak Riparian Forest, although the community is most likely planted or derived. Monotypic stands of *Casuarina cunninghamiana* are typical of this community and it is found on stream and river-banks between normal water levels and the maximum flood line. River She-oak Riparian Forest is generally restricted to the main rivers of the ACT such as the Cotter and Molonglo. The ACT Vegetation Types Database describes the community of having a landscape position on rivers and third order streams. Deep creek within the subject site is a second order stream and there is no evidence of this community on lower stretches of the creek until it intersects with the Molonglo river. The community is most likely derived at this elevated position in the landscape. The mid and ground storey is dominated by Blackberry – *Rubus fruticosus agg.* Some native ground layer species characteristic of the community are present, including *Einadia nutans, Microlaena stipoides* and *Dichondra repens*.



Photograph 4-4 Planted River She-oak Riparian Forest on Deep Creek

4.1.5 Planted Native Vegetation

Extents of apparently planted native woodland (Planted Native vegetation community) occur across the site. While some level of precaution has been applied to deciding whether certain extents of native woodland are a natural community or anthropogenically derived through planting, those areas of Planted Native community that are mapped with reasonable confidence generally show evidence of significant disturbance, lack of widespread intergenerational recruitment, often poor woody plant health, absence of widespread larger trees as seed parents, the occurrence of species not elsewhere identified in BGW and not showing evidence of recruitment or having hollows (Photograph 4-5). Areas of the Planted Native vegetation community also had more non-native species in the ground and shrub-layers and still contained planting stakes and tree guards.

The most common native species in the Planted Native vegetation community were *Eucalyptus rubida Eucalyptus mannifera*, *Casuarina cunninghamiana*, *Acacia pravissima, A. boormanii, A. melanoxylon* and *A. mearnsii*. Across the entire study area, patches of the Planted Native vegetation community covered an area of 7.06 hectares (13.76% of the study area).



Photograph 4-5 Example of Planted Native

4.1.6 Exotic Riparian Woodland

Deep Creek in the southern parts of the study area is a disturbed creek line mostly dominated by exotic species including willow trees *Salix babylonica* and *S. x fragilis* and there are large patches of Blackberry, *Rubus fruticosus agg. Some patches of native reeds Phragmites australis* and *Typha orientalis* are also present in more open stretches of the creek. Occasional *Casuarina cunninghamiana trees are found planted near the creek.* Larger *Casuarina* dominated stands were considered a distinct native riparian community – See River She-oak Riparian Forest.



Photograph 4-6 Example of Exotic Riparian Woodland

4.1.7 Exotic Grassland

The Exotic Grassland vegetation community occurs over much of the alignment being the most widespread vegetation community mapped in the study area – approximately 18.59 hectares or 36% of the study area. It is dominated by exotic species of grass which typically make up more than 90% of cover. The assemblage of exotic grasses is dominated by the species *Phalaris aquatica*, *Festuca arundinacea*, *Dactylis glomerata* and *Avena* sp. Patchy extents of other exotic and some native species occur within this community's extent.



Photograph 4-7 Example of Exotic Grassland

4.2 Flora survey results

The desktop assessment identified six threatened flora species with a moderate or higher likelihood of occurring in the study area (Appendix B). Five of these species were listed as threatened under the NC Act (*Leucochrysum albicans* var. *tricolor* is listed as threatened only under the EPBC Act). None of the five threatened flora species listed under the NC Act were recorded in the study area during the November/December surveys. However, *Leucochrysum albicans* var. *tricolor* was identified in the study area. A description of this species occurrence is provided in Section 5.4.1 under Matters of National Environmental Significance (MNES).

4.2.1 Dianella amoena

During the November/December threatened species surveys SMEC identified a number of plants from the genus *Dianella*. While little pattern in their distribution could be ascertained, plants were often recorded in the Native Grassland vegetation community. All *Dianella* plants were in flower and were identified as *D. longifolia*, not the threatened species *D. amoena*. Given the extensive survey effort it is unlikely that *D. amoena* occurs in the study area.



Photograph 4-8 Flower of *Dianella longifolia* observed in the study area

4.3 Fauna survey results and habitats

Fauna surveys identified 55 native species; 44 birds and 11 mammals (Appendix A). One of these species, the Superb Parrot (*Polytelis swainsonii*), is listed as vulnerable under the NC Act and EPBC Act and is discussed further in Section 5.3. In addition, five introduced species of bird were also recorded.

4.3.1 Fauna habitat

Fauna habitat types within the study generally correspond to the vegetation communities described in Section 4.1. The areas of each of these habitats correspond to the vegetation community areas in Table 4-1. The features of each fauna habitat type and fauna species likely to utilise these habitats are described in detail below.

4.3.1.1 **Native grassland**

Three small patches of native grassland have been identified in the study area, comprising a variety of native grasses herbs and forbs. These patches are isolated from other areas of native grassland associated with Box-Gum Woodland TECs. While these patches are small (total area of 0.76ha), limiting their ability to provide suitable habitat for large populations of native species, they may offer suitable habitat for Perunga Grasshopper, Striped Legless Lizard, Pink-tailed Worm-lizard, Golden Sun Moth, and a range of native birds that forage on native grass seed. They also provide critical stepping stone habitat connectivity for a range of smaller species in particular, as they move between higher quality grassland habitats throughout the study area and beyond..

4.3.1.2 **Exotic grassland**

Exotic grassland is the most common habitat type within the study area. Introduced species comprise over 90 percent of the vegetation cover, dominated by *Phalaris aquatica*, *Festuca arundinacea*, *Dactylis glomerata* and *Avena* species. Generally, important habitat features (such as rocks, logs, leaf litter and shrubs) are absent from this habitat. Isolated paddock trees occasionally occur. In some areas there are steep embankments topped with concrete drainage channels.

This habitat type can provide important foraging habitat values and connectivity for a range of native species, including:

- Connectivity between higher-value habitats for mammals, birds, echidnas, reptiles and amphibians
- Foraging for insects (plant material and other insects being available to feed on)
- Foraging for birds (grass seed heads, insects and small mammals/reptiles being available to feed on)

- Plant material for kangaroos and wallabies to feed on
- Ants for echidnas to feed on.

Such grasslands can provide important habitat support for a range of species during drought conditions, with some exotic grassland varieties being more palatable for kangaroos and wallabies. This diversity provided by exotic grassland is also important as an additional food source for granivorous birds. The grasslands provide habitat for a range of small mammals, reptiles and insects, which can then support predatory and insectivorous bird species. Some declining woodland bird species may also take advantage of these habitat features. .

4.3.1.3 Grassy Woodland

Patches of Box-Gum woodland TECs occur within the study area. These consist of a medium to tall canopy dominated by *Eucalyptus blakelyi*, *E. bridgesiana* and *E. melliodora*, with an occasional shrub layer. The ground cover is a mixture of native and non-native species of grasses, herbs and forbs. In areas with more mature trees, fallen logs and leaf litter are present. This habitat type also supports many hollow-bearing trees. Woodland vegetation provides suitable habitat for birds, reptiles and mammals including a number of threatened species. At the time of survey, this habitat and Planted Woodland were inundated with emerging Redeye Cicadas (*Psaltoda moerens*) which provide a good food source for many bird species.

This habitat type can provide important foraging habitat values and connectivity for a range of native species, including:

- Connectivity between higher-value habitats for mammals, birds, echidnas, reptiles and amphibians
- Foraging for insects (plant material and other insects being available to feed on)
- Foraging for birds (grass seed heads, insects and small mammals/reptiles being available to feed on and trees available for birds to perch on while they forage)
- Foraging for microbats (insects being available to feed on)
- Plant material for kangaroos and wallabies to feed on
- Ants for echidnas to feed on.

These plant communities can also provide important habitat support for a range of species during drought conditions, with some exotic grassland varieties being more palatable for Kangaroos and Wallabies. They also provide habitat for a range of small mammals, reptiles and insects, which can then support predatory and insectivorous bird species.

4.3.1.4 Planted Woodland

The planted woodland varies considerably across the site, but generally contains similar features to the more natural woodland. A range of Eucalyptus species are present including *Eucalyptus rubida*, *E mannifera*, *E bridgesiana and E. blakelyi.* Shrubs and small trees are mostly fast colonising Acacias including A mernsii, A dealbata, A pravissima and *A boormanii*. Some of the these are already sensing providing some fallen woody debris. Planted areas are identified as being more highly disturbed, lacking signs of recruitment, feature less tree hollows and have more non-native ground covers and shrubs that show evidence of being planted. Despite the absence of some features, this vegetation still provides suitable habitat for many woodland birds, reptiles and mammals and could be used by threatened species. Dense shrub species in particular provide good sheltering habitat.

4.3.1.5 Riparian habitat

Riparian habitat within the study area has been highly modified to facilitate drainage across William Hovell Drive. Deep Creek flows parallel to William Hovell Drive in the south of the study area before diverting to flow further south into the Molonglo River. All riparian habitat within the study areas drains into the Molonglo River, which flows in a north-westerly direction approximately 1.6 kilometres to the south-west (Figure 1-1).

Man-made drainage lines leading to culverts passing under the road include rocks to prevent scouring. Some of these rocky drainage lines hold water but aquatic vegetation is generally absent. Similar to the remainder of the site, drainage lines are dominated by exotic vegetation. These temporary water bodies provide temporary habitat for common frog species.

Areas of native sedges *Schoenoplecus validus* also provide frog habitat as do patches of native reeds including *Phragmites australis* and *Typha orientalis*, found in patches along the predominantly exotic portions of the Deep Creek. River-she oak trees, *Casuarina cunninghamiana* can provide nesting and foraging sites for a range of birds but are not considered a feed source for glossy black cockatoos, which have a preference for larger seeded *Allocasuarina* species. During periods of high rainfall, semi-aquatic species (such as turtles, frogs and invertebrates) may use riparian areas to traverse to other nearby areas of suitable habitat in the Belconnen nature reserves and Molonglo River valley.

Surveys did not identify any wetlands within the study area, although several farm dams occur in adjacent paddocks. ACTmapi (2021) classifies all waterbodies within the immediate vicinity of the study area as 'Modified Waterbodies'.

4.3.2 Other ecological features

The study area and surrounding landscape contains habitat features suitable for supporting a range of native species. A count of 33 hollow-bearing trees, that contain around 133 hollows, were recorded in the study area. Fallen logs also occur in areas with more mature vegetation.

Three pedestrian culverts pass under William Hovell Drive, two of which contained small mud nests that may also be used by microbats for roosting. It is not expected that these culverts are currently used for fauna passage under the road due to the presence of fencing along the length of the road reserve, with gates providing pedestrian access. Eighteen drainage culverts ranging from 525 to 1500 millimetre in diameter also occur along the length of the alignment. At the time of survey most of the culverts were covered by vegetation or were considered too small to provide suitable roosting habitat for microbats.

Surveys did not identify any wetlands within the study area, although several farm dams occur in adjacent paddocks. ACTmapi (2021) classifies all waterbodies within the immediate vicinity of the study area as 'Modified Waterbodies'.

Naturally occurring rocks are generally absent with the exception of the areas mapped as potential Pink-tailed Worm-lizard habitat.

4.4 ACT Registered Trees

One registered tree was identified as occurring wholly within the study area and with much of its canopy extending into the construction boundary (refer to Figure 4-2 below). In the ACT Tree Register, this tree is identified as Nomination 81, Tree Number PTR081. Further details recorded for the tree are provided in Table 4-2.

Under the *Tree Protection Act* (2005) certain criteria may apply to the registering of an important tree. The following criteria applies to tree PTR081:

(2) Landscape and aesthetic value

The object of this value is to identify trees that are of particular importance to the community due to their substantial contribution to the surrounding landscape. A tree may be considered to be of landscape and aesthetic value if it is situated in a prominent location when viewed from a public place and it:

(a) contributes significantly to the surrounding landscape based on its overall form, structure, vigour and aesthetic values; or

(b) represents an outstanding example of the species, including age, size or habit; or

(c) is an exceptional example of a locally native species that reached maturity prior to urban development in its immediate vicinity.

Table 4-2: Details of registered tree

Tree identification	Species name	Street address	Description	Statement against the Criteria for nomination
PTR081	*Eucalyptus blakelyi* (Red Gum)	William Hovell Drive, Higgins	Four trunks and crown radii ranging from 9 to 12 metres	*This Eucalyptus blakelyi is an exceptional example of a local native species that reached maturity prior to urban development. The tree is being nominated for inclusion to the ACT Tree Register due to its outstanding landscape contribution. This tree is located on urban open space next to William Hovell Drive in Belconnen. The tree contributes significantly to the surrounding landscape due to its large well balanced spreading crown and low branching habit. The tree is located in a very prominent location and easily seen from the street.*

The Project's design has been updated so that works in this vicinity only impact the existing pavement area. As additional earthworks will not be undertaken, the roots of this registered tree PTR081 will not be significantly impacted.



Figure 4-2 Registered tree

4.5 Habitat connectivity

Fragmented habitat can be connected by what are known as corridors. Corridors are linear extents of restored or remnant habitat that facilitate the movement of individuals or genetic material between larger patches of habitat (Townsend and Levey 2005). As implied, corridors can connect two or more larger patches of habitat over a range of scales and for a variety of organisms. For example, the native vegetation along the Great Dividing Range provides connectivity for migrating birds between their breeding and foraging habitats. Similarly, riparian forest may provide habitat connectivity between two conservation reserves that have become separated by a housing estate.

The two nature reserves of Kama Nature Reserve and The Pinnacle Nature Reserve (including The Pinnacle offset area) are currently intersected by William Hovell Drive. Kama Nature Reserve forms an important flora and fauna habitat link between the Murrumbidgee River Corridor and nature reserves across the north of Canberra including Black Mountain, Aranda Bushland, Mount Painter and The Pinnacle. These nature reserves provide a network of habitat connecting the remnant bushland of Canberra to Brindabella National Park.

Kama Nature Reserve adjoins the southern side of the road alignment near the central portion of the study area, with 1.2km frontage onto William Hovell Drive (Calibre, 2018). Kama Nature Reserve is one of only two ACT reserves which contains high quality BGW TECs and Natural Temperate Grassland, both of which are critically endangered ecological communities. Some of the native vegetation within the study area provides connectivity between these two reserves.

William Hovell Drive is currently about 18m wide where it intersects the two nature reserves. While it is currently an impediment to connectivity, both threatened and non-threatened fauna are likely to be able to traverse the gap through flight or by crossing the road surface. While collision with vehicles along the road surface is likely common, SMEC's observations of Eastern Grey Kangaroos, Eastern Brown Snakes (*Pseudonaja textilis*) and a Short-beaked Echidna (*Tachyglossus aculeatus*) within the road reserve indicates that there is still connectivity between the nature reserves for ground-dwelling fauna. There is currently an underpass between the road to facilitate human traffic between the two nature reserves.

Potential movement of fauna across the current alignment of William Hovell Drive increases in areas to the north and south-east of the interface between Kama and The Pinnacle Nature Reserves (Figure 4-3). Germinated seeds from some flora species, such as Hoary Sunray, are able to cross the road reserve at any location. The most likely connection points outside of this interface occur where native vegetation occurs on both sides of the road reserve. Examples of such connection points may include the native vegetation near Old Weetangera Cemetery (north of the nature reserve interface) and the vegetation near Deep Creek (to the south-east). These locations are likely to provide the best connection points for fauna as the distance between areas of habitat is smallest. Similarly, for flora species these connection points are most likely to facilitate the transfer of plant material across William Hovell Drive as seeds, pollen and other propagules have less distance to travel. Once William Hovell Drive is traversed, successful movement to either nature reserve is more likely.

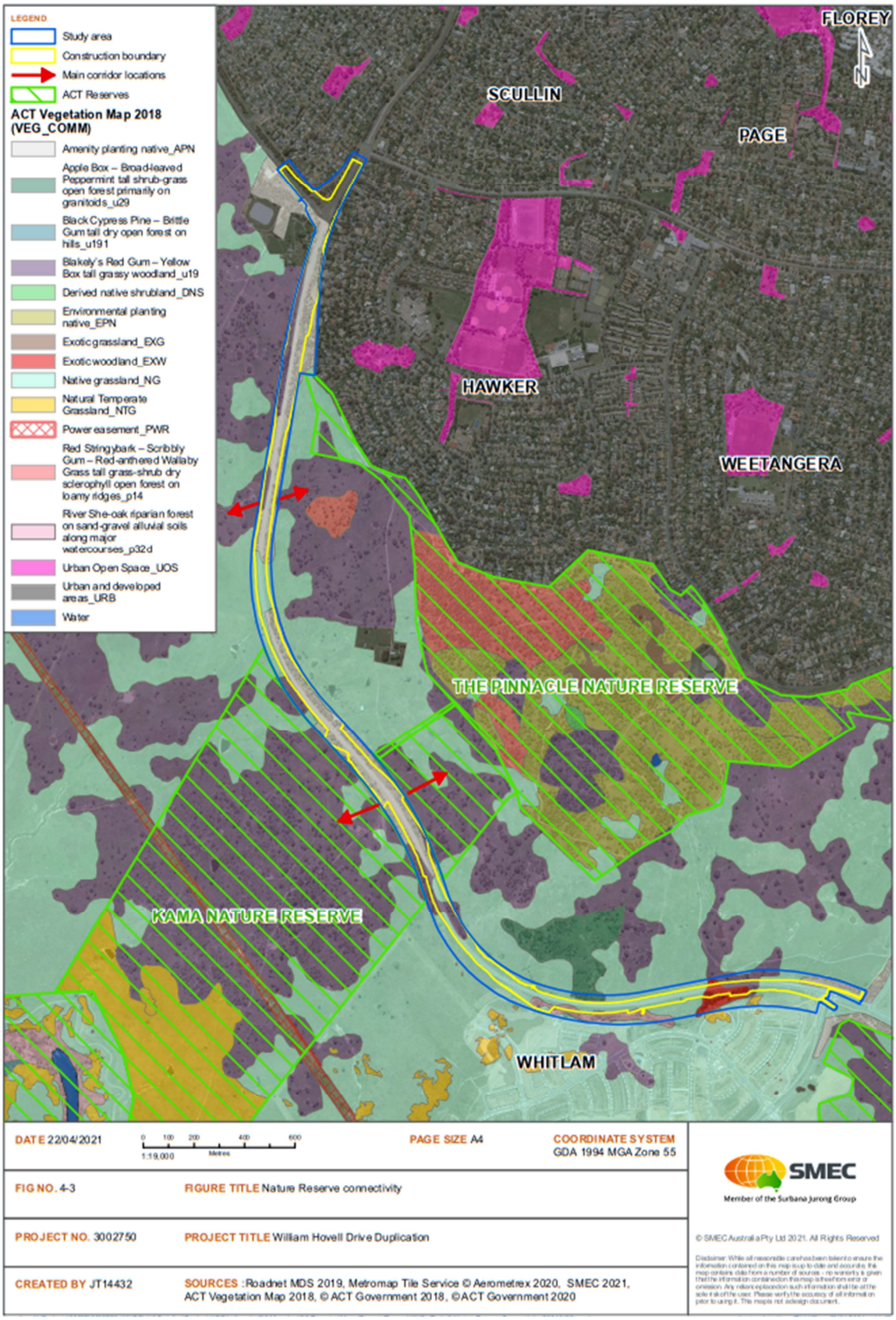


Figure 4-3: Location of nature reserves and habitat corridors

5 Threatened Biodiversity

5.1 Threatened Ecological Communities

The *Preliminary Environmental Assessment: William Hovell Drive Duplication* (SMEC 2020a) identified one TEC as occurring in the study area; Yellow Box–Blakely's Red Gum Grassy Woodland (critically endangered under the NC Act), which is considered equivalent to the White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (critically endangered under the EPBC Act). The TECs are referred to as BGW or Grassy Woodlands herein.

The identification and mapping of this TEC has been adopted in this assessment. A description of the occurrence of both these BGW TECs within the study area is provided in Section 5.1.1 and Section 5.1.2. Additional discussion of the occurrence of White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (EPBC Act) is provided in Section 5.4.2 under Matters of National Environmental Significance.

5.1.1 Yellow Box–Blakely's Red Gum Grassy Woodland – critically endangered under the NC Act

The critically endangered ecological community Yellow Box-Blakely's Red Gum Grassy Woodland has been assessed and mapped as occurring within the study area. This TEC occurred as patches across the study area (totalling 13.36 hectares), all of which were greater than 0.1 hectare in size and some of which extend outside the study area (Figure 5-1). The patches occurring within the study area had either the structure of an open woodland (mapped as Grassy Woodland) with a typically grassy ground-layer, or as a grassland (mapped as Native Grassland). Individual trees or clumps of trees without a dominant native perennial understorey were not mapped as the community. The following information was used to justify the occurrence of Yellow Box-Blakely's Red Gum Grassy Woodland in the study area:

- The Grassy Woodland within the study area is mapped as 'Potential Yellow Box-Blakely's Red Gum Grassy Woodland' in the ACT Government's ACTmapi viewer
- The Grassy Woodland in the study area supported a 'discontinuous stratum of trees of medium height (10-35 m) with canopies that are separated and with 4-30% foliage cover' (a characteristic identified in the Yellow Box-Blakely's Red Gum Grassy Woodland Action Plan)
- The woodland in the study area is dominated by Blakely's Red Gum (*Eucalyptus blakelyi*) with Yellow Box (*Eucalyptus melliodora*) and Apple Box (*Eucalyptus bridgesiana*) occurring less frequently (as specified in the Yellow Box-Blakely's Red Gum Grassy Woodland Action Plan)
- The ground-layer supported a diverse assemblage of native grasses, herbs and forbs. Lower quality patches may not be dominated by a native ground-layer as long as the canopy supports mature trees and/or natural regeneration of canopy species
- Two patches of Grassy Woodland didn't meet the condition thresholds for the BGW TECs, with one patch of 0.06 hectares not meeting the minimum patch size of 0.1 hectares, and the second patch while meeting the minimum patch size at 0.13 hectares, it did not have adequate important and minimum non-grass species richness
- The three patches of native grassland mapped in the study area have been mapped as a secondary/derived grassland component of Yellow Box–Blakely's Red Gum Grassy Woodland as species richness appears to meet the required number of important species and non-grass species in the groundlayer, with all three patches being larger than the 0.1 hectare minimum size to exceed the condition threshold as specified in the Yellow Box-Blakely's Red Gum Grassy Woodland Action Plan.

5.1.2 White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland - critically endangered under the EPBC Act

As noted earlier, Yellow Box–Blakely's Red Gum Grassy Woodland under the NC Act is encompassed in the White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland ecological community listed under the EPBC Act and thus the discussion of Section 5.1.1 has identified how the extents of Grassy Woodland meet the EPBC listed components of the EPBC listed TEC. The extent of this TEC is shown in Figure 5-2.

5.1.3 Natural Temperate Grassland - critically endangered under the NC Act

As discussed in Section 4.12, the current study has mapped approximately 0.7 hectares of Native Grassland across the study area. While there was limited evidence of fallen timber or stumps within areas of native grassland, indicating a previous extent of a treed woodland, the location of native grassland in the study area was assessed as derived from Grassy Woodland through clearing of woody species rather than a natural

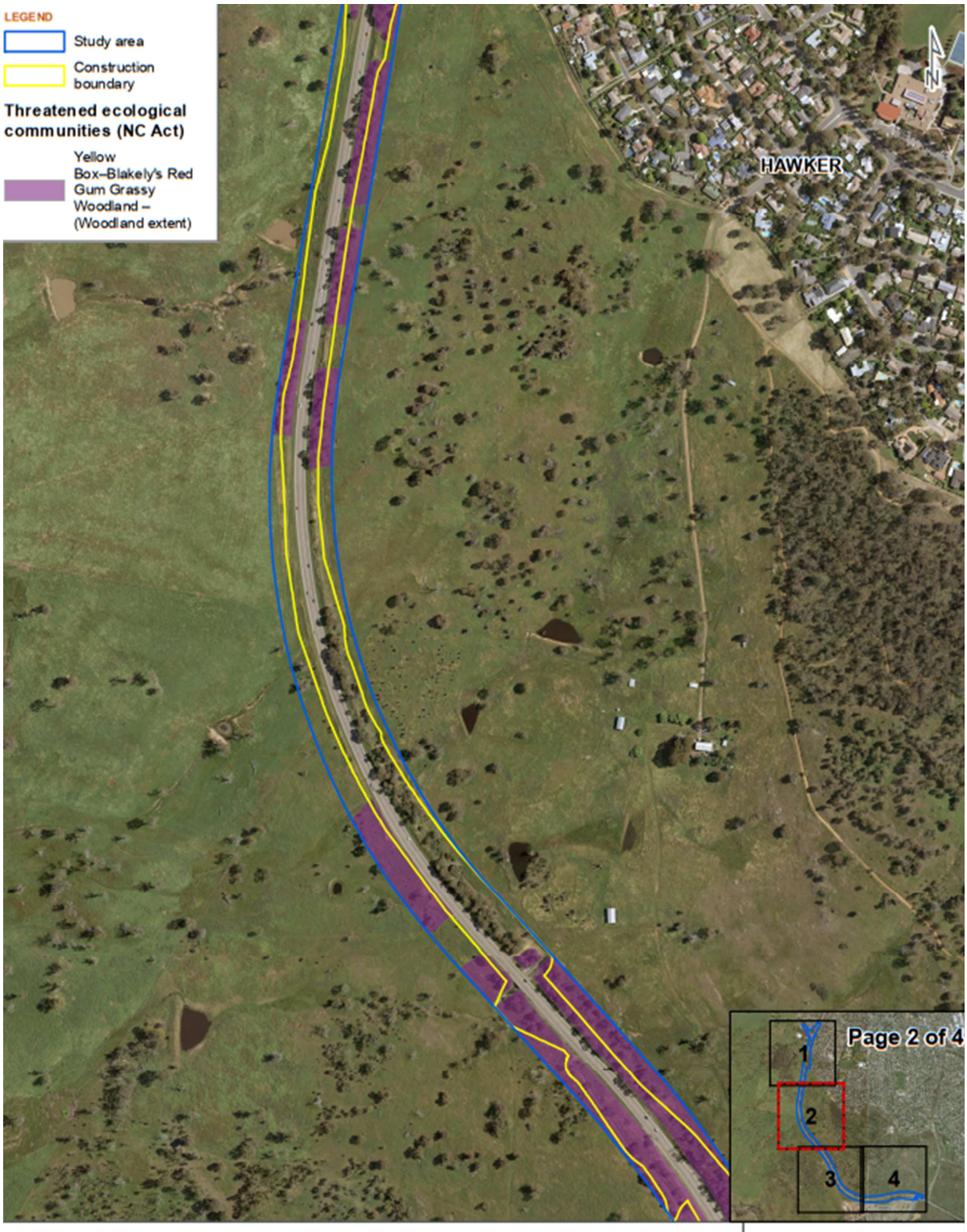
temperate grassland. This is supported by previous broad landscape scale mapping of ACTmapi mapping and Environment and Sustainable Development Directorate (2011). The existence of Grassy Woodland generally across the study area's intact treed areas, and the absence of any apparent correlation of native grassland in landscape features that would naturally inhibit tree or other significant woody growth such as areas of high drying wind exposure, very shallow soil, cold air drainage such as valley floors, or impeded hydrological drainage, indicate that the native grasslands in the study area aren't natural in structure but likely a response to timber removal with supported competition principally from grazing and weed competition. It is worth noting that while the 20 metre x 20 metre plot carried out in native grassland exceeded the condition thresholds for important species, non-grass species diversity and minimum patch size, but because it is considered highly likely that Grassy Woodland originally occupied these areas of the study area, supported by the evidence just noted, that areas of native grassland are not natural but secondary and derived from Grassy Woodland, that the critically endangered Natural Temperate Grassland listed under the NC Act does not occur.

5.1.4 Natural Temperate Grassland of the South Eastern Highlands – critically endangered under the EPBC Act

As noted earlier, Natural Temperate Grassland as listed under the NC Act is encompassed in the Natural Temperate Grassland of the South Eastern Highlands listing under the EPBC Act and thus the discussion of Section 5.1.1 has identified how the extents of Native Grassland do not meet the EPBC listed components of the EPBC listed TEC as no natural temperate grassland occurs on site.



Figure 5-1: ACT listed threatened ecological communities



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FIG NO. 5-1 | FIGURE TITLE Threatened ecological communities (NC Act)

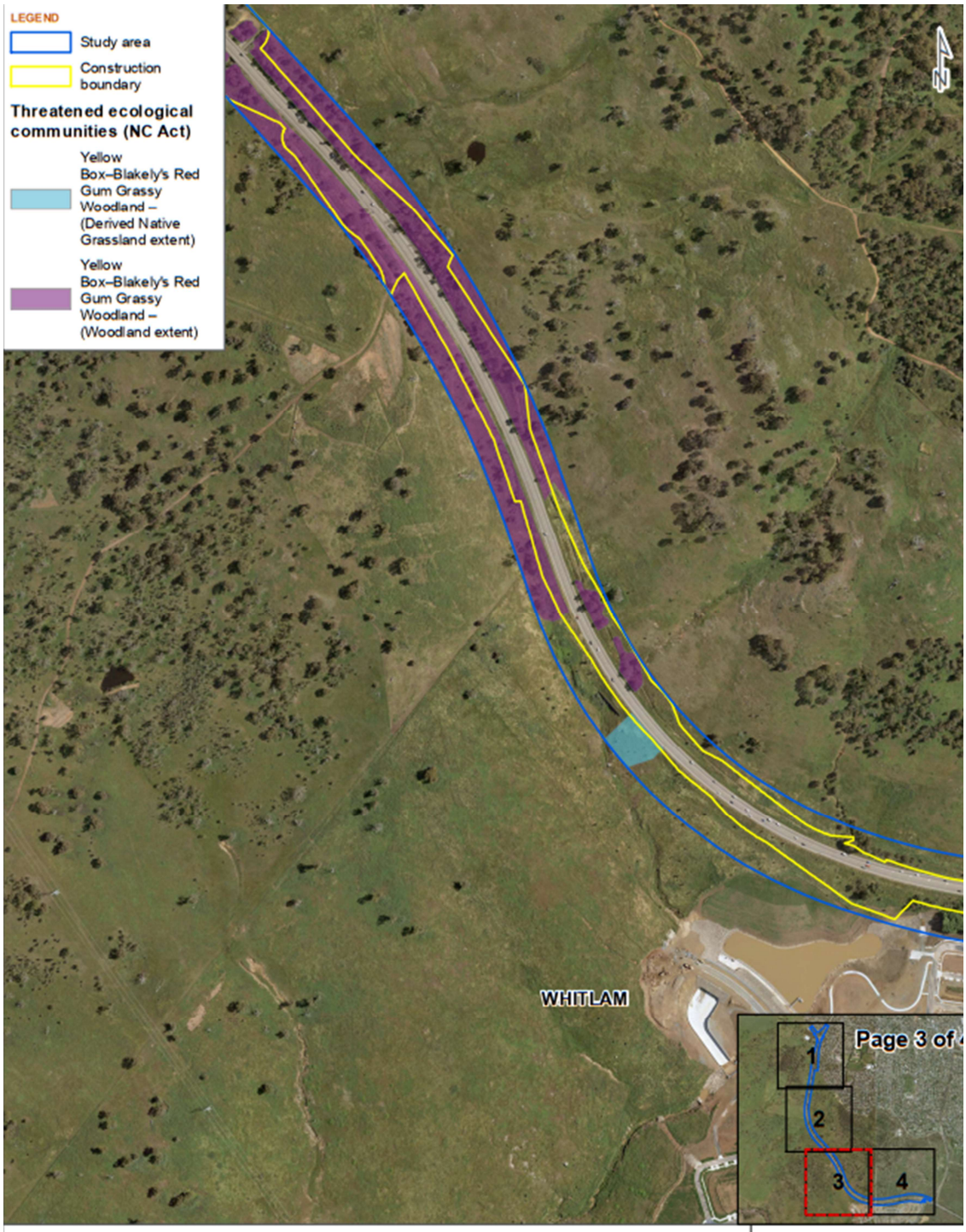
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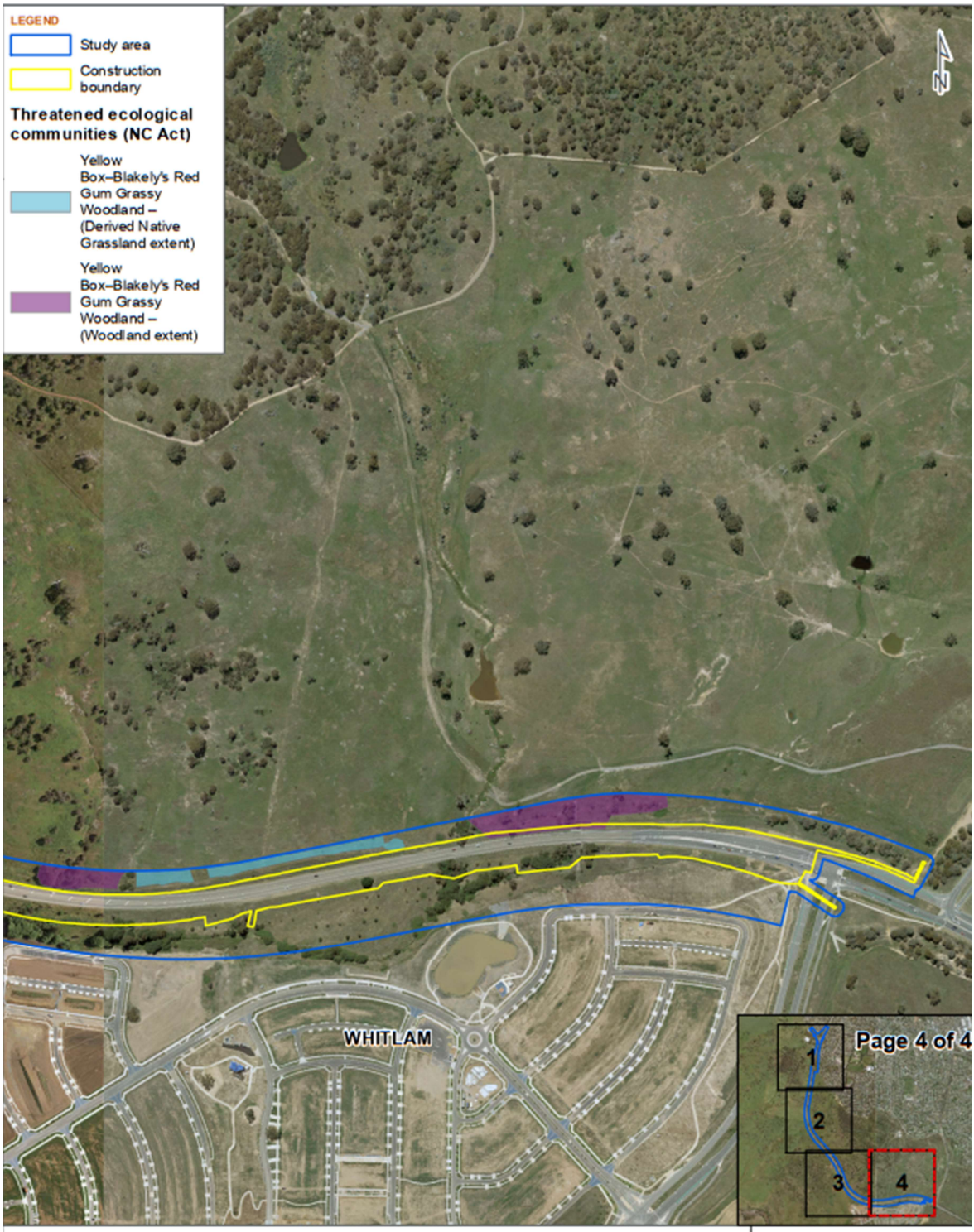
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LEGEND
Study area
Construction boundary
Threatened ecological communities (NC Act)
Yellow Box–Blakely's Red Gum Grassy Woodland – (Derived Native Grassland extent)
Yellow Box–Blakely's Red Gum Grassy Woodland – (Woodland extent)
WHITLAM
Page 3 of
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COORDINATE SYSTEM GDA 1994 MGA Zone 55
FIG NO. 5-1
FIGURE TITLE Threatened ecological communities (NC Act)
PROJECT NO. 3002750
PROJECT TITLE William Hovell Drive Duplication
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LEGEND
Study area
Construction boundary
Threatened ecological communities (NC Act)
Yellow Box–Blakely's Red Gum Grassy Woodland – (Derived Native Grassland extent)
Yellow Box–Blakely's Red Gum Grassy Woodland – (Woodland extent)
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FIGURE TITLE Threatened ecological communities (NC Act)
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PROJECT TITLE William Hovell Drive Duplication
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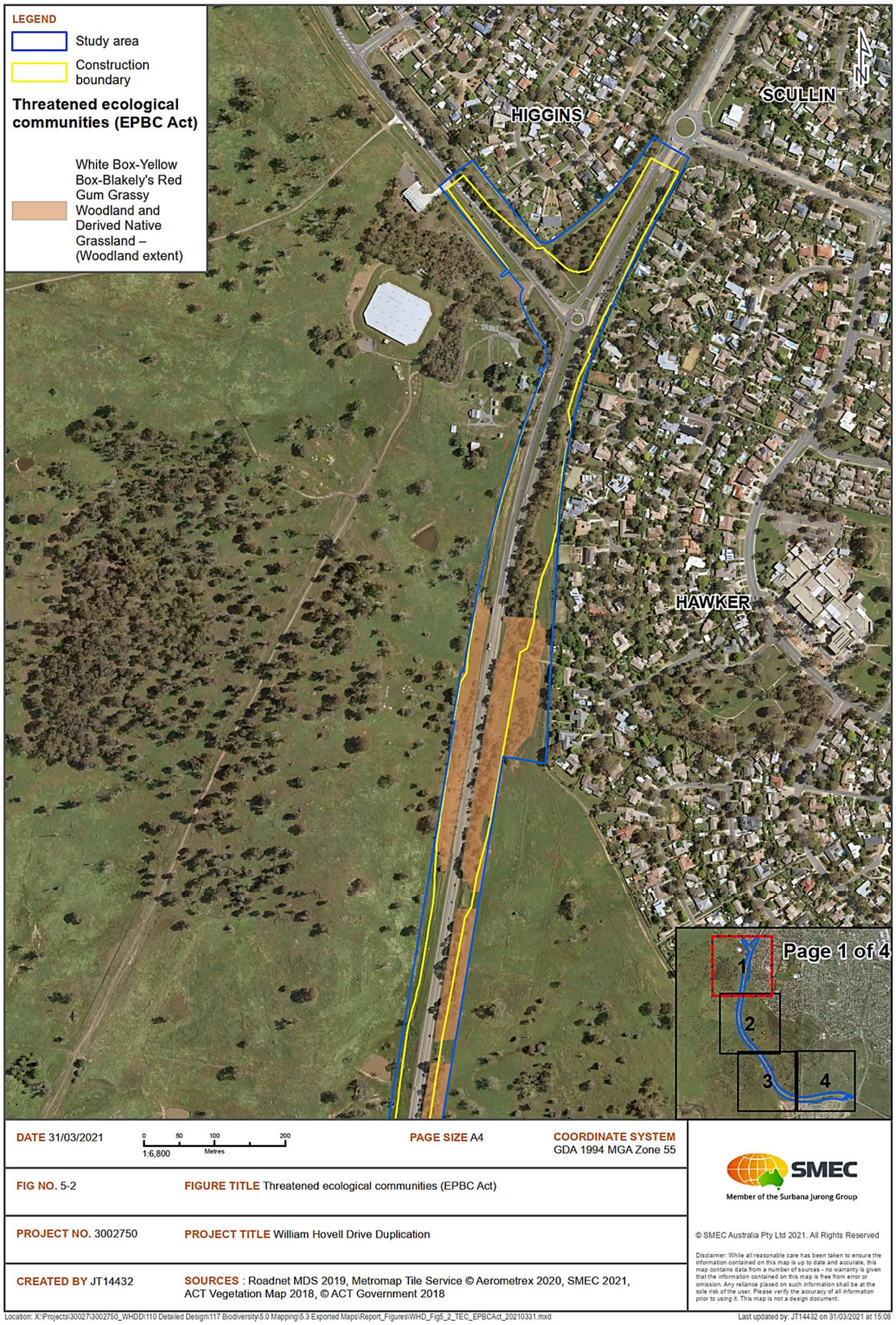
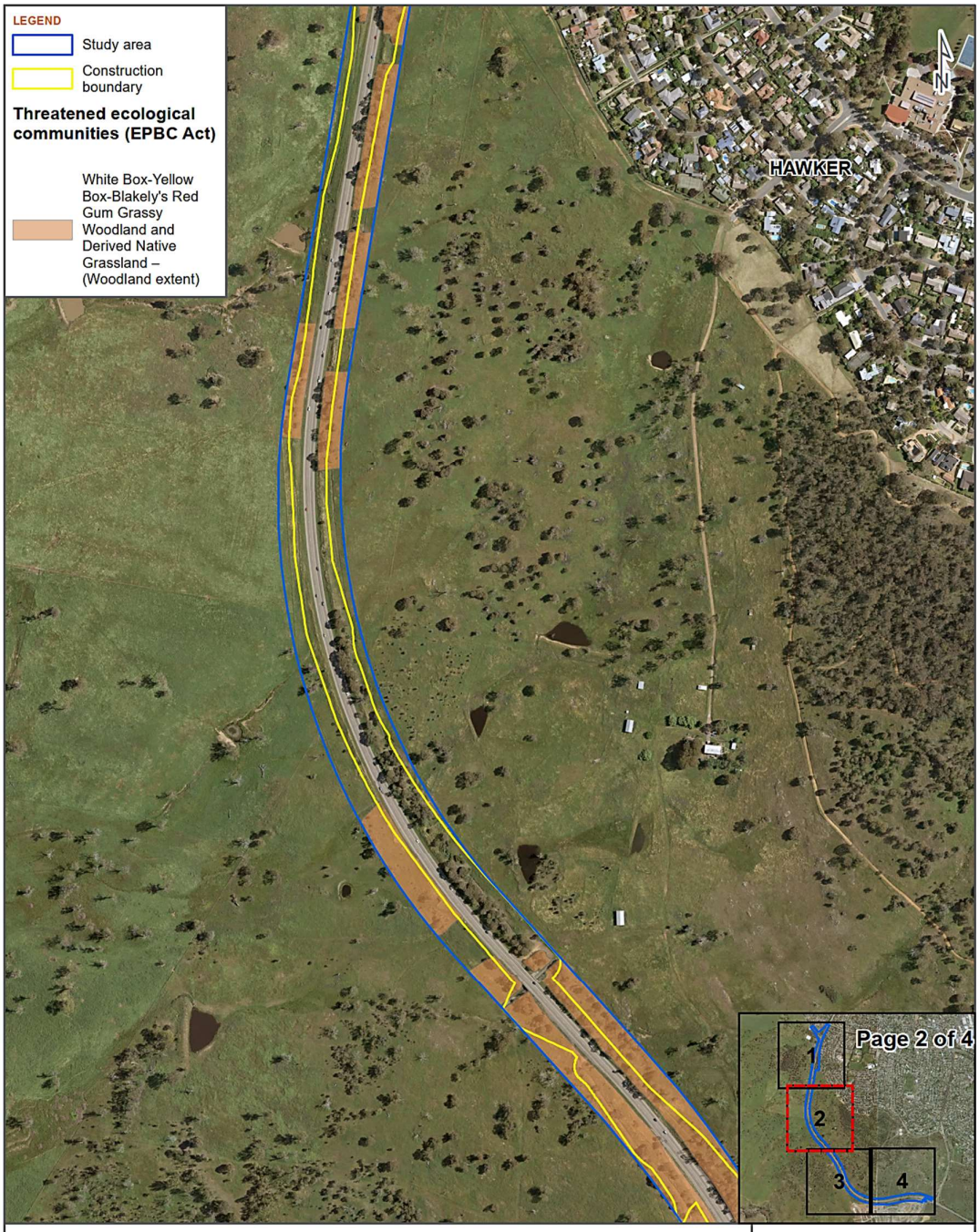
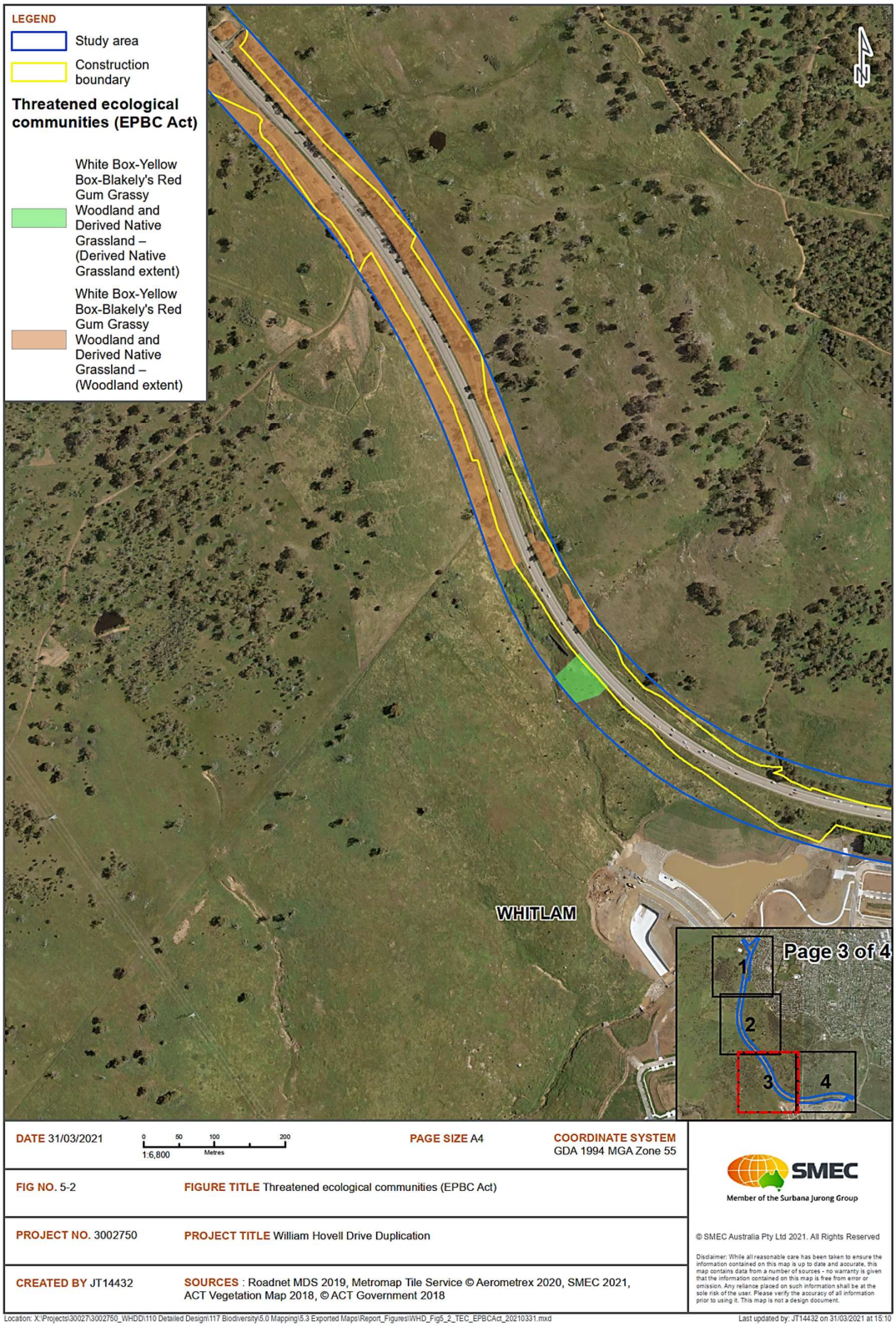
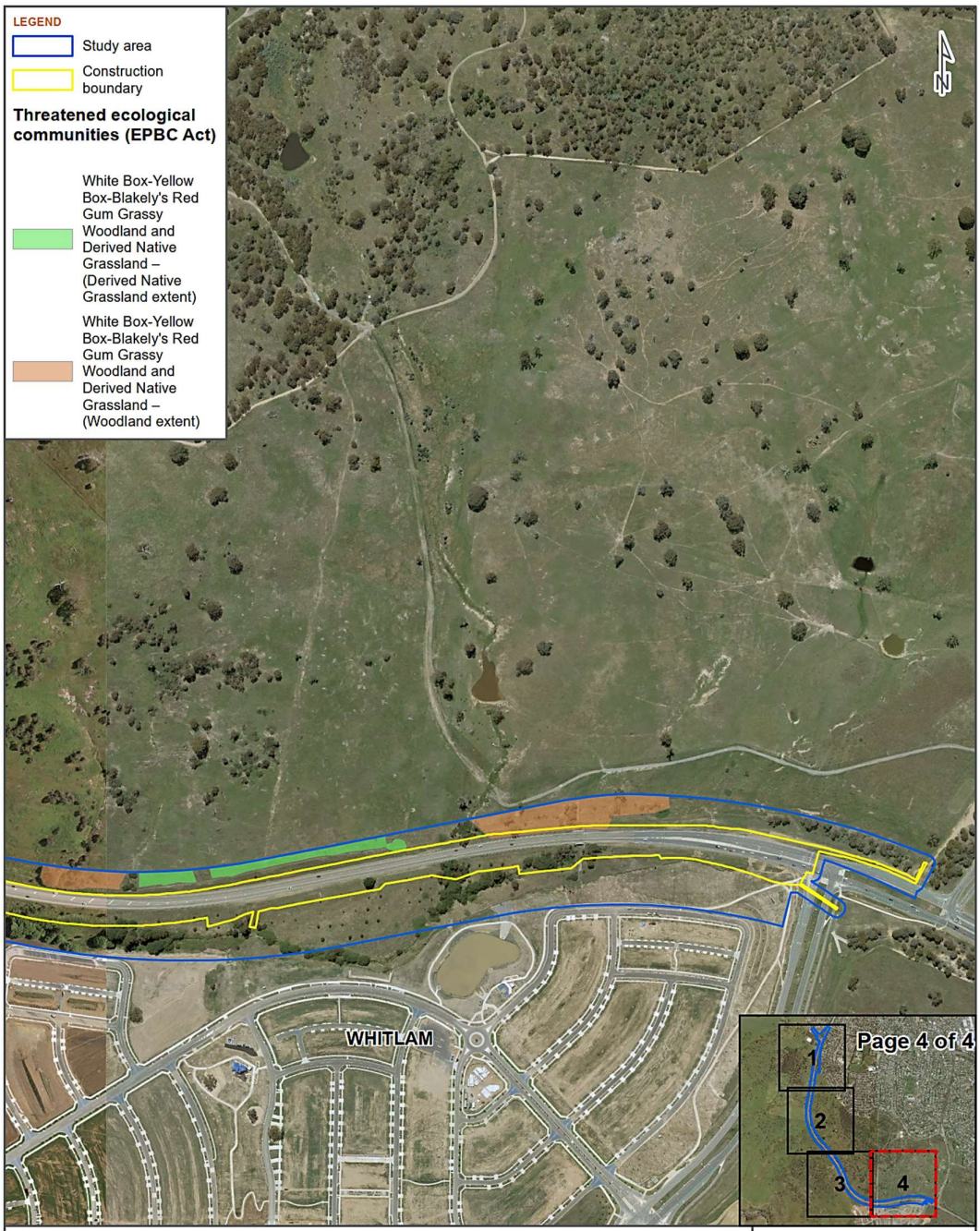


Figure 5-2: Threatened fauna habitat and records


LEGEND
Study area
Construction boundary
Threatened ecological communities (EPBC Act)
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland – (Woodland extent)
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FIGURE TITLE Threatened ecological communities (EPBC Act)
PROJECT NO. 3002750
PROJECT TITLE William Hovell Drive Duplication
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Last updated by: JT14432 on 31/03/2021 at 15:09


LEGEND
Study area
Construction boundary
Threatened ecological communities (EPBC Act)
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland – (Derived Native Grassland extent)
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland – (Woodland extent)
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FIG NO. 5-2
FIGURE TITLE Threatened ecological communities (EPBC Act)
PROJECT NO. 3002750
PROJECT TITLE William Hovell Drive Duplication
CREATED BY JT14432
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LEGEND
Study area
Construction boundary
Threatened ecological communities (EPBC Act)
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland – (Derived Native Grassland extent)
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland – (Woodland extent)
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COORDINATE SYSTEM GDA 1994 MGA Zone 55
FIG NO. 5-2
FIGURE TITLE Threatened ecological communities (EPBC Act)
PROJECT NO. 3002750
PROJECT TITLE William Hovell Drive Duplication
CREATED BY JT14432
SOURCES : Roadnet MDS 2019, Metromap Tile Service © Aerometrex 2020, SMEC 2021, ACT Vegetation Map 2018, © ACT Government 2018
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5.2 Threatened flora

The desktop assessment identified six threatened flora species with a moderate or higher likelihood of occurring in the study area (Appendix B). Five of these species were listed as threatened under the NC Act (*Leucochrysum albicans* var. *tricolor* is only listed as threatened under the EPBC Act). None of the five threatened flora species listed under the NC Act were recorded in the study area during the November/December surveys. However, *Leucochrysum albicans* var. *tricolor* was identified in the study area. A description of this species occurrence is provided in Section 5.4.1 under Matters of National Environmental Significance.

5.3 Threatened fauna

Thirty-four fauna species listed as threatened or migratory under the NC Act and/or EPBC Act were predicted to occur through database searches (Appendix B). A likelihood of occurrence assessment was undertaken for these species after the site visit was performed in order to determine whether suitable habitat for each species occurs within the study area (Appendix B). Of these species assessed for likelihood of occurrence, only 13 were identified as having a moderate or higher likelihood of occurrence in the study area based on the availability of suitable habitat and recent nearby sightings. One species listed as vulnerable under the NC Act and EPBC Act was recorded during the survey period; the Superb Parrot (Appendix A). Assessments of Significance were prepared for these species. In addition, an Assessment of Significance was also undertaken for the Golden Sun Moth. These species are discussed in more detail below.

Perunga Grasshopper (*Perunga ochracea*) (Endangered under the NC Act and not listed under the EPBC Act)

The Perunga Grasshopper is known to occur in the Lower Molonglo Nature Reserve (ACT Government 2017a). The species occupies natural temperate grasslands dominated by Wallaby Grasses (*Rytidosperma spp.*), Speargrasses (*Austrostipa spp.*) or Kangaroo Grass (*Themeda triandra*), and in other native grasslands. The species sometimes occurs in open woodland areas with a grassy understorey, including the endangered Yellow Box/Red Gum Grassy Woodland community. A total of 13.56 hectares of suitable habitat for the Perunga Grasshopper occurs in the study area (Table 6-3).

Pink-tailed Worm-lizard (*Aprasia parapulchella*) (Endangered under the NC Act and Vulnerable under the EPBC Act)

The Pink-tailed Worm-lizard is known to occur at The Pinnacle and other sites in the Molonglo Valley (EPSD 2017). The species occupies rocky areas within native or derived grasslands. A total of 0.27 hectares of suitable habitat for the Pink-tailed Worm Lizard has been mapped in the study area and continues north into The Pinnacle Nature Reserve (ACTmapi, 2021).

Striped Legless Lizard (*Delma impar*) (Vulnerable under the NC Act and the EPBC Act)

The Striped Legless Lizard occupies naturally open grassland dominated by medium-height native tussock grasses like Kangaroo Grass, wallaby grass and speargrass, but is also found in taller grasses and degraded grasslands dominated by exotic species (ACT Government 2017). A total of 19.42 hectares of suitable habitat for the Striped Legless Lizard has been mapped in the study area. The nearest identified mapped habitat occurs east of the Tuggeranong Parkway (ACTmapi, 2021).

Little Eagle (*Hieraaetus morphnoides*) (Vulnerable under the NC Act and not listed under the EPBC Act)

Sightings of the Little Eagle in the ACT are rare; there is one 2020 record of the Little Eagle in The Pinnacle Nature Reserve and records of the species in Kama Nature Reserve from 2019 (ebird 2021). The study area and nearby nature reserves may be used for foraging on occasion. Breeding is concentrated along the Murrumbidgee and Molonglo River corridors. The Little Eagle is unlikely to nest in the study area due to a preference for using mature trees in open woodland and along watercourses (ACT Government 2013).

Regent Honeyeater (*Anthochaera phrygia*) (Endangered under the NC Act and Critically Endangered under the EPBC Act)

The Regent Honeyeater is a critically endangered nomadic species with its movement predominantly governed by the availability of nectar (DoE 2016 in 2019a), particularly flowering eucalypts including Yellow Box (*Eucalyptus melliodora*) and Mugga Ironbark (*E. sideroxylon*), as well as mistletoe (mainly Needle-leaf Mistletoe (*Amyema cambagei*)) (Higgins *et al.* 2001, DoE 2016 in ACT 2019a). The Regent Honeyeater typically nests in the canopy of mature trees, including eucalypts (e.g. Yellow Box and Mugga Ironbark), Rough-barked Apple (*Angophora floribunda*), and River She-oak (*Casuarina cunninghamiana*) (ACT 2019a). The last recorded breeding event in the ACT was in 1995 when four pairs of Regent Honeyeaters nested in Yellow Box – Blakely's Red Gum Grassy Woodland near north Watson. The most recent record of this species in the ACT is from January 2020 where one individual was observed foraging at Justice Robert Hope Park in Watson.

The study area has 13.01 hectares of suitable foraging and breeding habitat for this species in the Grassy Woodland and riparian area with River She-oaks. No Mistletoe species were observed in the study area.

Scarlet Robin (*Petroica boodang*) (Vulnerable under the NC Act and not listed under the EPBC Act)

Scarlet Robins are distributed widely in the ACT and have been recorded as recently as 2020 in The Pinnacle Nature Reserve and Kama Nature Reserve (ebird 2021). They are more likely to be recorded in the lower altitudes of the ACT in the winter months. The Scarlet Robin occupied woodland habitat with shrubs, logs and native grasses. Grassy Woodland and planted native vegetation in the study area could provide suitable habitat for this species. There is 19.80 hectares of suitable habitat in the study area.

Superb Parrot (*Polytelis swainsonii*) (Vulnerable under the NC Act and EPBC Act)

The Superb Parrot was observed at all bird survey locations within the study area. On each occasion, the species was observed flying over William Hovell Drive. Superb Parrots were observed as individuals or in groups up to 7. A count of 15 birds was recorded during a 40 minute survey for this Project. No individuals were observed foraging in the study area, however suitable habitat occurs. Several individuals were observed perched in trees in land adjoining the study area. The study area is considered to provide 12.74 hectares of foraging and breeding habitat for the species based on the presence of tree hollows in the Grassy Woodland vegetation, although it is unknown whether the tree hollows they meet the specific requirements for successful breeding, based on research undertaken by the ACT Government (Allen 2021).

Varied Sittella (*Daphoenositta chrysoptera*) (Vulnerable under the NC Act and not listed under the EPBC Act)

The Varied Sittella has been recorded as recently as 2020 in both The Pinnacle Nature Reserve and Kama Nature Reserve (ebird 2021), including breeding activity in Kama Nature Reserve. A total of 19.80 hectares of suitable habitat for this species occurs in both the Grassy Woodland and planted woodland in the study area, although it is more likely to occupy nearby areas of large, undisturbed vegetation with a greater density of trees (EPSD 2019b). Observations in both nature reserves on either side of the alignment suggest that the Varied Sittella does cross William Hovell Drive on occasion, possibly during dispersal.

White-winged Triller (*Lalage sueurii*) (Vulnerable under the NC Act and not listed under the EPBC Act)

The White-winged Triller is an uncommon breeding summer migrant in the ACT, often more common in drought years. It was recorded during 2020 in The Pinnacle Nature Reserve and Kama Nature Reserve (ebird 2021). Critical habitat features for the species include large living and dead trees and insects in areas of grassland fallen timber for feeding (EPSD 2019c). Grassy Woodland and planted woodland in the study area provides 19.80 hectares of suitable habitat for this species. The White-winged Triller only occurs in Canberra in the summer months, and some individuals are likely to temporarily occupy the study area during migration from nearby areas of suitable habitat.

Grey-headed Flying-fox (*Pteropus poliocephalus*) (Vulnerable under the NC Act and the EPBC Act)

Grey-headed Flying-fox roosting camps are generally located within 20 km of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy. Feed on the nectar and pollen of native trees, in particular Eucalyptus, Melaleuca and Banksia. The study area does not have any active roosting colonies but it does have a suitable roost site along Deep Creek and 12.74 hectares of suitable foraging habitat within the Grassy Woodland areas. The only known regular roost in the ACT is the large (sometimes breeding) colony in Commonwealth Park beside Lake Burley Griffin. Bats are often seen foraging throughout the suburbs and reserves of the ACT.

Brown treecreeper (*Climacteris picumnus*) (Vulnerable under the NC Act and not listed under the EPBC Act)

The Brown treecreeper is a breeding resident of the ACT and may live in isolated family groups (ACT Govt 2019b). The preferred habitat in the ACT is within dry eucalypt woodlands and open forests, feeding on insects, notably ants, and also larvae. Features of habitat critical for the species are relatively undisturbed grassy woodlands with native understorey; large living and dead trees for roosting nesting and foraging; and fallen trees for foraging (ACT Govt 2019b). The species has historically been recorded in the region of the study area.

Swift Parrot (*Lathamus discolor*) (Vulnerable under the NC Act and Critically Endangered under the EPBC Act)

The Swift Parrot is a known migrant to the ACT over the winter (non-breeding) season, occurring regularly in small numbers. They forage mainly for nectar and also lerps, particularly from Yellow Box (Saunders and Tzaros 2011) and potentially also Blakely's Red Gum, preferring larger, more mature, trees that provide more reliable food sources. Their preferred habitats are Eucalypt woodland and drier forests. The Project will require the removal of 10.87 hectares of suitable foraging habitat of Yellow Box and Blakely's Red Gum along the road corridor.

White-throated Needletail (*Hirundapus caudacutus*) (Vulnerable under the NC Act and the EPBC Act)

The White-throated Needletail is migratory species to Australia over October to March from the northern hemisphere where they breed. They feed largely on insects including larvae and generally fly over wooded areas such as open forests and rainforests, as well as partly cleared pasture, remnant edge vegetation, and coastal areas. In the ACT the species is identified as a visitor with no key roosting sites or resting sites recorded

(ACT Government 2020c). The study area contains wooded vegetation that may provide a minor or indirect source of food.

5.4 Matters of National Environmental Significance

5.4.1 *Leucochrysum albicans* var. *tricolor* (Hoary Sunray) – Endangered under the EPBC Act

This species is not listed under the NC Act.

The threatened flora species - *Leucochrysum albicans* var. *tricolor* - was assessed with a high likelihood of occurring in the study area and was subsequently recorded in the study area. *L. albicans* var. *tricolor* is a small perennial everlasting daisy with flowering stems that can reach up to 20 cm tall (Sinclair 2010). This species grows in woodland and grassland communities in disjunct populations in south-east NSW, the ACT, Victoria and Tasmania. Within the study area *L. albicans* var. *tricolor* was recorded in a cluster spanning both sides of William Hovell Drive. This occurrence supported approximately 69 individuals – most of which were in flower (Photograph 5-1). The location corresponds to a low saddle intersected by the existing road alignment forming the most prominent rock cutting on the site.

Where the *L. albicans* var. *tricolor* were recorded, the existing road alignment separated Kama Nature Reserve in the south from The Pinnacle Nature Reserve in the north. An investigation of Kama Nature Reserve identified a large population of *L. albicans* var. *tricolor* immediately adjacent to those occurring in the study area. This population was comprised of a greater number of larger more mature plants compared to those recorded in the study area. The population in Kama Nature Reserve was growing in an area of relatively bare soils, distinctly cleared of exotic grasses compared to the surrounds (Photograph 5-1). Grassland regeneration trials using a "Scrape and sow" method have been performed in Kama reserve through efforts of the organisation Friends of Grasslands and the ACT Government. The population recorded in the study area may be recruiting through wind-blown seed from this larger population up-slope in Kama Nature Reserve.



Photograph 5-1 A flowering *Leucochrysum. albicans* var. *tricolor* recorded within the study area during the November surveys



Photograph 5-2 Open scraped areas in Kama Reserve with large population of Lecuchrysum allbicans



Photograph 5-3 Close-up of robust Leucochrysum albicans specimens in Kama Reserve.

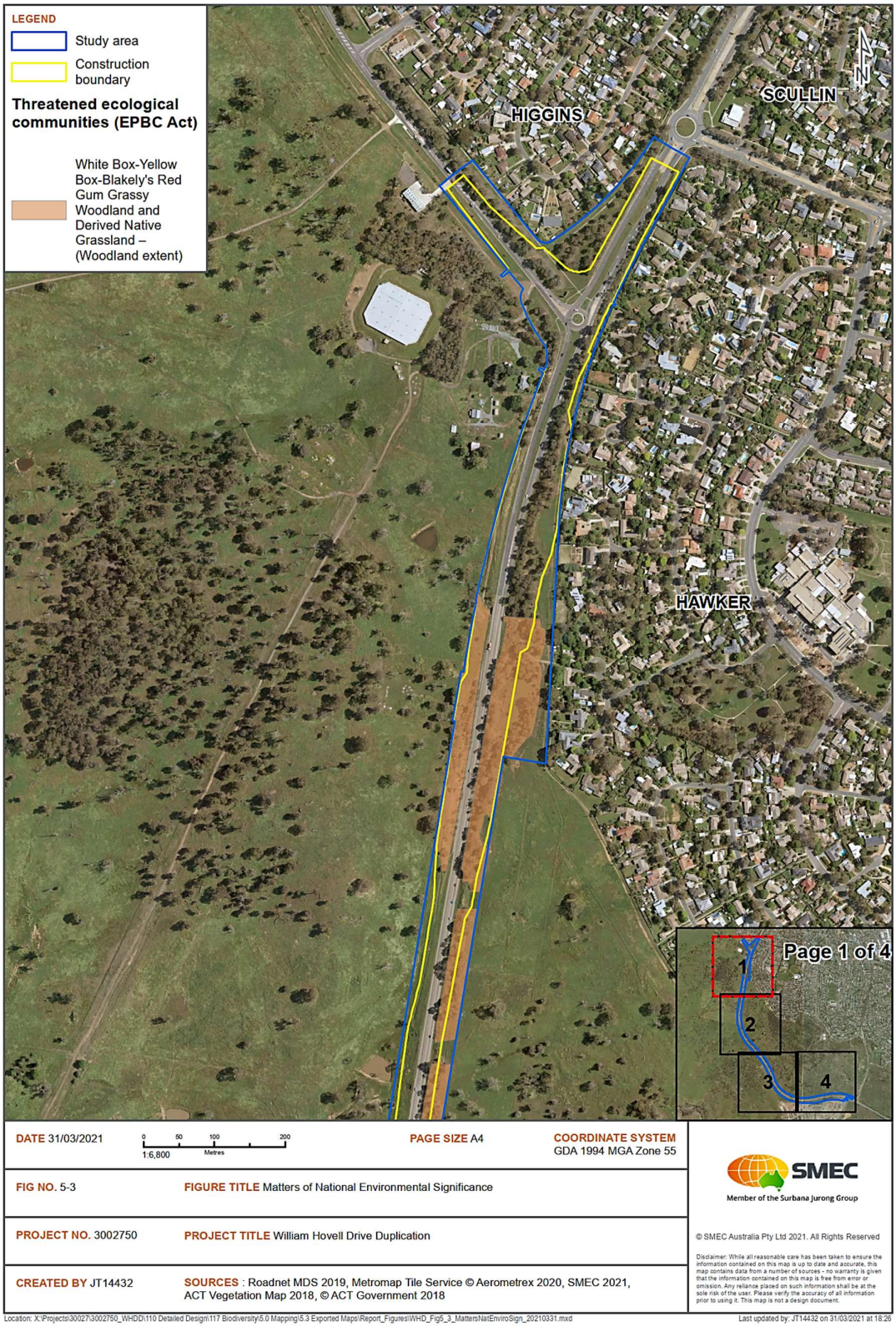
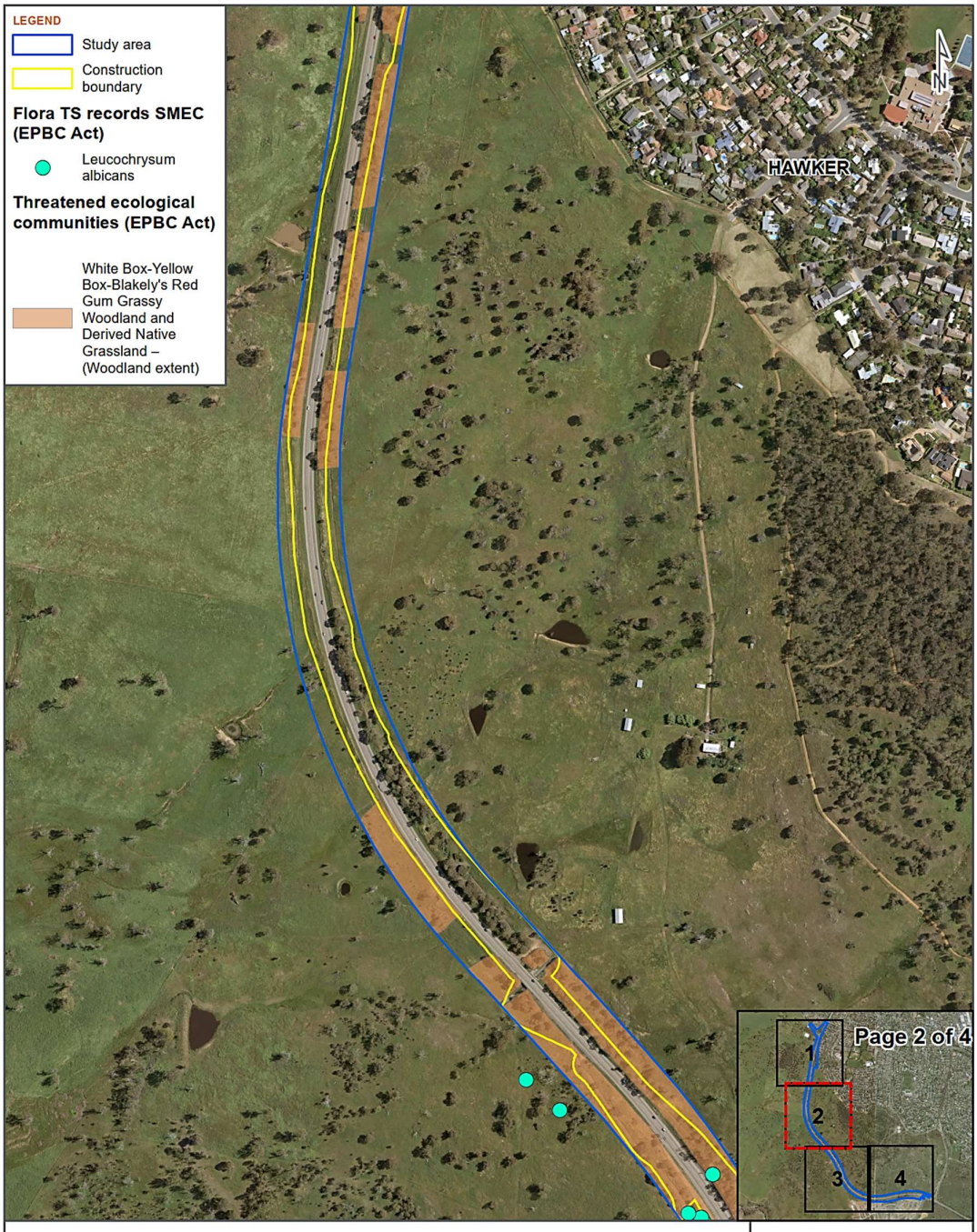
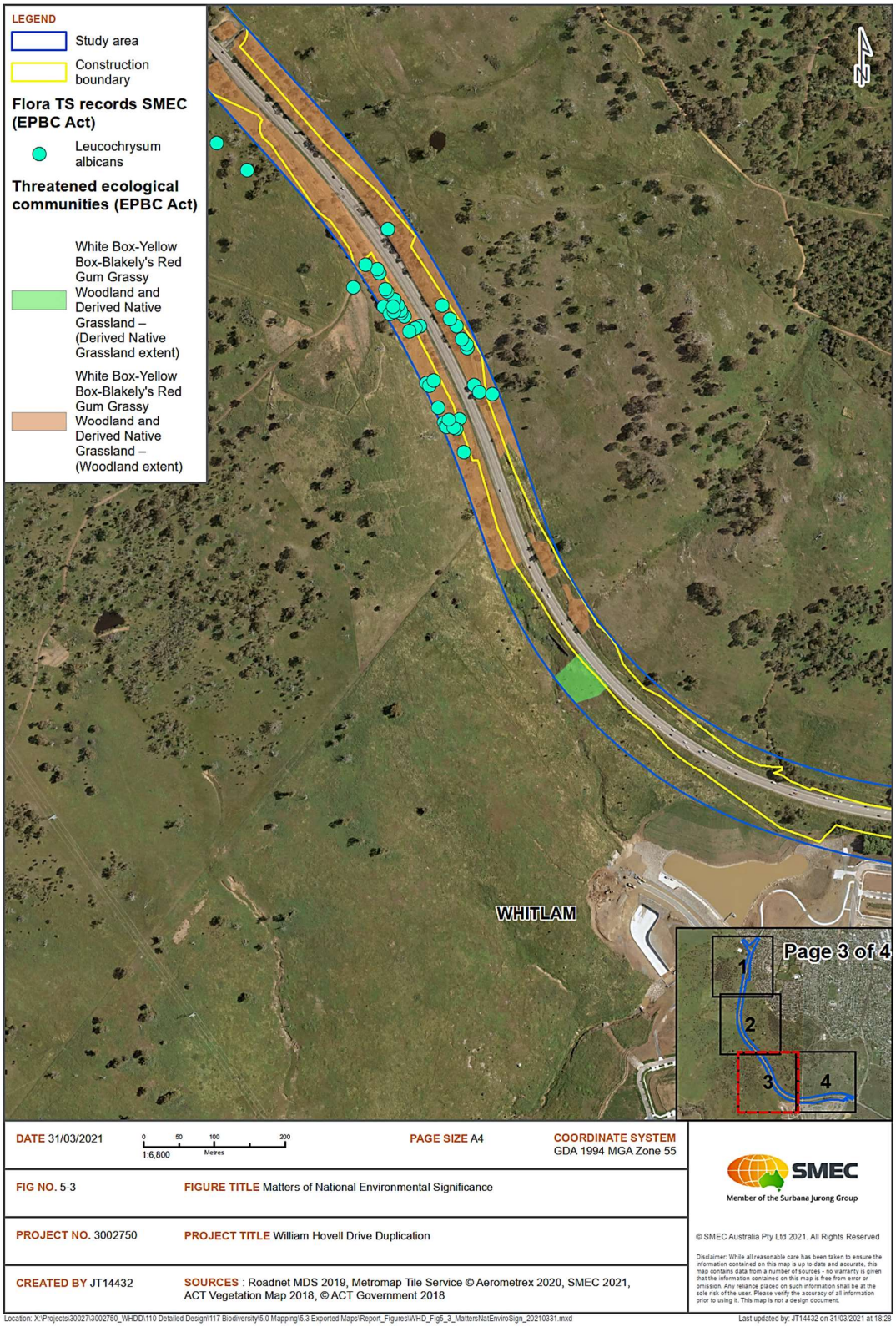
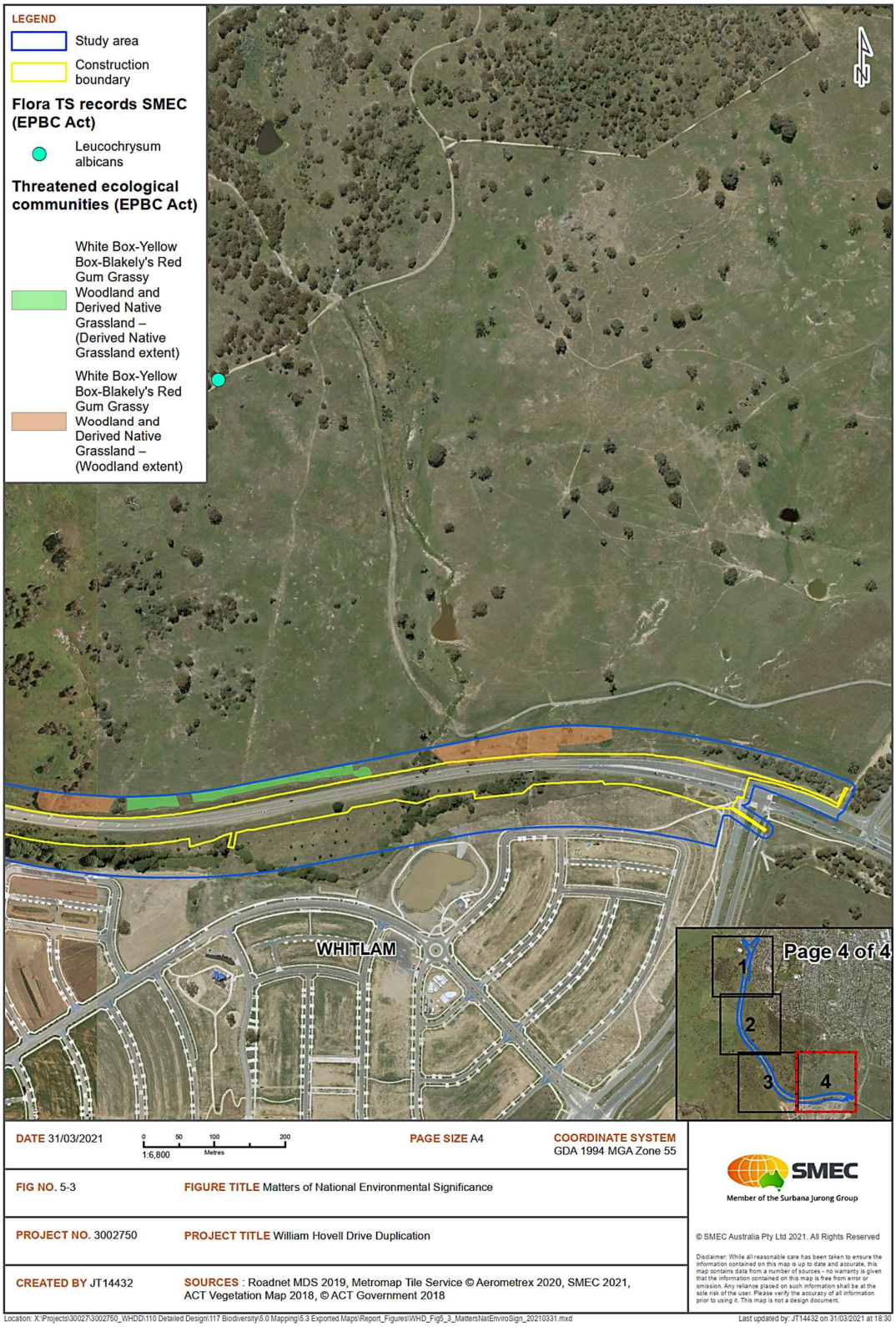


Figure 5-3: Location of threatened flora species


LEGEND
Study area
Construction boundary
Flora TS records SMEC (EPBC Act)
Leucochrysum albicans
Threatened ecological communities (EPBC Act)
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland – (Woodland extent)
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PROJECT NO. 3002750
PROJECT TITLE William Hovell Drive Duplication
CREATED BY JT14432
SOURCES : Roadnet MDS 2019, Metromap Tile Service © Aerometrex 2020, SMEC 2021, ACT Vegetation Map 2018, © ACT Government 2018
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Construction boundary
Flora TS records SMEC (EPBC Act)
Leucochrysum albicans
Threatened ecological communities (EPBC Act)
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland – (Derived Native Grassland extent)
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland – (Woodland extent)
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LEGEND
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Construction boundary
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Leucochrysum albicans
Threatened ecological communities (EPBC Act)
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland – (Derived Native Grassland extent)
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5.4.2 White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland – critically endangered under the EPBC Act

This TEC is also Critically Endangered under the NC Act.

All occurrences of the NC Act listed Yellow Box-Blakely's Red Gum Grassy Woodland conformed to the occurrence of the EPBC Act listed White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland. Additionally, all but one small extent of Grassy Gum Woodland in the study area satisfied the following criteria specified in the EPBC Act White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland Policy Statement:

Criterion: Is, or was previously, at least one of the most common overstorey species White Box, Yellow Box or Blakely's Red Gum?

Answer: Yes. Blakely's Red Gum is the most common overstorey species.

Criterion: Does the patch have a predominantly native understorey?

Answer: Yes. When fieldwork was conducted for the PEA the understorey throughout patches of Grassy Woodland was predominantly native. During the November/December surveys a native understorey was still present however the recent rains had facilitated the germination of invasive grasses in the understorey.

Criterion: Is the patch 0.1 ha or greater in size?

Answer: Yes. All patches identified as this TEC are greater than 0.1 hectare in size.

Criterion: There are 12 or more native understorey species present (excluding grasses). There must be at least one important species.

Answer: Yes. There are more than 12 native understorey species, including one important species, in all but one small patch of Grassy Woodland. From the plot data collected and observations of those Grassy Woodland patches in the study area it is considered that the species captured in the plot data is representative of White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland throughout the study area.

5.4.3 Superb Parrot

This species is also listed as Vulnerable under the NC Act.

The occurrences and habitat of the Superb Parrot within the study area are discussed in Section 5.3.

5.4.4 Migratory species

Thirteen species listed as migratory under the EPBC Act were predicted to occur through database searches (Appendix B). Of these species, three were identified as having a moderate or higher likelihood of occurrence in the study area based on the availability of suitable habitat and recent nearby sightings; the Fork-tailed Swift, White-throated Needletail and Satin Flycatcher. None of these species were recorded during recent surveys.

The Fork-tailed Swift and White-throated Needletail are aerial species, foraging above a variety of vegetation types. Although they may occur on occasion above the study area, the proposal is unlikely to affect their life cycle or behaviour. The Satin Flycatcher may occur in parts of the study area and cross William Hovell Drive during migration between larger areas of suitable habitat in nearby nature reserves and the Molonglo River corridor (ACT Government 2018).

5.5 Critical habitat

Critical habitat is defined as habitat that is critical to the survival of a threatened species, population or ecological community. Under the EPBC Act, habitat is listed on the National Critical Habitat register. To date, no areas of critical habitat on the register occur in the ACT.

Critical habitat for some species listed under the NC Act or EPBC Act have been identified in the relevant ACT action plans or national recovery plans:

- White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland – moderate to highly fertile soils of the western slopes of NSW and Queensland, the northern slopes of Victoria, and the tablelands of the Great Dividing Range from southern Queensland through NSW and the ACT. All areas of Box-Gum Grassy Woodland which meet the minimum condition criteria outlined in Section 3 should be considered critical to the survival of this ecological community. In addition, degraded

woodland areas not considered part of the listed ecological community may also be essential to the long-term conservation of Box-Gum Grassy Woodland, by virtue of their landscape setting or remaining flora/fauna habitat features, and should also be considered as potential habitat critical to the survival of this ecological community (DECCW 2010)

- Superb Parrot – breeding and foraging habitat has been identified as critical for this species. Potential foraging habitat occurs in the study area (Baker-Gabb 2011).

5.6 Wetlands of International Significance

Wetlands of International Significance (RAMSAR wetlands) are listed as MNES under the EPBC Act. The EPBC Protected Matters Search (DAWE 2020) identified four RAMSAR Wetlands:

- Banrock Station Wetland Complex, 700–800 kilometres upstream
- Hattah-Kulkyne Lakes, 500–600 kilometres upstream
- Riverland, 700–800 kilometres upstream
- The Coorong, and Lakes Alexandrina and Albert Wetland, 800–900 kilometres upstream.

Given that each of the identified wetlands occur a significant distance upstream of the study area, it is not considered that the Project will have any direct or indirect impact on a Wetland of International Significance.

6 Impact assessment

6.1 Direct impacts

The upgrade to William Hovell Drive will have a range of adverse impacts on biodiversity. These impacts have been identified as either direct or indirect and may contribute larger cumulative impacts with other developments in the locality. The following direct impacts to biodiversity are assessed in this report:

- Clearing of native vegetation
- Clearing and removal of threatened flora and fauna habitat
- Fauna injury and mortality
- Key threatening processes.

6.1.1 Clearing of vegetation

Works associated with the William Hovell Drive Upgrade will remove up to 19.85 hectares of vegetation, 6.49 hectares of which has been assessed as native. This native vegetation has not included planted native communities such as Planted River She-oak Riparian Forest or Planted Native. All vegetation has been stratified into the following communities:

- Grassy Woodland
- Native Grassland
- Planted River She-oak Riparian Forest
- Planted Native
- Exotic Riparian Woodland
- Exotic Grassland.

One other vegetation community was identified in the study area, Native Riparian Sedgeland. However, no areas of this community will be directly impacted by the Project.

A summary of the areas of direct impact to each vegetation community is provided in Table 6-1.

6.1.1.1 **Grassy Woodland**

All but one small patch of Grassy Woodland (as opposed to derived native grassland) within the study area has been mapped as one vegetation zone (Moderate), and has been precautionarily assessed as one condition class, "moderate". This moderate condition Grassy Woodland occupies 12.6 hectares in the study area. One small patch of Grassy Woodland occupying approximately 0.14 hectares is mapped as being in low condition. The Grassy Woodland that will be directly impacted by the proposal occurs scattered in patches along the alignment with the largest areas found approximately midway in proximity to the Pinnacle and Kama reserves. The combined impacted area of these stands is 6.46 hectares. Almost all of the impacted Grassy Woodland conforms to the NC Act listed TEC Yellow Box-Blakely's Red Gum Grassy Woodland and the EPBC Act listed TEC White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland. These areas that meet both these TEC condition thresholds are the 12.6 hectares of moderate condition Grassy Woodland, with the single 0.14 hectare patch of low condition not meeting the threshold for either the Box Gum Woodland TECs.

6.1.1.2 **Native Grassland**

Three patches of Native Grassland were observed in the study area. These patches occurred in the southern half of the road alignment. For offsetting purposes, all patches are assigned to one vegetation zone corresponding to a low condition of a Grassy Woodland in a derived native grassland formation (BGW_DNG). Across these three patches, 0.3 hectares of Native Grassland will be directly impacted. All of the impacted native grassland conforms to the NC Act listed TEC Yellow Box-Blakely's Red Gum Grassy Woodland and the EPBC Act listed TEC White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland.

6.1.1.3 **Planted River She-oak Riparian Forest**

Areas of this community occur along deep creek. Only a 0.01 ha area of this community will be directly impacted. The community does not conform to a TEC listed under the NC or EPBC Acts. This vegetation has not been considered for offset via the calculator as the community ACT22 - *Casuarina cunninghamiana* Tableland Riparian Woodland because it is derived and holds high position in the landscape (i.e. on a second order stream)

6.1.1.4 Planted Native

The Planted Native vegetation community occurred as one vegetation zone (PLN). A condition class was not designated to this community as the Planted Native vegetation did not conform to a native vegetation community recognised by the ACT Environmental Offset Calculator. An area of 7.06 hectares of this community was mapped within the study area, in patches found scattered along the whole alignment. Approximately, 4.41 hectares of Planted Native vegetation is expected to be directly impacted by the Project. The Planted Native vegetation community did not conform to a TEC listed under the NC or EPBC Acts.

6.1.1.5 Exotic Grassland

The Exotic Grassland vegetation community occurred as one vegetation zone (EXG). A condition class was not designated to this community as the Exotic Grassland vegetation did not conform to a native vegetation community recognised by the ACT Environmental Offset Calculator. An area of 18.52 hectares of this community was mapped within the study area, found distributed along many areas along the alignment. The mown verge of the existing road carries a narrow strip of this vegetation type along most of William Hovell Drive. Approximately 8.94 hectares of Exotic Grassland vegetation is expected to be directly impacted by the Project.

6.1.1.6 Exotic Riparian Woodland

Exotic Riparian Woodland corresponds to one zone found only in Deep Creek (ERW). A small section of the clearing boundary comes close to Deep Creek, resulting in clearing of 0.1 ha of Exotic Riparian Woodland. It is unlikely that whole trees will need to be removed. Some pruning of these willow trees may be required and there will be removal of the exotic blackberry shrub layer. This vegetation has value in creek bank stabilisation and habitat.

Table 6-1 Direct impacts to vegetation communities within the study area

SMEC vegetation community	ACT Vegetation Type (Act Government 2021	General ACTmapi vegetation community spatial correlation as mapped in study area (ACTmapi 2021)	Relationship to NC Act TEC	Relationship to EPBC Act TEC	Area within study area		Area within Construction boundary	
Grassy Woodland	ACT16: *Eucalyptus melliodora – E. blakelyi* Tableland Grassy Woodland	u19: Blakely's Red Gum – Yellow Box tall grassy woodland	Yellow Box–Blakely's Red Gum Grassy Woodland (critically endangered) - Moderate condition only	White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (critically endangered) - Moderate condition only	Low condition (Not TEC): 0.14 Moderate condition (TEC): 12.60	Total: 12.74	Low condition (Not TEC): 0.08 Moderate condition (TEC): 6.38	6.46
Native Grassland	ACTxx: Derived Native Grasslands	NG: Native Grasslands	Yellow Box–Blakely's Red Gum Grassy Woodland (critically endangered)	White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (critically endangered)	0.82		0.03	
Native Riparian Sedgeland	N/A	AFV - Aquatic Fringing Vegetation	N/A	N/A	0.07		zero	
Planted River She-oak Riparian Forest	N/A	P32d River She-oak Riparian Forest	N/A	N/A	0.27		0.01	
Planted Native	ACT25: Eucalyptus macrorhyncha Tableland Grass / Shrub Forest	Amenity planting native	N/A	N/A	7.06		4.41	
Exotic Riparian Woodland	NA	EXW: Exotic Woodlands	N/A	N/A	0.63		0.01	
Exotic Grassland	N/A	Exotic Grassland	N/A	N/A	18.52		8.94	

6.1.2 Removal of threatened species habitat

6.1.2.1 Flora

Approximately 56 *Leucochrysum albicans* var. *tricolor* (Hoary Sunray) individuals were recorded within the study area. Up to 13 individuals occur within the clearing boundary and will be directly impacted. Additionally, 20.56 hectares of Grassy Woodland, Native Grassland and Planted Native within the study area has been assessed as potential habitat for *L. albicans* var. *tricolor* (Table 6-2). Approximately 10.9 hectares of this habitat will be cleared by works associated with the Project (Table 6-1).

No other threatened flora species were recorded in the study area. As such, it is unlikely that the study area supports suitable habitat for the other plant species targeted in the SMEC surveys.

Table 6-2: Direct impacts on threatened flora habitat

Habitat feature	Threatened flora species	Potential habitat within study area (ha)	Potential habitat within clearing footprint (ha)	Individuals directly impacted	Offset required?
Grassy Woodland, Native Grassland, Planted Native	*Leucochrysum albicans* var. *tricolor* (Hoary Sunray)	20.56	10.9	13	[tba]

6.1.2.2 Fauna

The study area provides suitable foraging habitat for threatened woodland birds and the Grey-headed Flying-fox in the Grassy Woodland and Planted Woodland vegetation communities and is likely to form part of a larger home range for these species including nearby parks, reserves, streetscapes and gardens. During recent surveys, the Superb Parrot was observed flying over several locations of the study area. The highest fly over activity was at the north of the study area where individuals were flying in an east-west/west-east direction from the suburb of Hawker towards the direction of the Lower Molonglo Valley. The study area also supports a number of hollow-bearing trees that may provide breeding habitat for a number of arboreal mammals and birds including the Superb Parrot.

Vegetation in the study area is likely to provide stepping-stone habitat for many fauna species including the following threatened woodland birds known to occur in the area: Superb Parrot, White-winged Triller, Varied Sittella, Brown Treecreeper and Scarlet Robin.

Records of Pink-tailed Worm-lizard occur in the locality in the Molonglo Valley to the west and their habitat and extends to the study area and further east up to The Pinnacle Nature Reserve location. High quality potential habitat for this species will be impacted by the Project.

The study area is also considered to have potential Striped Legless Lizard habitat. Although there are no records for this species in the study area or locality it is a species that even following extensive surveys in areas known to have records, they are often extremely hard to detect.

Exact areas of potential threatened species habitat that will be directly impacted by the Project are provided in Table 6-4.

Table 6-3: Direct impacts on threatened fauna habitat

Threatened fauna species	Grassy Woodland- Moderate condition (ha)	Grassy Woodland- Low condition (ha)	Planted Native (ha)	Planted River She-oak Riparian Forest (ha)	Native Grassland (derived from Grassy Woodland) (ha)	Exotic grassland (ha)	Hollow-bearing trees (individuals)	Rocky habitat in native grassland (ha)	Total habitat directly impacted by the project (total area in study area)
Perunga Grasshopper Endangered under the NC Act Not EPBC listed	6.38	0.08	-	-	0.03	-	-	-	**6.49 ha (13.56 ha)**
Pink-tailed Worm-lizard (PTWL) Endangered under the NC Act Vulnerable under the EPBC Act	-	-	-	-	-	-	-	0.16	**0.16 ha (0.27 ha)**
Striped Legless Lizard Vulnerable under the NC Act and the EPBC Act	6.38	0.08	-	-	0.03	8.94	-	-	**15.43 ha (32.35 ha)**
Brown-treecreeper Vulnerable under the NC Act Not EPBC listed	6.38	0.08	4.41	0.01	-	-	-	-	**10.88 ha (20.07 ha)**
Little Eagle Vulnerable under the NC Act Not EPBC listed	6.38	0.08	4.41	0.01	0.03	8.94	-	-	**19.85 ha (39.41 ha)**
Regent Honeyeater Endangered under the NC Act Critically Endangered under the EPBC Act	6.38	0.08	4.41	0.01	-	-	-	-	**10.88 ha (20.07 ha)**
Scarlet Robin Vulnerable under the NC Act Not EPBC listed	6.38	0.08	4.41	-	0.03	8.94	-	-	**19.84 ha (39.14 ha)**
Superb Parrot	6.38	0.08	4.41	-	-	-	-[1]	-	**10.87 ha (19.80 ha)**

Threatened fauna species	Grassy Woodland- Moderate condition (ha)	Grassy Woodland- Low condition (ha)	Planted Native (ha)	Planted River She-oak Riparian Forest (ha)	Native Grassland (derived from Grassy Woodland) (ha)	Exotic grassland (ha)	Hollow-bearing trees (individuals)	Rocky habitat in native grassland (ha)	Total habitat directly impacted by the project (total area in study area)
Vulnerable under the NC Act and EPBC Act									**7 potential breeding trees (33)**
Swift Parrot Vulnerable under the NC Act Critically Endangered under the EPBC Act	6.38	0.08	4.41	-	-	-	-	-	**10.87 ha (19.80 ha)**
Varied Sittella Vulnerable under the NC Act Not EPBC listed	6.38	0.08	4.41	0.01	-	-	-	-	**10.88 ha (20.07 ha)**
White-throated Needletail Vulnerable under the NC Act and the EPBC Act	6.38	0.08	4.41	0.01	0.03	8.94	-	-	**19.85 ha (39.41 ha)**
White-winged Triller Vulnerable under the NC Act Not EPBC listed	6.38	0.08	4.41	-	-	-	-	-	**10.87 ha (19.80 ha)**
Grey-headed Flying-fox Vulnerable under the NC Act and the EPBC Act	6.38	0.08	4.41	-	-	-	-	-	**10.87 ha (19.80 ha)**

[1] Superb Parrots that have been observed flying over the study area, are likely to be part of the important population that occurs in the ACT. No individuals were observed utilising the study area for foraging, although suitable habitat is present in the Grassy Woodland and planted woodland. Despite the presence of hollow- bearing trees, some of which may have suitably sized hollows, the Superb Parrot is unlikely to breed within the study area. These are therefore considered to be seven *potential* breeding hollows only for this species.

6.1.3 Fauna injury or mortality

The current William Hovell Drive conditions present a risk to fauna attempting to cross the road. There is already evidence of fauna mortality, with multiple sightings of road kill along the length of the alignment. Fencing is present at the limit of the road reserve but is not of the type to prevent fauna entering the fauna corridor.

Injury or mortality of fauna is possible both during construction and operation of the Project. Removal of fauna habitat, including hollow-bearing trees, may result in the injury or mortality of species using this habitat, or more indirectly as they compete to establish a new territory in neighbouring habitat after being displaced. During operation, animals may be injured or killed by collisions with vehicles if they enter the road corridor. Kangaroos will remain one of the most at risk species due to their behaviour and abundance in the landscape.

According to the Transport Assessment (refer to EIS Appendix C) the Project will not generate any traffic according to traditional traffic generation methodologies. However, the upgrade will result in a redistribution of traffic across the Canberra road network and may also lead to a small increase in traffic volumes due to the relatively lower congestion and easier road travel. This increase on traffic should be accompanied by a reduction in traffic volumes across other arterial and lower order roads in Belconnen (refer to EIS Section 5.1.4).

William Hovell Drive shows a relatively low growth rate for the Annual Average Daily Traffic (AADT) at 1% per annum. This is from an average of 18,596 vehicles to 19,925 vehicles per day. SMEC 2021 noted that it is likely that this volume growth does not accurately reflect the increase in travel demand, and some trips are using other parts of the network.

Changes to road network usage which will occur with the Project in place alongside background vehicle movement growth can be summarised as follows:

- Traffic will be redistributed throughout the network
- For some directional turns at the intersection, traffic will be subject to longer average queue times compared to the current scenario. For some directional turns, traffic will be subject to shorter average queue times compared to the current scenario
- As congestion along the road network improves, it is more likely that vehicles travelling along William Hovell Drive can meet the maximum sign posted speed limit of 90km/hr
- While there is a substantial increase in overall traffic at the intersection, there is a decrease in some movements and an increase in others. In particular, the peak directional proportion along Kingsford Smith Drive and William Hovell Drive appears to reverse between 2020 and 2031
- In 2020, approximately 70% of the traffic at the intersection travels south (to the city) in the AM and north (to Belconnen) in the PM. In 2031, approximately 60% of the traffic is forecasted to travel in the opposite direction. It appears that this change is due to the development in Molonglo, near the southern end of William Hovell Drive. The extra traffic generated by Molonglo through Glenloch Interchange and along Parkes Way is likely to force traffic from Belconnen to use an alternative route (possibly Belconnen Way/Barry Drive). In addition, some of the residents of Molonglo will travel north to Belconnen, along Bindubi Street, Coulter Drive and William Hovell Drive.

These changes do not clearly demonstrate a greater likelihood of fauna vehicle strike compared to the current operational scenario. Indeed, William Hovell Drive is currently an existing risk of vehicle strike to fauna. The road upgrade has been designed to an increase the capacity of the existing road network to support greater volumes of traffic during peak times. An increase in vehicle traffic may increase the risk of vehicle strike on threatened species occurring in or near the development site. The road upgrade design improves sight vision ahead from the current design, which may be beneficial in drivers seeing fauna along or on the road (particularly at night).

The wildlife likely to be subject to vehicle collision and roadkill associated with the Project include:

- Mammals (Eastern Grey Kangaroo, Common Wallaroo, Swamp Wallaby, Red-necked Wallaby, Wombats and Spotted-tailed Quoll)
- Echidnas
- Woodland birds (Superb Parrot, Swift Parrot, Varied Sittella)
- Common birds (Galahs and Cockatoos)
- Owls (Southern Boobook, Tawny Frogmouth, Australian Owlet-nightjar)
- Reptiles (snakes, legless lizards, bearded dragon)
- Scavenger birds/raptors feeding on roadkill (Little Eagle and Wedge Tailed Eagle)
- Frog species.

Stepping stone vegetation such as vegetated median strips are important for some smaller species to cross the road. Provided the vegetation height along the road and median areas will be above vehicle height during operation the impact on these species from vehicle strike will be minimised. Moreover, all threatened species at risk of vehicle strike are highly mobile and agile species. Mitigation measures will be implemented to reduce the potential increase in vehicle strike from the Project.

It is proposed to mitigate these impacts by providing:

- One fauna crossing (rope bridge) to assist arboreal and avifauna to safely cross the road reserve
- Two fauna crossings (box culverts) to assist ground-dwelling fauna to safely cross the road reserve. These will be designed to be used by various wildlife
- Some batters will be laid back to allow Kangaroos and Wallabies to escape the roadway and back into the Nature Reserves. However, exclusion fencing (1.8 m tall chainmesh fence) will be included on each side of William Hovell Drive in the vicinity of the Nature Reserves, extending at least 200m past the fauna crossings. Exclusion fencing (1.8 m tall chainmesh fence) to be included on each side of William Hovell Drive in the vicinity of the Nature Reserves, extending at least 200m past the fauna crossings. This will assist in reducing the risks to native and non-native fauna from being injured or killed by road traffic. It will also improve the safety of road users by decreasing the risks of vehicle collision with large fauna species. The effectiveness of this exclusion fencing will be monitored during the operational stage of the Project.

An app (Roadkill Reporter) has recently been developed by a Sydney University Veterinary Science PhD Student, Bruce Engelfield, to allow citizen scientists to record road kill. The app is designed to take a photograph of roadkill anywhere in Australia with a GPS-time-and-date-stamp. Users can then upload the image to a website. This data can identify roadkill hotspots, tabulate species of animals killed and potentially be used for ecological studies of roadkill numbers, species distribution, population trends, animal behaviour and disease. Initial results indicate that mammal roadkill mostly occurs at night and that of birds and reptiles during daytime. If community members are encouraged to use this app to record road kill it will provide valuable data to identify operational hotspots. Adaptive management of the road to alleviate these hotspots can then be applied in the appropriate locations.

In addition, it is considered that the Project's commitment to replace native, mature trees at a ratio of 1:10 and native shrubs at a rate of 1:4 will assist bird and arboreal species in safely crossing the William Hovell Drive road reserve: i.e. by providing closer linkages along the newly disturbed roadside corridor, meaning there is less bare distance to cross. Plantings will also be strategically located near the proposed fauna rope bridge, to act as further encouragement for arboreal and bird species to use this crossing feature. Proposed landscaping trees will either be *Casuarina Cunninghamiana*, or one of six x different species of Eucalyptus.

A review of the road's current speed limit is outside the scope of this EIS, and current 90km/hr limit is proposed to remain. Nevertheless, It is considered that altering the speed limit will not significantly reduce the frequency of fauna strike incidents. Research from Deakin University indicates that occurrence of fauna strike in Australia tends to peak with moderate speed limits of around 60-80km/hr (Anthony R., 2020).

Mitigation measures to reduce fauna injury and mortality have been proposed in Section 7.2.

6.1.4 Key Threatening Processes

Two Key Threatening Processes (KTPs) are listed under the NC Act:

- The loss of mature native trees (including hollow-bearing trees) and a lack of recruitment
- Unnatural fragmentation of habitats.

Both are considered relevant to the Project. Likely impacts of these KTPs have been discussed in Sections 6.1.2.2 and 6.2.1.

One KTP listed under the EPBC Act is considered relevant to the Project is Land clearance. This KTP is discussed as part of native vegetation and threatened species habitat removal in Sections 6.1.1 and 6.1.2.

6.2 Indirect impacts

The following indirect impacts to biodiversity are assessed in this section:

- Habitat fragmentation
- Animal-vehicle collision and roadkill
- Edge effects
- Weed and exotic flora
- Changes to hydrology
- Invasion and spread of pests
- Invasion and spread of pathogens
- Noise, light and vibration.

6.2.1 Habitat fragmentation

Habitat fragmentation will increase, and connectivity will decrease as a result of the construction of the Project. The current width of the road surface is between about 17 and 20 metres and will increase to about 50 metres in some areas. The direct impacts to connectivity from clearing native vegetation will be by increasing the current fragmentation width (from the existing road) from about 25-30 metres to about 50-60m. However, the mitigation measures proposed as part of the Project will include the provision of two types of fauna crossing structures across the William Hovell Drive road reserve: box culverts; and rope bridges. The proposed biodiversity offset location to the west of Kama Nature Reserve will also provide opportunity to enhance species habitats, for example through the provision of improved Pink-tailed Worm-lizard habitat features (emplaced rocky areas).

At the interface between Kama and The Pinnacle Nature Reserves the Project will increase the width of the road surface from about 17 metres to about 31 metres. Areas of native vegetation on either side will increase from about 30 metres to about 80 metres. Near Old Weetangera Cemetery the width of William Hovell Drive will increase from about 20 metres to about 50 metres. The distance between patches of native vegetation in this area will increase from about 22 metres to about 80 metres. Similarly, the width of William Hovell Drive near Deep Creek will increase from about 18 metres to about 27 metres wide, with the total clearing boundary at this location being about 40 metres wide. The two putative connection points to the north and south-east of the nature reserve interface likely provide habitat connectivity across William Hovell Drive. Habitat connectivity is not restricted to the nature reserve interface as some fauna groups and plants (via seed dispersal) are able to traverse the fencing.

The increase in habitat fragmentation and the loss of habitat connectivity between the Kama and The Pinnacle Nature Reserves could trigger further indirect impacts to biodiversity. These potential impacts are difficult to predict and are often specific to the fauna, flora and ecological communities being impacted. Further impacts to biodiversity caused by an increase in habitat fragmentation and loss of habitat connectivity across William Hovell Drive may include:

- Impacts to seed dispersal
- Disruption of movement patterns
- Alteration of foraging behaviours
- Alteration of breeding behaviours and a potential increase in genetic isolation
- Decreased ability to adapt to a changing climate.

The severity of these impacts and how they affect different species groups is outlined in Table 6-4.

Table 6-4: Impacts of fragmentation on flora and fauna

Impact of connectivity loss	Species group	Impact description	Duration and severity
Seed-dispersal barrier	Flora	The increased distance between stands of native vegetation may decrease the likelihood that dispersed seed reaches an area of suitable habitat in which it can germinate.	Permanent Potentially severe to species with short seed dispersal distances
Disruption to movement patterns	Mammals	The increased width of William Hovell Drive will increase the risk of vehicle strike to ground-dwelling mammals. The threat of vehicle strike (or the action itself) may also impede movement across William Hovell Drive. The increased distances between trees on either side of William Hovell Drive may also prevent arboreal mammals from safely traversing the road tree to tree. Some species of microbat may not be able to utilise the airspace over William Hovell Drive if the distance between habitat increases. Increases to light, noise and vibration may disrupt the existing foraging behaviours of bats and flying foxes.	Permanent Potentially severe to ground-dwelling mammals. Potentially severe to arboreal mammals if the wider William Hovell Drive cannot be crossed tree to tree. Unlikely to significantly impact microbats.
	Birds	The increased width of William Hovell Drive will increase the risk of vehicle strike to birds known to fly at lower heights. The threat of vehicle strike (and the action itself) may also impede movement of birds that move closer to the ground. The increased fragmentation of vegetation will decrease the amount of sheltering habitat within the road reserve. This may reduce the number of connection points that a bird may utilise.	Permanent Potentially severe to birds that fly closer to the ground.
	Reptiles	The increased width of William Hovell Drive will increase the risk of vehicle strike to reptiles. The threat of vehicle strike (or the action itself) may also impede movement across William Hovell Drive.	Permanent Potentially severe

Impact of connectivity loss	Species group	Impact description	Duration and severity
	Amphibians	The increased width of William Hovell Drive will increase the risk of vehicle strike to amphibians. The threat of vehicle strike (or the action itself) may also impede movement across William Hovell Drive.	Permanent Potentially severe
	Invertebrates	The increased width of William Hovell Drive will increase the risk of vehicle strike to invertebrates.	Permanent Unlikely to place any species or population at risk of extinction
	Echidnas	Decreases to insect numbers may decrease the number of microbats moving over the road. Increases to light, noise and vibration may also disrupt foraging behaviour.	Permanent Impacts to foraging habitat may be harmful to some species but are unlikely to be severe.
Disruption of foraging behaviour	Mammals	The increased distance between patches of habitat either side of the road may prevent some mammals from crossing to forage. Increases to light, noise and vibration may disrupt the existing foraging behaviours of microbats. Threatened species of microbats are known to avoid well-lit areas.	Permanent Impacts to foraging habitat may be harmful to some species but are unlikely to be severe.
	Birds	Increases to light, noise and vibration may disrupt the existing foraging behaviours of birds in the study area. Changes to insect numbers as a result of increased street lighting in the study area may lead to increased numbers of certain bird species foraging within the William Hovell Drive road reserve at dawn and dusk (e.g. Varied Sittella, Satin Flycatcher, Scarlet Robin, Superb Parrot).	Permanent Impacts to foraging behaviour will be specific to species. The severity of inter and intra species foraging competition is unknown.
	Reptiles	Impacts to the foraging behaviour of reptiles are unknown.	Unknown
	Amphibians	The increased distance between habitat patches and increased threat of vehicle strike may prevent some species from crossing William Hovell Drive to forage. This may in turn increase intra and inter species foraging competition on either side of the alignment.	Permanent Potentially severe
	Invertebrates	Impacts to the foraging behaviour of invertebrates are unknown.	Unknown
	Echidnas	The increased distance between habitat patches and increased threat of vehicle strike may prevent some species from crossing William Hovell Drive to forage. This may in turn increase intra and inter species foraging competition on either side of the alignment.	Permanent Potentially severe
Disruption to breeding behaviour and a potential increase of loss of genetic diversity	Flora	The increased width of William Hovell Drive may prevent pollinators from crossing. This may isolate groups of individuals occurring on either side William Hovell Drive, effectively creating separate populations. Impediments to pollinators is likely to cause a restriction in the exchange of genetic material and may genetically isolate occurrences of some plant species on either side of William Hovell Drive.	Permanent Potentially severe to smaller populations which already have a lack of genetic diversity.
	Mammals	The upgrade to William Hovell Drive may prevent (or reduce the likelihood) some individuals from crossing and finding a mate. The upgrade may subsequently increase the likelihood of a smaller number of individuals mating with each other. This would reduce the genetic diversity within the groups isolated on either side of the road. The same risk applies so arboreal mammals if connection points are removed. The genetic diversity of some species of microbats and flying-foxes in the locality will not be impacted, as individuals will still be able to safely cross the William Hovell Drive road reserve.	Permanent Potentially severe if populations become isolated.
	Birds	The upgrade to William Hovell Drive may prevent (or reduce the likelihood) some individuals from crossing and finding a mate. The upgrade may subsequently increase the likelihood of a smaller number of individuals mating with each other. This would reduce the genetic diversity within the groups isolated on either side of the road.	Permanent Has the potential to be harmful to smaller birds that fly closer to the ground.

Impact of connectivity loss	Species group	Impact description	Duration and severity
	Amphibians	The upgrade to William Hovell Drive may prevent (or reduce the likelihood) some individuals from crossing and finding a mate. The upgrade may subsequently increase the likelihood of a smaller number of individuals mating with each other. This will reduce the genetic diversity within the groups isolated on either side of the road.	Permanent Potentially severe if populations become isolated.
	Reptiles	The upgrade to William Hovell Drive may prevent (or reduce the likelihood) some individuals from crossing and finding a mate. The upgrade may subsequently increase the likelihood of a smaller number of individuals mating with each other. This would reduce the genetic diversity within the groups isolated on either side of the road.	Permanent Potentially severe if populations become isolated.
	Invertebrates	Unknown	Unknown
	Echidnas	The increased distance between habitat patches and increased threat of vehicle strike may prevent some species from crossing William Hovell Drive to seek out mates. This may in turn decrease genetic diversity within the groups isolated on either side of the road.	Permanent Potentially severe

6.2.2 Animal-vehicle collision and roadkill reduction

William Hovell Drive currently is an existing risk of vehicle strike to fauna. According to the Transport Assessment Report (SMEC February 2021) the proposed development will not generate any traffic, according to traditional traffic generation methodologies. However, the upgrade will result in a redistribution of traffic across the Canberra road network and may also lead to a small increase in traffic volumes due to the relatively lower congestion and easier road travel. William Hovell Drive shows a relatively low growth rate for the Annual Average Daily Traffic (AADT) AADT at 1% per annum. This is from an average of 18,596 vehicles to 19,925 vehicles per day. SMEC 2021 noted that it is likely that this volume growth does not accurately reflect the increase in travel demand, and some trips are using other parts of the network.

An assessment of construction vehicles has not been estimated for the Project.

An increase in vehicle traffic, even if only a small percent, may increase the risk of vehicle strike on threatened species occurring in or near the development site. The road upgrade design does improve sight vision ahead from the current design, which may be beneficial in drivers seeing fauna along or on the road (particularly at night).

The wildlife which are likely to be subject to vehicle collision and roadkill along the William Hovell Drive road reserve include:

- Mammals (Eastern Grey Kangaroo, Common Wallaroo, Swamp Wallaby, Red-necked Wallaby, Wombats and Spotted-tailed Quoll)
- Echidnas
- Woodland birds (Superb Parrot, Swift Parrot, Varied Sittella)
- Common birds (Galahs and Cockatoos)
- Owls (Southern Boobook, Tawny Frogmouth, Australian Owlet-nightjar)
- Reptiles (snakes, legless lizards, bearded dragon, turtles)
- Scavenger birds/raptors feeding on roadkill (Little Eagle and Wedge Tailed Eagle)
- Frog species.

Evidence of vehicle strike was observed during surveys for this Project. Kangaroo corpses were observed at several locations along the road, with one location at the southern section considered a hotspot with several corpses were observed in the one area. William Hovell Drive is located in an area that the *ACT Kangaroo Management Plan* (Territory and Municipal Services, 2010) describes as the 'hills, ridges and buffer spaces' separating the different urban areas, as well as the reserves created from the late 1990s to protect highly significant remnants of natural temperate grassland and yellow box – red gum grassy woodland. Many of these areas are ideal kangaroo habitat and important wildlife corridors (Territory and Municipal Services, 2010). The observation of kangaroos in grassy areas and reserves surrounding the study area combined with evidence of past vehicle strike on kangaroo reflect this.

There is no existing fauna fencing or fauna specific crossing areas (under or overpasses) in the study area. This presents a risk both to existing fauna and road users.

The Superb Parrot was the only threatened species recorded in the study area. Superb Parrots are prone to being hit by vehicles on regional roads, however this is primarily when they feed on spilt grain after harvest. Additionally, they have a tendency to mourn the death of their own by gathering around the bodies. This combined with their camouflage with green grass on roadside verges and motorists' not being aware of their presence has resulted in many vehicle deaths of this species across its range.

Other threatened species recorded in the surrounding nature reserves include the Scarlet Robin, Varied Sittella, White-winged Triller and Swift Parrot. These birds have varied flight and foraging behaviours. All may use native vegetation along the road and could fly at vehicle height along sections of the road where vegetation height is in line with vehicle height. The two existing cut areas are where fauna vehicle strike is not considered to be an issue for birds as the vegetation is well above the vehicle height. Height of trees either side of the road and median strips is important as birds will fly above this vegetation when traversing across the study area. If this vegetation is higher than vehicle height, then strike is minimised. Stepping stone vegetation such as vegetated median strips are important for some smaller species to cross the road.

6.2.3 Edge effects

Edge effects relate to where ecological processes, interactions and conditions are altered along the boundary of two or more different adjoining habitats. Often at these boundaries, ecological conditions like air temperature, soil moisture or light intensity may be different to adjoining habitats. The differentiation of these conditions to may decrease the suitability of the altered habitat for native species yet increase its suitability for non-native and invasive species.

The remnant native vegetation along William Hovell Drive is currently subject to edge effects. The vegetation clearing associated with the Project will increase edge effects to the remaining vegetation. Edge effects will also be moved inward (away from the boundary of the current alignment) which is likely to increase the adverse impacts to both Kama and The Pinnacle Nature Reserves. The edge effects that will impact the remaining vegetation along William Hovell Drive may facilitate the invasion and spread of exotic species, reduce the resilience of native vegetation and change predator-prey relationships.

To help manage this, it is proposed to strategically locate dense *Lomandra Longifolia* and shrub plantings along the boundary of the Kama Nature Reserve and The Pinnacle Nature Reserve (and their buffers). This will enhance habitat connectivity whilst also reducing the spread of African Lovegrass and other invasive plant species.

As a result of the duplicated road, the area of hardstand will increase and there will be an associated minor increase in peak stormwater runoff. The Project will maintain or increase the stormwater drainage provisions to manage the surface water for events up to the one percent AEP, while also providing additional protection during and following major storm events. As such, there will be no change with regard to the risk for erosion and scour at the stormwater discharge points or potential for sediment discharge and pollution.

The existing transverse drainage systems under the proposed upgrade will be retained where practically possible to ensure consistency in the flow regime between existing and post-developed conditions. As such, there will only be a minor change in flow attenuation between the present day and post construction. The drainage plans provide the details and locations of the proposed culverts to protect the road from flooding for events up to 1% AEP.

Deep Creek is not being used as a water treatment or attenuation facility in the updated drainage design of the Project. Deep Creek will still receive runoff from the portion of the road reserve within its catchment area as it is a downstream facility. However, this runoff will not be included in its treatment volumes.

Where kerbs and gutters are provided, the stormwater runoff from the road surface will be collected in sumps which will then discharge into vegetated swales within the road verge. The proposed section of the road falls within Deep Creek catchments and the runoff from the road catchment will directed through vegetated swales for water quality treatment and eventually flow into Deep Creek. Further information is provided within the EIS Section 5.7.

Protection measures for the two nature reserves will therefore also include the erection of man proof fencing, treatment of drainage lines with sediment control, installation of sediment basins (if required during construction) and a strict 'No Entry' during construction. Any other reasonable requirements from the EPA and other Government agencies will also be implemented.

Public access directly off William Hovell Drive to the Kama Nature Reserve is no longer considered to be a safe option with the Project in place, as the William Hovell Drive road corridor will gradually hold increasing volumes of traffic under a 2031 design scenario. Parks and Conservation will work with TCCS to ensure a new Whitlam access point into the Kama Nature Reserve is available before access from William Hovell Drive is closed to the public.

6.2.4 Weeds and exotic flora

Non-native plants and exotic weeds were observed throughout the study area. The highest densities of these plants occurred in the disturbed areas adjacent to the existing roadway. The most common non-native and exotic species included *Phalaris aquatica*, *Festuca arundinacea* (Tall Fescue), *Dactylis glomerata* (Cocksfoot) and *Avena* species. Other less commonly observed species included *Echium plantagineum* (Paterson's Curse), *Hypericum perforatum* (St. John's Wort), *Eragrostis curvula* (African Lovegrass) *Rosa rubignosa* (Sweet Briar) and *Rubus fruticosus agg.* (Blackberry). These 5 less commonly observed species have all been identified in the ACT Government's Invasive Plant Control Maps and Progress Reports as occurring within or immediately adjacent to the study area. The duty/management actions for these weeds are outlined in Table 6-5.

Table 6-5: Weeds and their duty/management actions as specified in the ACT Government's Invasive plant control maps and progress reports

Weed	Duty/management action
Echium plantagineum (Paterson's Curse)	Must be contained / Herbicide: MCPA
Hypericum perforatum (St. John's Wort)	Must be contained / control method: spot spray
Eragrostis curvula (African Lovegrass)	Must be contained / Herbicide name: flupropanate; control method: spot spray
Rosa rubiginosa (Sweet Briar)	Must be suppressed / Herbicide name: glyphosate; control method: cut and paint
Rubus fruticosus agg. (Blackberry)	Must be contained / triclopyr; control method: spot spray.

The Project has the potential to increase the spread and facilitate the establishment of the weeds listed in Table 6-5 throughout the study area. The spread and establishment of these weed species is most likely to occur through:

- The movement of soil (containing seed and propagules) from machinery or introduced fill
- The spread of seed and propagules through runoff
- Colonisation of previously undisturbed areas post construction
- Increased nutrient runoff, particularly an elevation in phosphorus.

The identified exotic grasses were prevalent throughout the study area and the adjacent nature reserves. The Project is unlikely to increase their abundance within the study area however if equipment and machinery are not subject to the correct hygiene protocols these grasses may be spread elsewhere. Additionally, if hygiene protocols are not followed these grasses have the potential to spread into areas of native vegetation that have been restored (such as those proposed in Kama and The Pinnacle Nature Reserves).

6.2.5 Changes in hydrology

The Project has the potential to change the hydrology of the study area. By broadening the width of the road surface, the Project will increase the area of impervious watershed. It is expected that the upgraded design will divert this run-off away from the road via a drainage system. While beneficial to the road and its supporting infrastructure, the diversion of this water may adversely impact some areas of retained vegetation. For example, diverting water into an area of Grassy Woodland has the potential to adversely impact some of the characteristic native species yet benefit non-native species such as *Phalaris aquatica*.

A modification to surface runoff has the potential to act as a source of pollutants - such as tyre dust and hydrocarbons - to areas of retained native vegetation. Pollutant laden runoff also has the potential to drain into Deep Creek and the un-named creek running through Kama Nature Reserve. Both creeks support areas of native vegetation and run into the Molonglo River. The Project has the potential to adversely impact the areas of native vegetation supported by these creeks and the Molonglo River if it increases pollutant levels into these water bodies.

6.2.6 Invasion and spread of pests

Vertebrate pests such are already likely to be present in the study area due to the proximity to urban areas and farmland. The European Red Fox (*Vulpes vulpes*) and domestic and feral cats (*Felis catis*) are likely to roam freely throughout the study area and prey on native birds, reptiles and small mammals. Fox control is not undertaken in the Pinnacle Nature Reserve due to potential effects on non-target animals (Parks and Conservation Service, 2016).

Ground-dwelling, ground-foraging (such as birds) and tree-roosting fauna species are susceptible to predation by introduced predators such as cats (*Felis catus*) and foxes (*Vulpes vulpes*). Given the proximity to urban developments and farmland, it is likely that both these species already occupy the study area and so there is not

necessarily additional risk created by the Project and its associated vegetation clearing and provision of shared pathway routes.

The implementation of the *ACT Cat Plan 2021-31* (ACT Government, 2021) in conjunction with existing Cat Containment Areas in some of the suburbs surrounding the William Hovell Drive road reserve is likely to assist in improving these outcomes for the locality in the long-term. Updates have been made to the Project design to ensure no significant impacts to existing off-leash dog parks. The Project allows for shared paths to be constructed along its alignment. This, alongside ACT-wide rules around dog management in public spaces will also assist the potential future management of feral foxes in the area, as baiting may be able to be considered alongside responsible dog ownership measures.

Overall, it unlikely an invasive species that are harmful to the species of concern in the study area will be introduced by the Project.

Feral deer are known to occur in the region (Andrew Brown, 2021), however, are not currently recognised as a threat to the Kama or the Pinnacle Nature Reserves (Capital Ecology, December 2016); (Parks and Conservation Service, 2016). There have been changes in the movement patterns of feral deer populations recorded in the ACT since the 2019-2020 bushfire summer season (Andrew Brown, 2021). Revegetation activities at the site will be subject to monitoring to ensure the occurrence of feral animal species is not significantly hampering revegetation efforts. Fencing may be required in areas subject to grazing by herbivores (native and introduced) until plants are established.

Rabbits (*Oryctolagus cuniculus*) are known to occur in the Pinnacle Nature Reserve and undergo regular monitoring and biannual control programs (Parks and Conservation Service, 2016). Regular control programs in this reserve are likely to reduce the numbers of rabbits that occupy the study area.

Five species of introduced birds were recorded during recent surveys (Appendix A). Of particular concern are the large numbers of Common Myna (*Acridotheres tristis*) and Common Blackbird (*Turdus merula*). Both are aggressive, territorial species known to displace native woodland species from their habitat. Removal of native vegetation exacerbates this process as the introduced species thrive in disturbed habitats and are territorial and aggressive towards native birds competing for nesting sites in hollow bearing trees. A Common Myna control plan for Molonglo 3 is expected to minimise the impacts of the Common Myna on the biodiversity values of Kama Nature Reserve (Capital Ecology, 2016) and is likely to have positive flow-on effects in the study area.

During construction works, the additional noise, vibration and lighting generated by construction equipment, vehicles, human activities and the use of construction fencing are all likely to act as a deterrent to feral animal species, preventing them from colonising the site. Revegetation and offset plantings proposed as part of the Project will assist in supporting habitats which are favoured by native species, such that the Project will not result in feral species colonising land within the study area over the long-term.

6.2.7 Invasion and spread of pathogens and disease

Pathogens have the potential to spread disease throughout an ecosystem. Two pathogens that have the potential to cause disease and effect the biodiversity throughout the study area are:

- Amphibian Chytrid Fungus (*Batrachochytrium dendrobatidis*)
- Root Rot Fungus – Phytophthora (*Phytophthora cinnamomi*).

Like non-native plants, these pathogens can be spread through soil. In the case of *P. cinnamomi*, this pathogen can also be spread through infected plant material. The incidence of *P. cinnamomi* in the ACT is low and the *Offset Management Plan for the extension of the Pinnacle Nature Reserve* states there are no records of *P. cinnamomi* within the Offset Area or surrounding landscape (Parks and Conservation Service 2016). The Amphibian Chytrid Fungus may also be spread between infected animals by water. Given that permanent water bodies are absent from the study are, chytrid is unlikely to be present.

Psittacine Beak and Feather Disease (PBFD) is a disease affecting Australian parrot species and listed as a key threatening process under the EPBC Act. Threatened parrots, including the Superb Parrot, are at risk of contracting the disease. Increased competition for nesting habitat by the removal of hollow-bearing trees increases interactions between birds and therefore increase the risk of spread of PBFD (DoE 2015). It is unknown if the disease is present within local populations of parrots that occupy the study area. However, it is unlikely that the Project will result in the introduction of PBFD to the study area.

It is important that hygiene protocols – such as the cleaning of equipment and machinery prior to use on site – be followed. Hygiene protocols to prevent the introduction and spread of these two pathogens in the study area are outlined in Section 7.2.

6.2.8 Noise, light and vibration

The study area is already subject to noise, vehicle light and vibration from traffic along William Hovell Drive .

Fauna habitat in the immediate vicinity of the study area is considered to be sub-optimal habitat for most fauna species for these reasons. However, it does provide good stepping-stone habitat for fauna moving through the landscape.

There is no existing lighting along the length of the study area or underpasses. Exiting lighting occurs at the north and south end of the study area where the roads meet the suburbs of Hawker and Whitlam. The current unlit underpasses may be utilised by mammals to cross from one side of William Hovell Drive to the other, providing some form of wildlife crossing between the east and west of the road and surrounding habitat.

Artificial light is known to adversely affect many species and ecological communities (Commonwealth of Australia, 2019). It can change behaviour and/or physiology, reducing survivorship or reproductive output (Commonwealth of Australia, 2019). It can also have the indirect effect of changing the availability of habitat or food resources. It can attract predators and invasive pests, both of which may pose a threat to listed species (Commonwealth of Australia, 2019).

There will be a notable increase in light from the installation of lights at approximately 65m intervals along the widened road alignment road. Additionally, two of the three underpasses will be upgraded including the addition of three 30 Watt LED strip lights per underpass. This will most likely deter mammals from utilising these structures for crossing as most mammals are nocturnal and the presence of light will make them more susceptible to predators (Bhardwaj M., Soanes K., Lahoz-Monfort JJ., Lumsden LF., van der Ree R., 2021). This increase in lighting may also alter movement and foraging behaviour of nocturnal mammals and birds that occur in the locality.

However, as set out within EIS Section 5.3.3.7 and EIS Appendix I, the Spill Light Assessment has established that, with the exception of the area between chainage 2,320 and 2,440, the average horizontal illumination level is below the level of full moonlight (0.27 maximum lighting levels or lux). At the Kama Nature Reserve boundary, between chainages 2,320 and 2,440, the light penetration for values over 0.27 lux extends 15m. In all other locations, this penetration is less than 10m beyond the boundary. Further details about how lighting can positively impact on certain species by attracting insects to feed on is set out in the EIS Section 5.2.3.3.

Overall, it is therefore considered that the additional lighting introduced into the locality as a result of the Project will not generate significant impacts for species, and no specific mitigation measures are considered necessary to mitigate such impacts.

Traffic noise levels were calculated to increase naturally by 0.3dBA by 2031 if the road upgrade did not occur. The increase as a result of the project is generally less than 1dBA at most receptors modelled by the William Hovell Drive Duplication: Road Traffic Noise Assessment (SLR, 2021 – refer to EIS Section 5.5 and EIS Appendix F). Receptors in this study are generally residences a moderate distance from the roadway in the suburb of Hawker already subject to between 53 and 60dBA. Varied topology of the landscape alters the extent of areas subject to increases noise exposure, however the outward shift in area subject increase in noise exposure as shown in the noise contour mapping models, is similarly minor as sound pressure (dBA) falls with the simple inverse of distance, and intensity falls with the inverse square of distance. In keeping with the conclusion for human dwellings it is reasonable to conclude that there are no significant noise impacts associated with the project, except for a minor shift in habitat suitability away from the road alignment expected for sound sensitive species. “Road-effect-zones,” areas where habitat suitability is degraded for certain types of fauna, is partially a result of traffic noise and vibration. Microbats are known to be particularly effected. In a Victorian freeway study, reduced habitat for bats spanned an average of 307m outwards from the freeway for 10 species of microbat, while the largest road-effect zone was 890m for one species (Bhardwaj M., Soanes K., Lahoz-Monfort JJ., Lumsden LF., van der Ree R., 2021).

6.3 Cumulative impacts

A cumulative impact assessment considered the combined effects of projects occurring within the same locality or region, where each impact has been assessed individually.

Table 6-6 provides a summary of the projects recently or currently being undertaken in the vicinity of William Hovell Drive and their associated impacts on biodiversity. Projects were identified from the ACT Government Directorate Planning website for EIS and EIS exemptions. It should be noted that only key projects have been included within the assessment. Furthermore, for some projects, there is no publicly available information about the extent of the construction and operational impacts of the project, or they are yet to be determined.

Table 6-6: Summary of nearby projects and associated impacts

Project	Proximity to study area	Impact summary
John Gorton Drive Stage 3C (Jacobs 2019)	1.5 kilometres south of the study area on the Molonglo River	Clearing approximately 2.5 hectares Box-Gum Woodland TEC in low to moderate condition Loss of less than one hectare of high quality Pink-tailed Worm-lizard habitat Loss of hollow-bearing trees
John Gorton Drive Stage 3A (Calibre 2018)	Overlaps with the eastern end of the study area	Part of the Molonglo Valley Strategic Assessment Area
Molonglo Valley Stage 3 Urban Development	800 hectares immediately south of the study area, also bounded by the Molonglo River to the south, the Tuggeranong Parkway and National Arboretum to the east and Kama Nature Reserve to the west	Clearing 43 hectares of native vegetation including Box Gum Woodland and Natural Temperate Grassland TECs Loss of hollow-bearing trees Habitat loss for Pink-tailed Worm-lizard, woodland birds, Hoary Sunray and Tarengo Leek Orchid
Molonglo Valley Stage 3 - Deep Creek Corridor Regional Water Quality Pond	South of the study area within the Molonglo Valley Stage 3 Urban Development site	The project area will impact on 0.76 hectares of low quality habitat, 3.47 hectares of moderate and 0.03 hectares of high quality Pink-tailed Worm-lizard habitat.
Molonglo Stage 3 Transmission Line Relocation (Umwelt 2019)	Part of the project overlaps with the southern extent of the current project area and continues west of Coulter Drive. Additional areas south of the study area in the Molonglo River valley near the Tuggeranong Parkway	Loss of up to 5.9 hectares of White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grasslands Impacts to potential Golden Sun Moth and Perunga Grasshopper habitat

Most projects occurring in the region have some impact on the threatened White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grasslands vegetation community and require the removal of habitat for threatened flora and fauna. Combined, these impacts are likely to contribute to the local extinction of these populations and communities.

6.4 Assessments of significance

6.4.1 Threatened species and ecological communities listed under the EPBC Act

Assessments of significance for EPBC listed threatened entities with a higher than a moderate likelihood of occurring the study area are provided in Appendix C and are summarised in Table 6-7.

Table 6-7: Summary of EPBC Act assessments

Scientific Name	Common Name	Status	Direct impacts	Indirect impacts	Significant impact?
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland		Critically Endangered under the NC Act and the EPBC Act	The Project will directly clear 6.41 hectares of this Box-Gum Woodland TEC therefore reducing its extent in the locality. Under the National Recovery Plan for the community all areas of Box-Gum Grassy Woodland which meet the minimum condition criteria should be considered critical to the survival of this ecological community. Clearing of 6.41 hectares in extent and habitat. The Project, including the proposed Offset Management Strategy, is not inconsistent with Threat Abatement Plans in place for this community.	The Project will increase the distance separating stands of this Box Gum Woodland TEC bisected by the existing road such as those occurring on the edges of Kama and The Pinnacle Nature Reserves. The existing roadway already constitutes a significant fragmentation of such patches. Widening constitutes a relatively marginal increase in fragmentation. Increased fragmentation The potential of increased nutrient levels in runoff, and a potential increase in surface water will favour some invasive species – such as *Phalaris aquatica* – thereby promoting their establishment within the study area. The increased traffic of plant, equipment and people during the construction may spread new non-native flora and weeds into the study area. These weeds may then be spread throughout the study area and into Kama and The Pinnacle nature reserves. The Project has the potential to spread pollutants and chemicals – such as hydrocarbons and tyre dust from cars – via a modified drainage system. These chemicals and pollutants are also likely to increase with greater traffic on William Hovell Drive. The increased traffic of plant, equipment and people during the construction may spread new non-native flora and weeds. The Project has the potential to spread pollutants and chemicals – such as hydrocarbons and tyre dust from cars – via a modified drainage system. These chemicals and pollutants are also likely to increase with greater traffic on William Hovell Drive. Changes to hydrological environment Potential increase in pollutants.	Yes

Scientific Name	Common Name	Status	Direct impacts	Indirect impacts	Significant impact?
Leucochrysum albicans var. *tricolor*	Hoary Sunray	Endangered under the EPBC Act	The Project will clear thirteen individuals of this species. As the species is a short-lived perennial, it is not known how many more seasons each of these individuals would have persisted at this location without clearing works to support the Project, before they would have died back and been replaced by the next generation (which is propagated by seed dispersal). The Project will also clear 10.9 hectares of potential habitat, including 6.46 hectares of Grassy Woodland, 0.03 hectares of Native Grassland and 4.41 of Planted Native habitat. All these communities have been assessed as the 'area of occupancy' for L. albicans var. tricolor within the study area.13 individuals cleared The 10.9 hectares of habitat (area of occupancy) within the study area, and the 13 individuals known to be removed as part of the project, are unlikely to be critical to the survival of the species or the population. 10.9 hectares of habitat cleared The removal of this available habitat could cause the population to decline. However, the National Recovery Plan for this species does acknowledge that some disturbance is required for successful establishment and seedlings often appear on areas that have been scraped. The species has been observed recruiting on scraped road edges in the ACT. Monitoring of newly created road verges as created by the Project and adaptive management to limit mowing or encourage recruiting specimens could have the potential to align with Recovery Plan if implemented. The Project, including the proposed Offset Management Strategy, is not inconsistent with Threat Abatement Plans in place for this species.	Currently, individuals of this species occurring on different sides of William Hovell Drive are able to interact with each other as pollinators and the dispersal of seed is likely able to cross the existing alignment. The widening of the road corridor is unlikely to completely prevent seed dispersal and pollinators crossing the road. As such, the Project is unlikely to fragment the existing population in to two or more smaller populations. Minor impediments to seed dispersal and pollination The species is adversely impacted from the competition of non-native and invasive flora species. Non-native grasses such as Phalaris aquatica and Festuca arundinacea (Tall Fescue) were commonly observed throughout the study area. It is unlikely that the Project will further increase the occurrence of these species. It is also important to note that the individuals recorded in the study area were growing along a ridge line with thinner soils. The recorded invasive grasses are less likely to become established in this type of habitat, preferring wetter habitat with higher nutrient levels and deeper soil.	No
Pteropus poliocephalus	Grey-headed Flying-fox	Vulnerable under the NC Act and the EPBC Act	Removal of 6.41 hectares of foraging habitat (Grassy Woodland). The Project study area, or the locality in general, is not critical habitat for the Grey-headed Flying-fox because it is not highly productive during winter and spring, there are not >30,000 individuals within a 50km radius. The Grey-headed Flying-fox would only be present in the locality during flowering events. Important foraging resources in the Project study area are likely to include Blakely's Red Gum (*Eucalyptus blakelyi*) and Yellow Box (*E. melliodora*) typical of Box-Gum Grassy Woodlands. The Project will entail the loss of 6.4 hectares of this habitat in an area of generally low tree density. There are 12.7 hectares of this habitat type in the study area. This area of habitat (which represents the maximum possible impact) would only support a small number (<10) individuals even during significant flowering events. Thus,	The Grey-headed Flying-fox is a highly mobile species capable of extensive landscape-scale movements. The Project is not likely to cause the population to fragment. Increased fragmentation and disruptive inputs to foraging behaviour While it is likely that lactating females are sometimes likely to feeding in the study area, the Project is not likely to disrupt the breeding cycle of the Grey-headed Flying-fox. The Project will not result in the establishment of invasive species harmful to the Grey-headed Flying-fox. The Project will not introduce disease harmful to the Grey-headed Flying-fox. The Project is not likely to interfere with the National Recovery Plan for the Grey-headed	No

Scientific Name	Common Name	Status	Direct impacts	Indirect impacts	Significant impact?
			the Project is unlikely to result in the long-term decrease in the size of an important population of the Grey-headed Flying-fox The removal of this habitat is not expected to reduce the area of occupancy of the ACT population of Grey-headed Flying-fox. The Project, including the proposed Offset Management Strategy, is not inconsistent with Threat Abatement Plans in place for this species.	Flying-fox because it does not affect critical foraging or roosting habitat.	
Polytelis swainsonii	Superb Parrot	Vulnerable under the NC Act and the EPBC Act	Removal of 6.41 hectares of foraging habitat (Grassy Woodland) and seven (7) hollow-bearing trees as potential breeding habitat The Project will require the removal of 10.87 hectares of potential Superb Parrot habitat along a major road, primarily feeding and foraging habitat. The removal of this habitat is not expected to reduce the area of occupancy of the ACT population of Superb Parrots. The Superb Parrot breeds in tree hollows with specific dimensions, most often in Blakely's Red Gums. Seven potential breeding hollows for this species will be removed. Despite the presence of hollow-bearing trees, some of which may have suitably sized hollows, the Superb Parrot is unlikely to breed within the study area due to its proximity to the road corridor. It is recommended that the size of these hollow entrances which could potentially support Superb Parrot breeding be confirmed and considered as part of the Draft Offset Strategy and final Offset Management Plan. This will establish whether any compensatory nest box habitat needs to be established for this species. The Project, including the proposed Offset Management Strategy, is not inconsistent with Threat Abatement Plans in place for this species.	Increased fragmentation and disruptive inputs to foraging behaviour. Given that the species is known to fly distances of around 9km, it is considered that the Project will not have any long-term impacts on the local movement of this species across the William Hovell Drive road corridor as it crosses to access a range of habitat features. Although the widening of William Hovell Drive may increase collision risk, it is unlikely to fragment any important population of the species. Ground foraging activities of the Superb Parrot make them susceptible to predation by introduced predators such as cats (Felis catus) and foxes (Vulpes vulpes). Given the proximity to urban developments and farmland, it is likely that both these species already occupy the study area and so there is not necessarily additional risk created by the Project. The implementation of the ACT Cat Plan 2021-31 in conjunction with existing Cat Containment Areas in some of the suburbs surrounding the William Hovell Drive road reserve is likely to assist in improving these outcomes for the locality in the long-term. Updates have been made to the Project design to ensure no significant impacts to existing off-leash dog parks. The Project allows for shared paths to be constructed along its alignment. This, alongside ACT-wide rules around dog management in public spaces would also assist the potential future management of feral foxes in the area, as baiting may be able to be considered alongside responsible dog ownership measures. It is unlikely an invasive species that are harmful to the Superb Parrot will be introduced by the Project. Psittacine Beak and Feather Disease (PBFD) is a disease affecting Australian parrot species and	No

Scientific Name	Common Name	Status	Direct impacts	Indirect impacts	Significant impact?
				listed as a key threatening process under the EPBC Act. Threatened parrots, including the Superb Parrot, are at risk of contracting the disease. Increased competition for nesting habitat by the removal of hollow-bearing trees increases interactions between birds and therefore increase the risk of spread of PBFD (DoE 2015). It is unknown if the disease is present within local populations of parrots that occupy the study area. However, it is unlikely that the Project will result in the introduction of PBFD to the study area. No other diseases are known to affect the Superb Parrot.	
Lathamus discolor	Swift Parrot	Swift Parrot	Vulnerable under the NC Act and Critically Endangered under the EPBC Act	The Swift Parrot occurs as a single population across its range. Small numbers of Swift Parrots are known to regularly occur in the ACT. The Project study area supports known foraging resources (Yellow Box and likely Blakely's Red Gum) at a low tree density due to previous partial clearing. However, the Project study area is not recognised as priority habitat for the species. The Projectproposal willould result in the loss of a relatively small area of low quality (i.e. low tree density) foraging habitat (10.87 ha). This extent of non-breeding habitat clearing in a marginal part of its range would not cause the Swift Parrot population to decline. The Project would require the removal of 10.87 hectares of Swift Parrot foraging habitat along a major road. The removal of this habitat is not expected to reduce the area of occupancy of the Swift Parrot population. Habitat critical to the survival of the Swift Parrot (the analogue of Priority Habitat) is not present in the project study area. The Project, including the proposed Offset Management Strategy, is not inconsistent with Threat Abatement Plans in place for this species.	No
Anthochaera phrygia	Regent Honeyeater	Endangered under the NC Act and Critically Endangered under the EPBC Act	Removal of 10.88 hectares of foraging habitat (Grassy Woodland Planted Native and Planted River She-oak Riparian Forest). The Project study area supports known foraging resources (Yellow Box and likely Blakely's Red Gum) at a low tree density due to previous partial clearing. While the Regent Honeyeater is known to breed, at least occasionally, in the ACT, it is unlikely that the timid Regent Honeyeater would breed in the Project study area due to current levels of disturbance arising from the operation of the existing road.	Increased fragmentation and disruptive inputs to foraging behaviour. The Regent Honeyeater is a highly mobile species capable of extensive landscape-scale movements. The Project is not likely to cause the population to fragment. As it is unlikely that the Regent Honeyeater would breed in the Project study area, the Project will therefore not, therefore, impact on the breeding cycle of the Regent Honeyeater.	No

Scientific Name	Common Name	Status	Direct impacts	Indirect impacts	Significant impact?
			However, the definition of habitat critical to the survival of the Regent Honeyeater merely requires the presence of foraging habitat; there is no threshold for the intensity of foraging activity (i.e. frequency of use or numbers present). Given that the species could potentially forage in the Project study area, it is therefore critical habitat (it is noted that, as per the National Recovery Plan, all known and potential foraging habitat for the Regent Honeyeater must be regarded as critical habitat). Despite the potential presence of critical habitat, the Project will result in the loss of a relatively small area (10.88 ha) of low quality (i.e. low tree density) foraging habitat as Grassy Woodland (6.46 ha), Planted Native (4.41 ha) and Planted River She-oak Riparian Forest (0.01 ha). This extent of non-breeding habitat clearing in a marginal part of its range will not cause the Regent Honeyeater population to decline or reduce the area of occupancy of the species. The Project, including the proposed Offset Management Strategy, is not inconsistent with Threat Abatement Plans in place for this species.	Habitat fragmentation is known to alter habitats in a way that favours the Noisy Miner, a recognised threat to the Regent Honeyeater. Due to existing levels of habitat fragmentation and partial canopy removal, it is likely that the Noisy Miner is already present in the study area. While the Project will cause further clearing, in light of the preceding it is unlikely that the Project will result in the establishment of invasive species harmful to the Regent Honeyeater. The Project will not introduce disease harmful to the Regent Honeyeater.	
Hirundapus caudacutus	White-throated Needletail	Vulnerable under the NC Act and the EPBC Act	It is likely that the White-throated Needletail will occasionally to rarely forage over the study area. Given the presence of two nature reserves near this area, it is likely that the terrestrial habitat provides some flying insects that will be consumed by the White-throated Needletail. However, the amount of habitat in the study area is not likely to be a limiting factor for the White-throated Needletail population and this habitat is not regarded as habitat critical to the survival of the White-throated Needletail. The area of occupancy of the White-throated Needletail is estimated to be 126,200km^2. The vegetated (native and exotic) area of the Project clearing footprint is 19.85 hectares (i.e. 0.198km^2). Thus, the Project will not reduce the area of occupancy of an important population of the White-throated Needletail. It is unlikely that the Project will directly or indirectly reduce the size of the Australian White-throated Needletail population. Unlikely direct impacts The Project, including the proposed Offset Management Strategy, is not inconsistent with Threat Abatement Plans in place for this species.	Removal of 19.85 hectares of vegetation that may be a minor or indirect source of flying insects consumed. However, lighting installed as part of the Project's design is likely to act as an insect attractant, ensuring that suitable food sources remain for the species in this locality. The White-throated Needletail is a migratory species capable of very long distance movements and can forage over a range of habitat types. The Project will not fragment the White-throated Needletail population. The White-throated Needletail breeds in Asia and Siberia. The Project will not affect breeding by this species. No invasive species are known to be harmful to the White-throated Needletail. The Project will not introduce disease harmful to the White-throated Needletail.	No
Aprasia parapulchella	Pink Tailed Worm Lizard (PTWL)	Endangered under the NC Act and Vulnerable under the EPBC Act	0.16 ha of rocky habitat in grasslands or grassy woodland communities. The sites' proximity to the Molonglo River corridor, as well as its slope and drainage qualities increase its candidacy for PTWL habitat. Much of the study area falls into vegetation categories including	Increased fragmentation and disruptive inputs to foraging and breeding behaviour Marginal increase in potential for vehicle strike. The Project will not introduce disease harmful to the PTWL.	Potentially

Scientific Name	Common Name	Status	Direct impacts	Indirect impacts	Significant impact?
			primary and secondary grassland, or grassy woodland communities. Two very small patches of treeless rocky outcrop, likely to support scattered, loosely embedded rocks, were mapped on site (0.044 ha, 0.005 ha). The larger patch fell within Box Gum Woodland where native grasses (notably kangaroo grass *Themeda triandra*) were present. The smaller patch was surrounded by dense exotic grassland. No assessment of associated ant activity was carried out. Overall, within the locality, significant patches of suitable habitat have been identified. Precautionarily, the exposed rock created by the road cuttings, has been assessed as potential habitat for PTWL. While there is very limited vegetation directly associated with the road cuttings, and the rock does not show clear significant weathering, and may have limited loosely embedded rock, the habitat has been precautionarily assessed as marginal. 0.16 ha of rocky habitat in grasslands or grassy woodland communities will be impacted by the Project. The Project, including the proposed Offset Management Strategy, is not inconsistent with Threat Abatement Plans in place for this species.		
Delma impar	Striped Legless Lizard	Vulnerable under the NC Act and the EPBC Act	The Striped Legless Lizard was subject to a habitat assessment rather than directly surveying for the species. Habitat critical to the survival of the Striped Legless Lizard is present in the study area. This consists of a mixture of box-gum grassy woodland with a low tree density, native grassland and exotic grassland totalling 15.43 hectares within the construction footprint. The Project has the potential to directly reduce the size of this important population due to habitat clearing and indirectly by exacerbating habitat fragmentation. The area of occupancy of the Striped Legless Lizard is not known. The Project will require the permanent removal of 15.43 hectares of Striped Legless Lizard habitat along a major road. Thus, the Project has the potential of reduce the area of occupancy of an important population of the Striped Legless Lizard. However, as this area of suitable habitat which will be removed is in a marginal part this species' range, it is not sufficient to cause the species to decline. The Project, including the proposed Offset Management Strategy, is not inconsistent with Threat Abatement Plans in place for this species.	The study area supports habitat critical to the survival of the Striped Legless Lizard. While there is already habitat fragmentation due to the existing road, the road duplication will increase the intensity of the existing habitat fragmentation by creating a wider road corridor. It is unknown whether the species will use fauna underpasses. While it is likely that the Striped Legless Lizard will breed in the study area, the Project is not likely to disrupt the breeding cycle of the Striped Legless Lizard. Predation is regarded as a potential threat to the Striped Legless Lizard. Introduced predators (e.g. foxes, cats and dogs) are already be present in the locality. Thus, the Project will not result in the establishment of invasive species harmful to the Striped Legless Lizard. The Project will not introduce disease harmful to the Striped Legless Lizard.	No

Scientific Name	Common Name	Status	Direct impacts	Indirect impacts	Significant impact?
Synemon plana	Golden Sun Moth	Vulnerable under the EPBC Act and Endangered under the NC Act	The Project will result in the removal of 0.06 hectares of marginal habitat immediately adjacent to the existing road. This habitat is unlikely to be occupied by the Golden Sun Moth due to the infrequent mowing and absence of grazing to control growth of grasses (unpublished observations, A. Rowell 2021). Native grasses mostly occurred amongst eucalypts, where GSM are generally not found. The nearest known population of GSM occurs approximately 750 metres west of the study area. The Project is unlikely to have any indirect impacts on this population due to the distance between the sites. Given that no areas of known habitat will be removed as a result of the proposal, and GSM are considered not likely to occur within the small areas of marginal habitat adjacent to the existing road, the Project is considered unlikely to lead to a long-term decrease in the size of a population. No critical habitat has been specified for GSM within significant impact guidelines for the species. It is considered that habitat enabling breeding is critical to its survival. Vegetation within the study area does not constitute suitable breeding habitat for the GSM and is unlikely to be occupied. As there is no recorded population within the Study Area, land clearing and earthworks to support the Project are not anticipated to result in direct impacts to Golden Sun Moths over-wintering in underground tunnels. The Project, including the proposed Offset Management Strategy, is not inconsistent with Threat Abatement Plans in place for this species.	The proposed Offset Management Strategy, though not directed towards the establishment of Golden Sun Moth habitat, will benefit local populations of this species by providing habitat enhancement. The species is diurnal and so night lighting proposed as part of the Project is not expected to impact local populations of Golden Sun Moth. Minor changes to the acoustic environment (i.e. differences of up to 2dB(A)) will not significantly impact local populations of this species. It is unlikely that the Project will result in an increase in the presence and/or establishment of invasive species which may impact the GSM. Weeds that negatively affect GSM habitat are already present and will be subject to mitigation strategies to avoid spread. No invasive fauna species are considered a threat to the GSM. The proposal is unlikely to introduce disease that may lead to declines of this species. The Significant Impact Guidelines for the species do not reference any diseases that affect the GSM. No Recovery Plan has been prepared for the GSM and the site is not subject to any targeted recovery actions. The Project is unlikely to interfere with the recovery of the species.	

6.4.2 Migratory species listed under the EPBC Act

The Protected Matters Database search identified 14 migratory species listed under international agreements with the potential to occur on the site. None were found to be subject to more than a low likelihood of any impact as shown in Table 6-8, and are therefore do not require further test of significance. The criteria use by the EPBC Act to determine a significant impact to a Migratory species is as follows:

An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:

- Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species
- Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species, or
- Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.

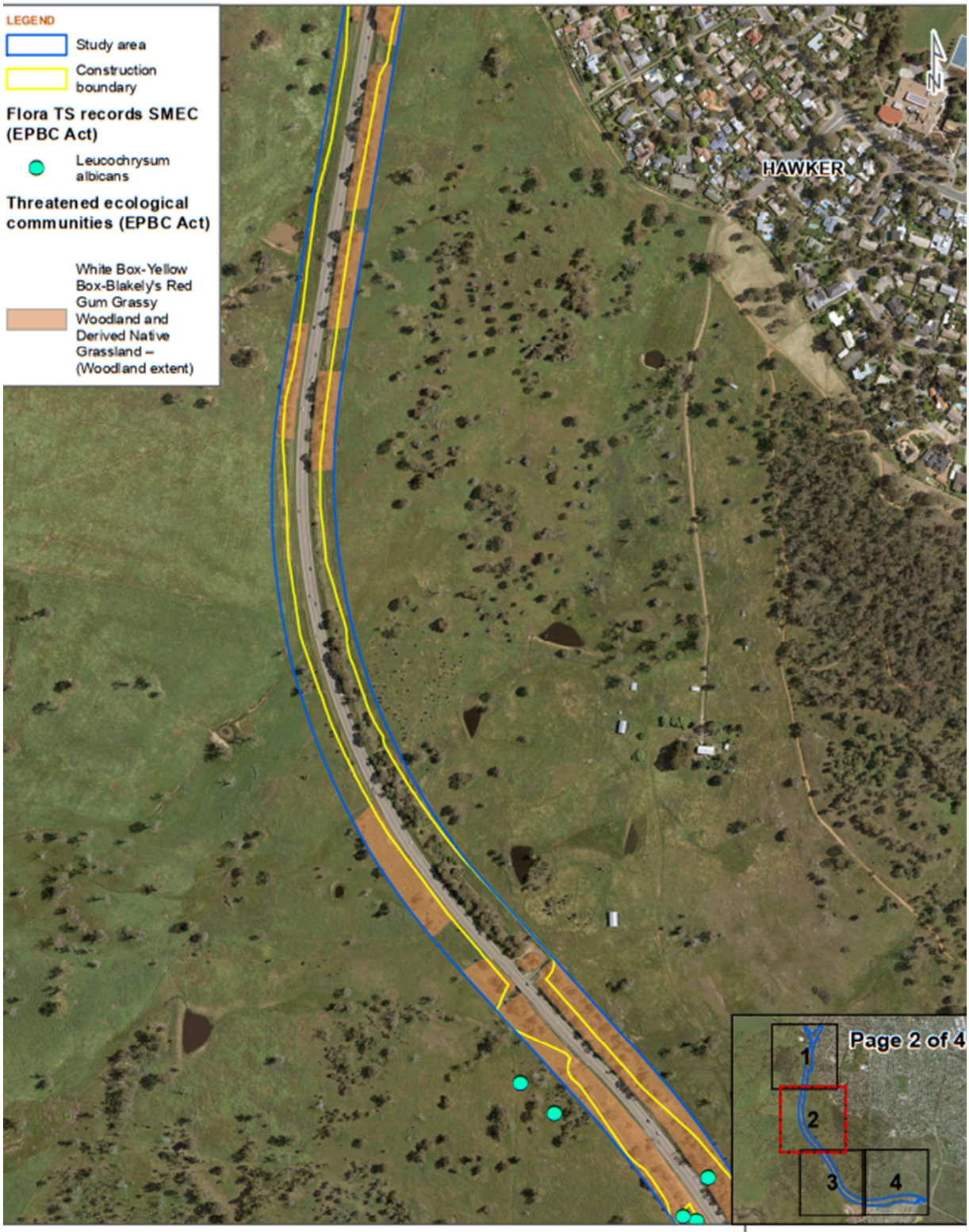
The following eight Wetland migratory species were all given negligible likelihood of being impacted due to the lack of substantial wetland habitat on or in proximity to the Project site: *Actitis hypoleucos* (Common Sandpiper), *Calidris acuminate* (Sharp-tailed Sandpipe), *Calidris ferruginea* (Curlew Sandpiper), *Calidris melanotos* (Pectoral Sandpiper), *Gallinago hardwickii* (Latham's Snipe*), Limosa lapponica* (Bar-tailed Godwit), *Numenius madagascariensis*, (Eastern Curlew) and *Pandion haliaetus* (Osprey).

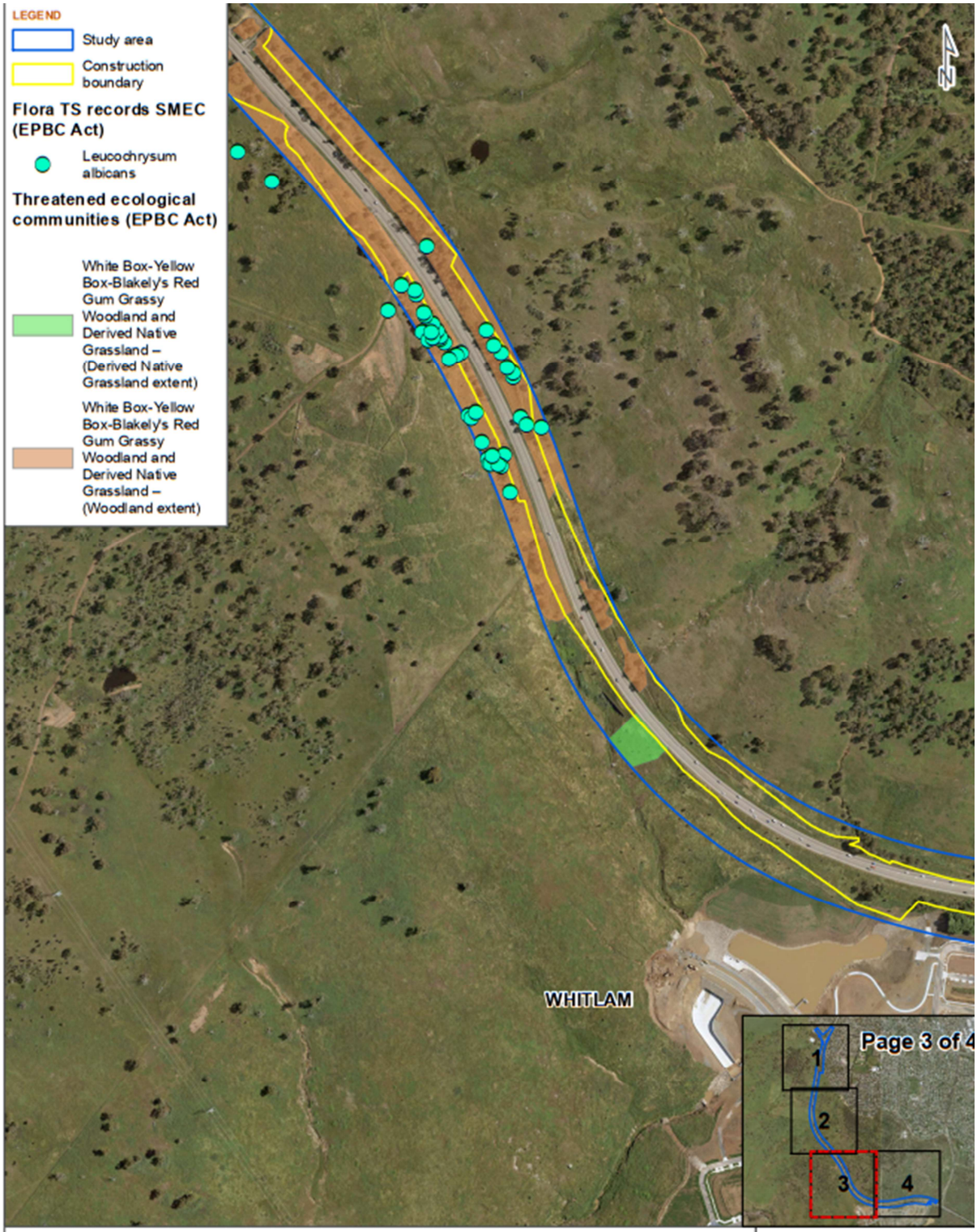
Table 6-8 EPBC listed migratory species considered for likelihood of impacts:

Scientific Name	Common Name	EPBC Act status	Direct impacts	Indirect impacts	Significant impact?
Apus pacificus	Fork-tailed Swift	-	Very unlikely – no breeding habitat in Australia	Negligible impact to aerial feeding range.	No
Hirundapus caudacutus	White-throated Needletail	V	Very unlikely – no breeding habitat in Australia	Negligible impact to aerial feeding range.	No
Monarcha melanopsis	Black-faced Monarch	-	Very unlikely – lack of rainforest or suitable mesic habitat.	Unlikely – lack of rainforest or mesic habitat in proximity	No
Motacilla flava	Yellow Wagtail	-	Low likelihood – No breeding habitat and presence is unknown in ACT (ALA)	Low – presence in ACT possible but unknown.	No
Myiagra cyanoleuca	Satin Flycatcher	-	Low likelihood - prefers well-wooded wet sclerophyll forest. Some potential to use grassy woodland. One sighting record approximately 10km away near Cotter dam.	Low likelihood – few indirect impacts to adjacent woodland.	No
Rhipidura rufifrons	Rufous Fantail	-	Very unlikely - primary foraging and breeding habitat wet sclerophyll forest with dense shrubby understory. Drier woodland is occasionally seen to host migrating birds on passage.	Low likelihood – Woodland adjacent to the Project could provide possible passage habitat	No



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LEGEND
Study area
Construction boundary
Flora TS records SMEC (EPBC Act)
Leucochrysum albicans
Threatened ecological communities (EPBC Act)
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland – (Woodland extent)
HAWKER
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Page 2 of 4
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DATE 31/03/2021
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Metres
PAGE SIZE A4
COORDINATE SYSTEM GDA 1994 MGA Zone 55
FIG NO. 5-3
FIGURE TITLE Matters of National Environmental Significance
PROJECT NO. 3002750
PROJECT TITLE William Hovell Drive Duplication
CREATED BY JT14432
SOURCES : Roadnet MDS 2019, Metromap Tile Service © Aerometrex 2020, SMEC 2021, ACT Vegetation Map 2018, © ACT Government 2018
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LEGEND
Study area
Construction boundary
Flora TS records SMEC (EPBC Act)
Leucochrysum albicans
Threatened ecological communities (EPBC Act)
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland – (Derived Native Grassland extent)
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland – (Woodland extent)
WHITLAM
Page 3 of 4
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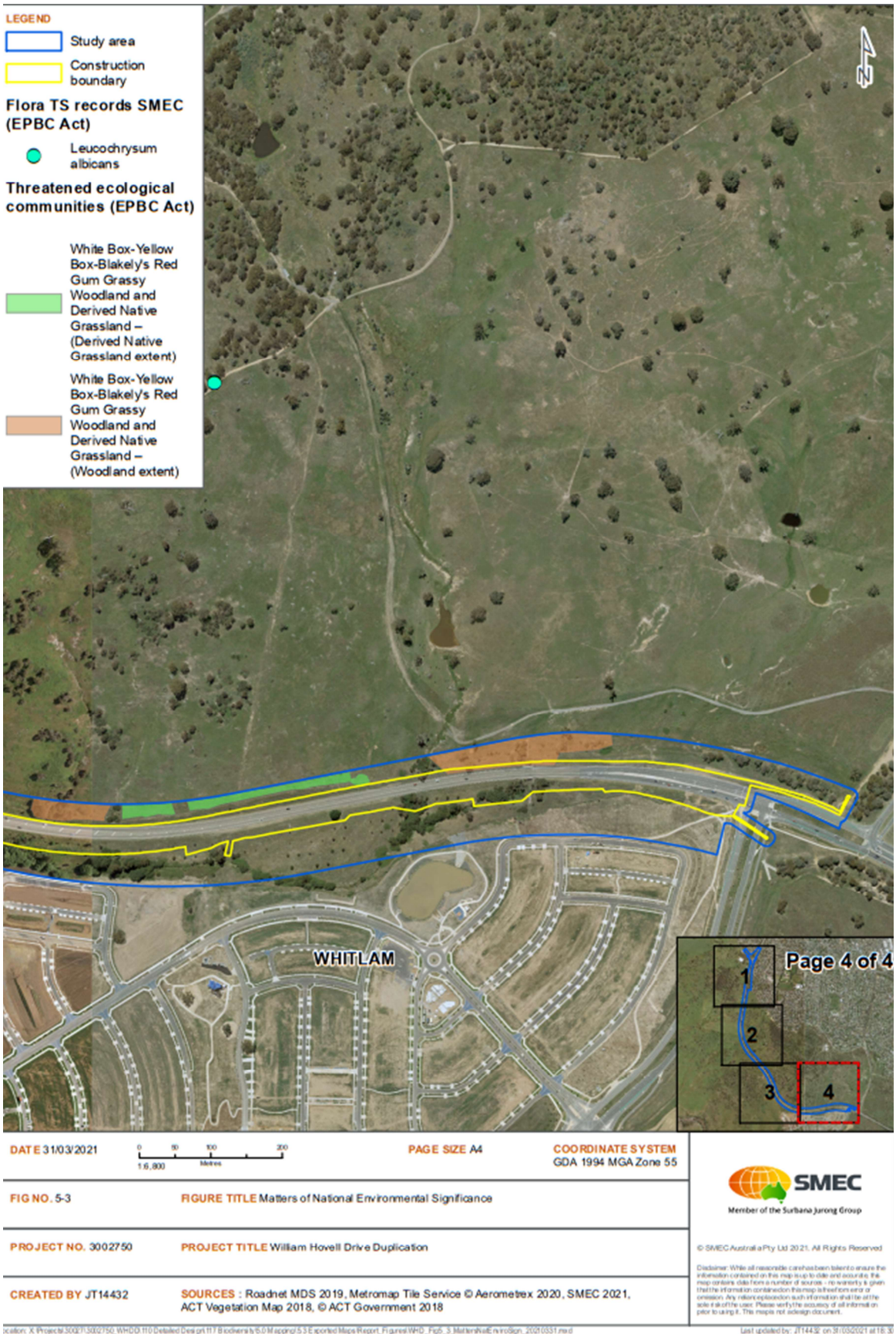


Figure 6-1 Impacts on MNES listed species habitat

7 Avoidance, minimisation and mitigation measures

7.1 Avoidance and minimisation

An environmental assessment was completed to investigate the potential biodiversity impacts of the Project. The proposed alignment of the road duplication has been used to calculate the potential vegetation clearing using a worst case scenario. The amount of vegetation clearing is expected to be about 6.76 hectares.

The safeguards and management measures detailed in this report will be implemented to minimise the impacts of the road duplication on the ecology of the study area. These safeguards and management measures will be incorporated into a Construction Environmental Management Plan (CEMP) to be implemented for construction. A CEMP must be developed by the proponent prior to construction that appropriately provides measures to minimise and avoid potential impacts and provides contingency measures should they occur. The CEMP must be implemented during the construction phase.

7.2 Mitigation and safeguards

The approach to minimising fragmentation, improving connectivity and reducing the incidence of roadkill events that is being incorporated into the Project's design is:

- One fauna crossing (rope bridge) to assist arboreal and avifauna to safely cross the road reserve
- Two fauna crossings (box culverts) to assist ground-dwelling fauna to safely cross the road reserve These will be designed to be used by various wildlife .

Some batters will be laid back to allow Kangaroos and Wallabies to escape the roadway and back into the Kama and The Pinnacle Nature Reserves. However, exclusion fencing (1.8 m tall chainmesh fence) will be included on each side of William Hovell Drive in the vicinity of the nature reserves, extending at least 200m past the fauna crossings. Exclusion fencing (1.8 m tall chainmesh fence – refer to Figure 7-1 below) to be included on each side of William Hovell Drive in the vicinity of the nature reserves, extending at least 200m past the fauna crossings. This will assist in reducing the risks to native and non-native fauna from being injured or killed by road traffic. It will also improve the safety of road users by decreasing the risks of vehicle collision with large fauna species. The effectiveness of this exclusion fencing will be monitored during the operational stage of the Project.

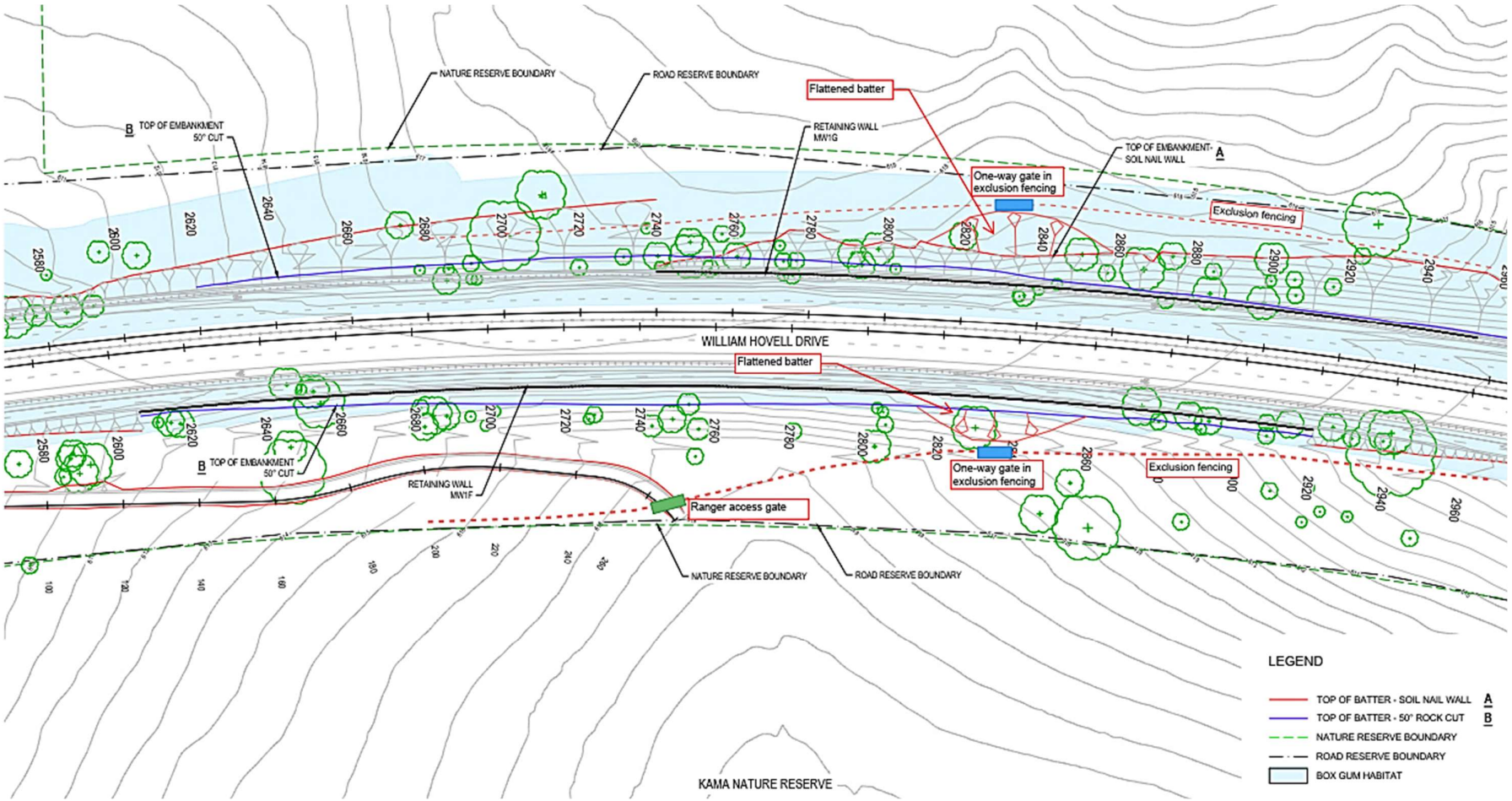


Figure 7-1: Proposed exclusion fencing and gates

TCCS and SMEC have met with the Conservator and agreed a pathway forward to achieving a Draft Offset Strategy and final Offset Management Plan for the Project. This is based on the first choice of offset being located to the west of Kama Nature Reserve. The following key points have been established regarding this Draft Offset Strategy between TCCS and the Conservator:

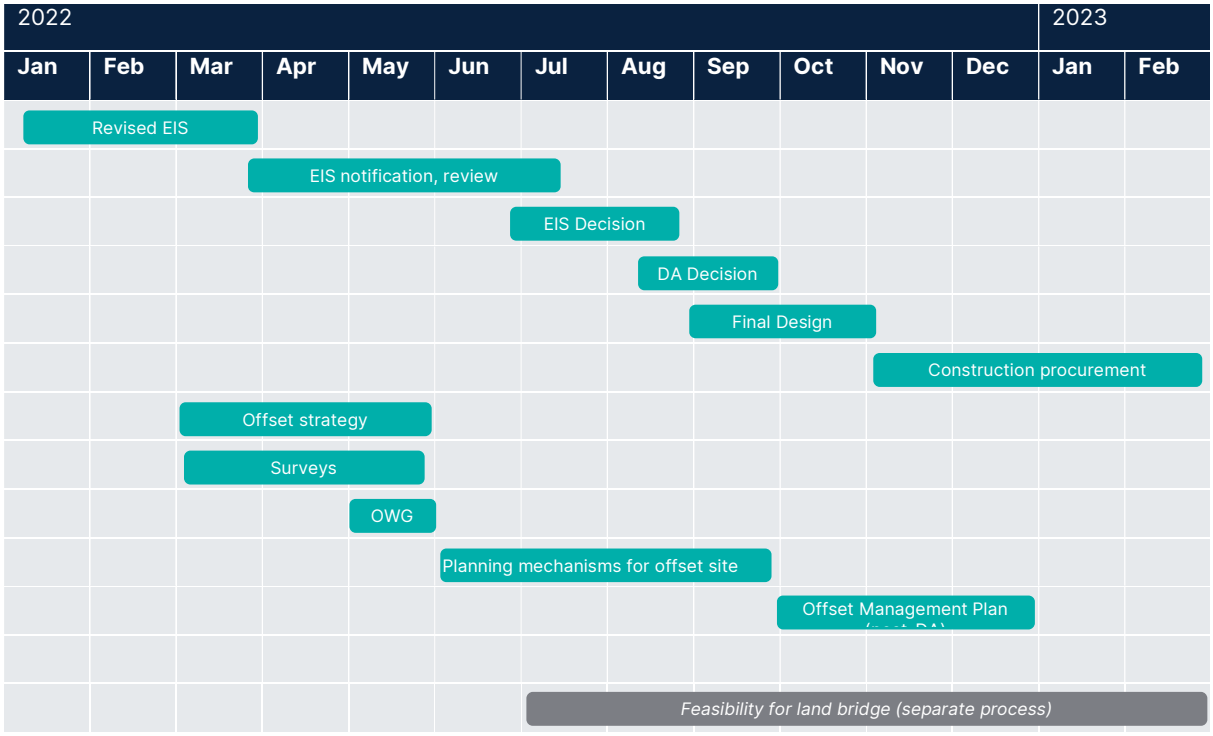
- The agreed approach is to use the Commonwealth Offsets Calculator (for calculation of offset areas required) in conjunction with the ACT Environmental Offsets Delivery Framework
- An appropriate offset is to be provided within the ACT, as a first choice. Whilst it will be advantageous to nominate the offset area close to the Project, this is not an absolute requirement. Therefore, the first choice of offset location is to the west of the Kama Nature Reserve. This area holds additional advantages, as it includes further connectivity along the Molonglo River, both further into the ACT and north-west towards the NSW border
- Some potential issues with using an offset site to the west of Kama Nature Reserve remain unresolved, and these are currently being worked through with the Conservator:
    - There is an ACT Heritage Overlay for Kama Woodland which needs to be respected. There is a recommendation under the EPBC Environmental Offsets Policy, which states "for direct offsets, the securing of existing unprotected habitat as an offset only provides a conservation gain if that habitat was under some level of threat of being destroyed or degraded…" As such, the suitability of the area west of Kama Nature Reserve may be questionable as it may not "be under threat of being destroyed" due to this heritage overlay
    - The area in question includes land under a sub-lease to SLA which may be currently subject to grazing. This could detract from the quality of the vegetation currently in this location, meaning it could be suitable for enhancements to improve the quality of locally occurring Box Gum Woodland and other related habitat features for the relevant species of concern.
    - This locality is being concurrently investigated as a potential site for the Big Canberra Battery project, which is still in the procurement stage. Consultations will continue with the ACT Government around the suitability of designating land in this location as a Box Gum Woodland offset with the Battery project potentially located alongside it
    - It is proposed to undertake a survey effort for this site in Autumn 2022 to confirm its suitability for providing this offset. The Conservator has confirmed in principle support for this approach on the current Project, given the potential complexity of issues surrounding the land west of Kama Nature Reserve
    - Consultations will continue with the ACT Government, the Conservator, and ACT Government Offsets Team to ensure this land can be subject to the relevant legal instruments which are required to secure an offset for the purposes of land and property law
- The Draft Biodiversity Offset Strategy for the Project is expected to be established over the next two quarters of 2022
- The approach to conducting an Offset Strategy (and surveys as appropriate) in parallel to the notification of the Revised Draft-EIS is appropriate
- Should the location to the west of Kama Nature Reserve prove unsuitable to provide the required level of quality offset for the Project, an alternative offset will be devised. This could include another offset in the general location of Kama Nature Reserve – for instance, further to the south of the Molonglo River as a second option. Third and fourth tier options could include finding a suitable offset site in NSW, providing funds for urban ecology offsets within the broader ACT. These will be discussed with the Conservator only where it is apparent that the area surrounding Kama Nature Reserve cannot provide a suitable offset. However, it is considered that this is unlikely, and TCCS is committed, in the first instance, to finalising the Project's offset next to Kama Nature Reserve in consultation with the Conservator and the Offsets Working Group (OWG).

It is understood that the Conservator also wishes funds from the Project's offset package to be made available to enable data held by EPSDD on Kangaroo-vehicle collision incidents to be analysed so as to inform other future road design packages.

The next OWG meeting is scheduled to take place in May 2022. TCCS aims to have a Draft Offsets Strategy for review by the OWG at that time (refer to Table 7-1 below). TCCS is aware that the Project cannot commence construction procurement until an approved Offsets Management Plan is in place. An indicative timeframe for achieving these items is as per the below Table 7-1.

Moreover, the public will be kept up to date during this process of finalising the Offset Strategy for the Project and the relevant consultation processes will be followed.

Table 7-1 Indicative timeframe for finalising the Project's Offsets Management Plan



Whilst a potential fauna bridge will be the subject of a Future Feasibility Study (refer to EIS Section 2.4.1), if it is implemented it will be in addition to the minimum offsetting measures which the Project has otherwise agreed to under the biodiversity offset strategy process, as outlined in the EIS. It is considered that a potential fauna bridge does not provide the most suitable and immediate offset for the Project at this time.

It is considered that protection of land to the west of Kama Nature Reserve which will preserve nesting habitat for Superb Parrot and retain old growth trees and native grassland understorey.

The recommended safeguards and management measures to safeguard biodiversity are provided in Table 7-2.

Table 7-2: Summary of proposed mitigation measures

Potential Impact	Mitigation Measure	Effectiveness	Timing	Responsible Agency
Presence or extent of threatened species and ecological communities not identified prior to development design, resulting in unanticipated impacts Project activities facilitate spread of exotic flora into adjacent areas, leading to weed establishment Project attracts additional vermin and pest species, which result in greater competition for resources with native species	A Flora and Fauna Management Plan (FFMP) will be prepared and implemented as part of the CEMP. It will include, but not be limited to: • A Tree Management Plan (to be determined by the Conservator of Flora and Fauna) • Plans showing areas to be cleared and areas to be protected, including exclusion zones, protected habitat features and potential revegetation areas • Pre-clearing survey requirements • Procedures for unexpected threatened species finds and fauna handling • Protocols to manage weeds and Pathogens • Procedure for stockpiling materials including topsoils and subsoils to be stockpiled separately to avoid mixing in a manner that will facilitate the return of soils to location of original source and tracking and treatment of stockpiles. The CEMP will also outline contractor and other personnel responsibilities and actions in the event of an unforeseen environmental harm incidents, including first response and agency notification requirements. Rubbish removal is to be undertaken prior to construction and throughout construction in retained areas of vegetation in the road reserve. Revegetation and offset plantings proposed as part of the Project will assist in supporting habitats which are favoured by native species, such that the Project will not result in feral species colonising land within the study area over the long-term.	High	Prior to construction	TCCS Construction contractor
Incursion of vehicles, light, noise, invasive species and increased recreational use caused by greater human access into areas of environmental significance, causing damage to or destruction of habitat	Site inductions will be mandatory for all personnel working and visiting the Project area. The site induction will include information on threatened species and ecological communities, identify exclusion zones and the unexpected finds procedure for threatened species. Personnel involved in vegetation clearing and clearing of threatened species habitat will have a more detailed toolbox to ensure all personnel are clear on the clearing procedure and sensitive ecological features of the area to be cleared for that day.	High	Prior to construction	TCCS
Removal of native vegetation and threatened species habitat	Provide an offset against the loss of Box Gum Woodland TEC habitat by protection of land to the west of Kama Nature Reserve which will preserve nesting habitat for Superb Parrot and retain old growth trees and native grassland understorey. Development of this Draft Offset Strategy will follow these key points, as agreed to between TCCS and the Conservator: • The Commonwealth Offsets Calculator will be used (for calculation of offset areas required) in conjunction with the ACT Environmental Offsets Delivery Framework • An appropriate offset is to be provided within the ACT, as a first choice. Whilst it will be advantageous to nominate the offset area close to the Project, this is not an absolute requirement. Therefore, the first choice of offset location is to the west of the Kama Nature Reserve. This area holds additional advantages, as it includes further connectivity along the Molonglo River, both further into the ACT and north-west towards the NSW border	Moderate	Prior to construction	TCCS

Potential Impact	Mitigation Measure	Effectiveness	Timing	Responsible Agency
	• The Draft Biodiversity Offset Strategy for the Project is expected to be established over the next two quarters of 2022 • Should the location to the west of Kama Nature Reserve prove unsuitable to provide the required level of quality offset for the Project, an alternative offset will be devised. This could include another offset in the general location of Kama Nature Reserve – for instance, further to the south of the Molonglo River as a second option. Third and fourth tier options could include finding a suitable offset site in NSW, providing funds for urban ecology offsets within the broader ACT. These will be discussed with the Conservator only where it is apparent that the area surrounding Kama Nature Reserve cannot provide a suitable offset. However, it is considered that this is unlikely, and TCCS is committed, in the first instance, to finalising the Project's offset next to Kama Nature Reserve in consultation with the Conservator and the Offsets Working Group (OWG) • The public will be kept up to date during this process of finalising the Offset Strategy for the Project and the relevant consultation processes will be followed • As requested by the Conservator, funds from the Project's offset package will be made available to enable data held by EPSDD on Kangaroo-vehicle collision incidents to be analysed so as to inform other future road design packages.			
Clearing of protected trees that have not been approved to be cleared Direct impacts on threatened flora and fauna, threatened ecological communities and non- threatened flora and fauna from clearing and other construction works	Establish exclusion zones including: • Prior to construction commencing, exclusion fencing or flagging and signs is to be installed at the limit of works • Trees to be retained are to be clearly demarked with fencing and signage • Threatened species habitat to be retained is to be clearly demarked with fencing and signage. Contractors and site workers to be advised of criminal penalties available for unauthorised vegetation clearing in the ACT. The construction contractor will hold responsibility for ensuring only approved vegetation is cleared.	High	Prior to construction	TCCS Construction contractor
Removal of native vegetation and threatened species habitat	Pre-clearance protocols will include: • Demarcation of habitat trees indicating which of these are to be cleared and which of these are to be retained • Pre-clearing and daily surveys • A two-staged tree clearing procedure including designated areas for release of any rescued fauna • Presence of a qualified ecologist/fauna rescue person throughout clearing.	High	Prior to construction and during construction	TCCS Construction contractor
Removal of native vegetation and threatened species habitat	• Measures to further avoid and minimise the construction footprint and native vegetation or habitat removal will be investigated during detailed design and implemented where possible throughout pre-construction and construction • Avoid where possible loss of Grassy Woodland, Native Grassland and PTWL habitat • Coarse woody debris and rocks will be placed in the adjoining reserves following consultation with the land manager for these reserves • Avoid loss of mature eucalypt trees over 50 cm in diameter, including all mature trees with hollows where possible • Where vegetation clearing is required, limit it to the minimum extent practicable required for the construction of the project	High	Detailed design and construction	TCCS Construction contractor

Potential Impact	Mitigation Measure	Effectiveness	Timing	Responsible Agency
	• The limits of clearing will be clearly marked on construction work plans and on the ground prior to clearing. Vegetation to be retained will be protected through exclusion fencing (e.g. safety mesh) and 'no-go' signage • Only trees specified in the Tree Management Plan (if required) will be removed. All other trees are to be retained • Felled trees are to be stockpiled on site for re use in the landscape such as roost trees • Should any injured animals be found within the construction area, ACT Wildlife will be contacted to collect the injured animal.			
Removal of native vegetation	Revegetation and rehabilitation will be undertaken during the Project and include: • Prior to revegetation works excavated or disturbed areas to be rehabilitated so that material is reinstated in original sequence i.e., topsoil at surface and subsoil below • All areas of disturbance must be revegetated immediately following construction • Revegetation to be undertaken using a cover crop of sterile Rye Grass to ensure that rapid stabilisation occurs • A suite of suitable local native species will be used in conjunction with the Rye Grass cover crop. The seed mix will be a locally collected species mix including four species.	High	During construction	TCCS Construction contractor
Removal of a threatened ecological community	• Areas of Box-Gum Woodland TEC to be retained will be clearing marked on maps and provided to construction supervisors • Any indirect or indirect impact to Box-Gum Woodland TECs outside the designated clearing area will be immediately reported to the Conservator and DAWE • Non weedy BGW topsoil to be stockpiled for use in revegetation areas.	High	During construction. Offset strategy approved before construction.	Construction contractor
Removal of threatened species habitat (Pink Tailed Worm Lizard (PTWL))	• The requirement for exclusion (no-go) zones to be confirmed by an ecologist to mark and exclude PTWL habitat • The limits of construction works areas which are to be located inside identified PTWL habitat are to be clearly marked on construction work plans prior to the commencement of works in these areas • The limits of construction works areas within PTWL habitat are to be clearly marked out on the ground using exclusion fencing and 'no-go' signage where appropriate • No vehicles and machinery are to operate within areas of PTWL habitat which have been demarcated • No site laydown areas, vehicle parking, turning areas, temporary equipment or stockpiles will be located within PTWL habitat areas which have been demarcated. Pre-clearance surveys: • All areas of identified PTWL habitat which are within the construction footprint will be surveyed by a suitably qualified ecologist prior to construction activities taking place • Timing of these surveys will be as close to the clearing as practicable to ensure lizards present can be relocated prior to construction activities commencing • When conducting the pre-clearance surveys, all suitable habitat rocks within the disturbance area will be rolled over to check for individual lizards • Any individual PTWL found during preclearance surveys will be relocated by the ecologist to a nearby safe and suitable patch of habitat outside the construction area, in accordance with Animal Care and Ethics Approval and project-specific Scientific Licence held by the ecologist. PTWL habitat relocation: • Prior to construction activities commencing within PTWL habitat, and following the pre-clearance surveys undertaken by the ecologist, all surface rocks within the construction areas which are deemed	High	Before, during and after construction	TCCS Construction contractor

Potential Impact	Mitigation Measure	Effectiveness	Timing	Responsible Agency
	by the ecologist to represent suitable habitat rocks will be relocated to a location or locations outside the construction area for preservation. Generally, suitable habitat rocks include those that are plate-like in shape with a 15-60cm basal diameter. Relocation of surface rocks will be undertaken by the ecologist and by construction personnel under supervision of the ecologist as required • Suitable PTWL habitat rocks which are stockpiled will be utilised during rehabilitation of disturbed sites upon completion of construction works • The stockpile site will be located within the general vicinity of the work to avoid long cartage distances and multiple handling. During construction: • The unexpected finds protocol will include a procedure for snakes and legless lizards • Should any PTWL be observed during construction, works will cease, and the ecologist will be notified. The ecologist will be required to attend the site to relocate the lizard to a safe and suitable nearby patch of habitat, in accordance with the Scientific Licence held by the ecologist • Should any PTWL be injured during construction works, the animal will be handled in accordance with scientific licence conditions • All vehicles to operate within PTWL habitat will be free from vegetative materials and propagules • Should any trenches be left open overnight, these trenches will be inspected each morning to check for trapped PTWL. If any PTWL are observed within the trench, the ecologist will be contacted immediately to relocate the individual as per the conditions of the Scientific Licence held by the ecologist • All trenches will be inspected for the presence of PTWL immediately prior backfilling. If any PTWL are observed within the trench, the ecologist will be contacted immediately to relocate the individual as per the conditions of the Scientific Licence held by the ecologist The Draft Offset Strategy and the Offset Management Plan will confirm habitat rehabilitation actions for the PTWL. Actions will include: • Upon completion of the construction works, the extent and location of disturbance within the encountered PTWL habitat will be measured and recorded. The total area of disturbance will be indicated (in hectares) on a map, or by GPS locations. • Findings from this will be documented and reported to the Contractor's Representative in the form of a letter. This information must be supplied to the ACT Government as per the conditions of the Scientific Licence held by the ecologist • Upon completion of construction works, disturbed areas within identified PTWL habitat will be rehabilitated in accordance with a PTWL Rehabilitation Plan (if required).			
Removal of threatened flora species and their habitat	All personnel working on site will receive training to ensure awareness of the potential for the threatened flora species listed in Appendix B of the Biodiversity Assessment Report within the construction boundary. Training will include photographs of the species, key identification features, flowering times and protocols if any are identified during clearing or construction.	High	During construction	Construction contractor
Clearing of trees and other vegetation causing impacts including loss of amenity, loss of habitat, increased erosion and water runoff	Re-use of habitat features: • Hollows from hollow-bearing trees that are removed will be salvaged and re-used as habitat for ground-dwelling fauna or made into a natural hollow nest box and reattached to a suitable nearby tree • Installation of nest boxes will be undertaken by a suitably qualified ecologist • Logs will be relocated to suitable nearby habitat.	High	Prior to construction and during construction	TCCS

Potential Impact	Mitigation Measure	Effectiveness	Timing	Responsible Agency
Edge effects	• Weed extent in the adjoining nature reserves will be documented before construction and monitored monthly during construction. If weed presence and/or extent has increased the construction contractor is to engage a suitably qualified regeneration specialist to undertake weed removal of these areas in line with the management plan for the reserve • African Lovegrass, a highly invasive exotic and serious pest plant, is currently well established right along William Hovell Drive edges. Removal of this weed will be undertaken prior to and during construction. Care will be taken for this species to not spread to the adjoining land and reserves • Dense Lomandra Longifolia and native shrub plantings will be strategically located along the boundary of the Kama Nature Reserve and The Pinnacle Nature Reserve (and their buffers) • Protection measures for the two Nature Reserves will include the erection of man proof fencing, treatment of drainage lines with sediment control, and a strict 'No Entry' during construction. Sediment basins would be constructed as required. Any other reasonable requirements from the EPA and other Government agencies will also be implemented.	High	Prior to construction and during construction	Construction contractor
Weeds and exotic flora	• Prior to the commencement of works, existing weed infestations are to be treated using appropriate methods • Non weed infested areas of native dominant understorey within the road reserve will be protected and not disturbed wherever possible • All vehicles must be clean and free of visible plant propagules prior to entering and exiting the site. A vehicle brush down/washdown area will be provided • Records will be maintained demonstrating compliance. • Weedy vegetation with viable propagules (seeds, fruit, rhizomes etc) will be removed from site for safe transport and disposal at appropriate waste facility. Non-viable woody vegetation can be chipped on site • Vehicle and machinery movements will be confined to disturbed areas and existing tracks where possible. Vehicles and machinery will be cleaned (tyres brushed or washed down) prior to accessing and/or leaving areas where weeds have been identified • Use weed matting to cover any areas of exposed soil • Undertake revegetation as soon as possible post-construction • Maintain revegetated areas by undertaking weed removal until growth is enough to prevent weed invasion, as determined by a qualified ecologist • Do not stockpile vegetation containing weeds on site • Use of herbicides will be undertaken in line with the NSW Weed Control Handbook • Where reasonable possible, the contractors tasked with revegetation activities will have demonstrated capability in successfully restoring native vegetation communities • A suitably qualified ecologist will verify that revegetation activities have been undertaken to a reasonably satisfactory standard • Materials introduced into the site, such as topsoils, seeds and mulches, will be free of as much weed contamination as is reasonably possible to achieve • Revegetation seed used at the site will be fresh (or otherwise viable), and a sufficient sowing rate (kg/ha) will be used to ensure adequate coverage.	High	Prior to construction and during construction	Construction contractor
Changes in hydrology	• Prevent any sediment or vegetation from the site entering waterways • Ensure the design does not change the existing hydrology of the adjoining properties and nature reserves.	High	Design and construction	TCCS and construction contractor

Potential Impact	Mitigation Measure	Effectiveness	Timing	Responsible Agency
Invasion and spread of pests	• Pest species will be managed within the Project Site. This will be coordinated with surrounding landholders.	High	Construction	TCCS and construction contractor
Invasion and spread of pathogens and disease	• Maintain hygiene protocols to prevent the introduction of spread of pathogens from outside the site • Chytrid protocol in line with the latest national guidelines will be followed during construction.	High	Construction	Construction contractor
Noise, light and vibration impact on fauna	• Avoidance of lighting in the key wildlife linkage areas. Any lighting which is installed will be considered to act as a physical "barrier" to movement, likely to create a road kill hotspot at either end where animals move around it to access nearby habitat • Lighting of underpasses will be on a sensor that is not triggered by small mammals to prevent unnecessary light • Lighting of intersections with ample escape routes through the limited use of barriers within several hundred meters (either on road edges or central median strips) • Artificial light impact to biodiversity will be minimised through detailed design. Lighting will be designed in accordance with AS 4282-1997 Control of the obtrusive effects of outdoor lighting.	High	Detailed design Construction Operation	TCCS
Animal-vehicle collision and road kill reduction	• During construction and operation no barriers to movement will be created that will funnel fauna directly into the road corridor • At key crossing points lowering the road or keeping high steep cuttings or other measures to encourage flying wildlife to cross road at a height that is above the level of traffic • Prevent access by wildlife from either side of the road, where road barriers are required particularly where central safety barriers between carriageways are in place • Use of fences and other barriers (including street lighting) in a way that directs wildlife to underpasses or safer crossing points which are away from intersections, have opportunities for escape, and have good line of sight. Escape ramps near intersections where fencing ends and several points along the exclusion fencing in the event that a kangaroo does enter the road corridor • Escape routes (e.g. paths of lower gradient cut into roadside batters or cuttings) will be designed to allow the exit of animals that have become trapped on the road where there are banks, cuttings or fences • Table drain design and management will consider management of the road verges to make it less attractive for grazing herbivores • Where there is no fencing then ensure roadside maintenance to deter herbivores from this area and good lighting and line of sight • Fauna identification road sighs will be located at each end of the road alignment to indicate to drivers the presence of animals crossing • The use of the 'Roadkill Reporter' app will be promoted within the local community • Plantings will be strategically located near the proposed fauna rope bridge, to act as further encouragement for arboreal and bird species to use this crossing feature • Road kill will be monitored monthly during construction by a suitably qualified person and for two years during operation to determine if mitigation measure have been effective. Adaptive management (e.g. moving barriers and wildlife fencing) will be adopted based on the results of the monitoring. A report on road kill will be written to determine if there are hotspots on the new road and include recommendations for reducing roadkill in these hotspots. Adaptive management will be used to undertake recommendations of the report.	Moderate	Detailed design, construction and operation	TCCS and construction contractor

Potential Impact	Mitigation Measure	Effectiveness	Timing	Responsible Agency
Increased habitat fragmentation impacting species movement	When finalising the proposed wildlife crossing structures, the following will be taken into consideration: • Two main biodiversity corridors have been identified, both are the existing large cutting areas (one near the cemetery and one between The Pinnacle and Kama Nature Reserves) • Installation of a rope bridge and box culvert underpasses in areas of connectivity will be employed so as to benefit a range of ground-dwelling and arboreal/avifauna species • An arboreal mammal specialist will be engaged to determine the location of these crossing structures • Any connectivity structures will be monitored by remote sensor cameras for a period of three years after construction • Newly created road verges will be monitored, and adaptive management undertaken to limit mowing/encourage recruiting Hoary Sunray specimens within the site. Culverts will be designed to facilitate wildlife movement including: • One fauna crossing (rope bridge) to assist arboreal and avifauna to safely cross the road reserve • Two fauna crossings (box culverts) to assist ground-dwelling fauna to safely cross the road reserve • Exclusion fencing (1.8 m tall chainmesh fence) to be included on each side of William Hovell Drive in the vicinity of the Kama and The Pinnacles Nature Reserves, extending at least 200m past the fauna crossings. The effectiveness of this exclusion fencing will be monitored during the operational stage of the Project. Where possible, culverts will be designed to facilitate fauna movement. This will include consideration of the size of the culvert, revegetation at the entrances to the culvert and no artificial lighting. Existing fencing blocking the culvert locations will be removed. Appropriate habitat structures will also be installed along box culverts in particular to facilitate wildlife movement through these underpasses where possible, such as poles, logs, rocks, woody debris at ground/mid-level or other habitat structures to enable small fauna to safely pass through. The existing culvert at the south of the study area will not be used for pedestrians. Lighting will be designed so as to not deter fauna from utilising the rope bridge and box culvert underpasses.	Moderate (until operational modelling can demonstrate high operational effectiveness	Design, construction and during operation	TCCS
Fauna injury or mortality	Road design will include: • Fauna exclusion fencing is to be used to prevent wildlife accessing the road. • Fauna friendly fencing is to be installed between the underpasses and culverts to prevent access onto the road but guide fauna to these potential crossing areas. Fencing will be chainmesh fence 1.8 m tall is designed to exclude a range of native mammal species such as macropods, possums, Spotted-tail Quoll. • Existing gates and fencing near the underpasses will be replaced with structures that allow fauna movement through the underpasses. • Barbed wire will not be used on any fences. • Central medians designed to not to trap fauna on the road.	High	Design and pre construction	TCCS
Clearing of vegetation results in a loss of connectivity through fragmentation in the landscape, or obstructing local movement corridors Clearing of protected trees that have not	Re-vegetation of biodiversity corridors will include: • Revegetation in areas where birds are likely to cross the alignment, particularly at the top of cuttings to encourage flight above the height of the road • Where possible revegetation will include planting along the edges of adjoining paddocks to close any vegetation gaps. This principle will extend to all areas where trees will be retained where the revegetation will enhance native species habitat values in the landscape • Re-vegetation will use species that are found in the local Box-Gum Woodland TEC and include trees, shrubs and groundcovers • Tube-stock for revegetation will be sourced from local providers	Moderate	Design and construction	TCCS

Potential Impact	Mitigation Measure	Effectiveness	Timing	Responsible Agency
been approved to be cleared Increased habitat fragmentation impacting species movement Impacts to adjoining nature reserves during construction and operation	• Areas of re-vegetation will be maintained for a minimum of two years until plantings are established, with additional maintenance undertaken for a period of five years where required • Weed control will also be undertaken in revegetation areas • Revegetation will occur where required near fauna crossing structures to enhance connectivity and provide shelter in the approaches to the structures.			

8 Offset strategy

8.1 Offset obligation

The goal of offsetting is to maintain or improve the likelihood of threatened flora, fauna and ecological communities of persisting in the ACT. Ecological offsets provide benefits to those threatened flora, fauna and ecological communities that are impacted by a development after avoidance and mitigation measures have been considered. The impacts that remain after avoidance and mitigation measures have been considered are known as residual impacts. In the ACT, offsets 'are generally only required if residual impacts are significant' (ACT Government 2015a).

The following documents were reviewed to determine the requirement for offsets:

- *ACT Environmental Offsets Policy* (ACT Government 2015a)
- *ACT Environmental Offsets Delivery Framework* (ACT Government 2015b)
- *ACT Environmental Offsets Calculator Operational Manual* (ACT Government 2016).

These documents, specifically the ACT Environmental Offsets Policy, outline the ACT Government's approach and responsibility to deliver offsets to significant residual impacts to flora, fauna and ecological communities protected under the EPBC and NC Acts.

As stated, threatened species and ecological communities listed under the NC Act (ACT listed species and ecological communities) require offsets. However, 'to avoid overlap with the EPBC Act Offsets Policy additional environmental offsets are not required' (ACT Government 2015). Offsets for ACT listed threatened species and ecological communities are not required if one of the following criteria are met:

- If an ACT listed threatened species is also listed as threatened under the EPBC Act, because the offset requirements are considered to have been met through the EPBC Act requirements.
- Where an ACT listed species is strongly associated with Box–Gum Woodland TECs these will not be subject to any additional offset requirements because offset requirements under the EPBC Act for the ecological community will provide an offset for the species as well.
    - Species with strong associations to an EPBC Act listed ecological community are:
        - Little Eagle (foraging requirements are covered by requirements for BGW TECs)
        - Varied Sittella (covered by requirements for BGW TECs)
        - Painted Honeyeater (covered by requirements for BGW TECs)
        - White-Winged Triller (covered by requirements for BGW TECs).
- For minor impacts where there is no appreciable long-term impact on the threatened species; and
- For ACT listed ecological communities. While differing in description to EPBC Act ecological communities, the listed communities are essentially protecting similar habitat.

It should be noted that due to technical issues with the ACT offsets calculator the Project team has been directed by the Conservator to calculate offsets using the Commonwealth offsetting methodology.

8.1.1 Direct vs. indirect offsets

The *ACT Environmental Offsets Policy* (ACT Government 2015a) outlines that offsets must be 'like for like', that is 'any offset must relate to that same specific matter which is impacted'. These offsets can be either direct offsets, indirect offsets (also known as other compensatory measures) or advance offsets. Direct and (potentially) indirect offsets apply to this Project. A brief description of each offsetting type is provided below.

8.1.2 Direct offsets

Direct offsets compensate for the impacts to threatened species or ecological communities with an 'on-the ground outcome' (ACT Government 2015a). For example, a direct offset for the clearing of Box Gum Woodland TECs might involve the transfer an area of developable land containing the same ecological community (like for like) into the ACT reserve network and improving its condition.

For impacts to EPBC Act listed biodiversity, the ACT Environmental Offsets Policy requires offset strategies to deliver 90% of the offset requirement using direct offsets. Deviation from the 90% direct offset requirement can be considered when:

- It can be demonstrated that a greater benefit to the protected matter (threatened biodiversity) is likely to be achieved through increasing the proportion of other compensatory measures in an offsets package or
- Scientific uncertainty is so high that it is not possible to determine a direct offset that is likely to benefit the protected matter.

8.1.3 Indirect offsets (other compensatory measures)

For impacts to EPBC Act listed biodiversity other compensatory measures (indirect offsets) can be considered. According to the ACT Environmental Offsets Policy this may include 'education and training, research or projects which relate to the matter of NES that is impacted'. For biodiversity listed under the NC Act (ACT protected matters) additional indirect offsets - to those applicable to federally listed biodiversity – may include 'broad habitat measures that improve outcomes for a broad range of species, and not just the species impacted by the development' (ACT Government 2015a). Such an offset might aim to improve the habitat connectivity within the locality.

8.2 Offset Strategy

This document does not contain a complete Offset Strategy, which is expected to be produced once potential offset sites have been identified. The Offset Strategy document will show a high-level proposal outlining how potential offset sites can provide appropriate direct offsets associated with the Project. This section has been included to guide the impact obligation section of a future Offset Strategy document. An Offset Management Plan is also expected to be produced with the purpose of providing details on the commitments and management actions that will be undertaken to secure and implement the proposed offsets.

8.2.1 Framework

The ACT Environmental Offsets Policy is to be the primary frameworks for offsetting. As described in the Offsetting background there is significant overlap with the EPBC and ACT Offsets Policies. On advice from The Conservator, EPBC offsetting is to be used as the primary method for calculating offset obligations. There a several areas where the ACT policy is slightly divergent from the EPBC Act, and the ACT provisions which are to take precedence are as follows:

- An offset package (of direct offsets and other compensatory measures) must deliver an overall positive conservation outcome taking into account the viability of the species affected by the proposed development and ensuring that the package improves or maintains outcomes for the species' habitat
- Direct offsets should be in the same bioregion as the development site, as defined by the Interim Biogeographic Regionalisation for Australia, version 7
- Other compensatory measures (indirect offsets) must be in the ACT.

8.2.2 Project residual impacts for offsetting

8.2.2.1 **Vegetation communities.**

Table 8-1 shows the vegetation community to be offset (Box Gum Woodland) for the Project stratified into zones based on condition classes.

Table 8-1 Vegetation communities to be offset for the Project

ID	Area	Notes
BGW_Moderate	6.38	Yellow Box-Blakely's Red Gum Grassy Woodland with trees.
BGW_DNG	0.3	Derived Native Grassland form without tree cover.
BGW_Low	0.08	small area low condition Box Gum Woodland is does not qualify as a MNES but requires offset under the ACT NC act.

8.2.2.2 Threatened species with specific habitat requirements

The species below are either confirmed as present within the clearing areas or have a high likelihood of presence and require habitat features that are more specific than a native vegetation community alone. Offsetting will need to ensure habitat compensatory values in line with those outlined in Table 8-2. Further detail on the quality of the offset habitat is given in Section 8.2.3.

Table 8-2 Threatened species to be offset for the Project

Name	Total Area	Notes
Hoary Sunray	10.9	Mostly included in BGW as surrogate habitat but also includes areas of planted native vegetation.
Pink-tailed Worm-lizard and Striped Legless Lizard	0.16	Rocky habitat in native grassland and woodland.
Superb Parrot (Breeding)	N/A	7 Hollow bearing trees.

8.2.2.3 Impacts on threatened fauna associated with native vegetation.

Most of the 11 threatened fauna species identified with a moderate or higher likelihood of occurring on the site are assumed present on the site based on the availability of suitable native vegetation acting as a surrogate for their habit. Offsetting of the BGW community is to ensure suitable habitat equivalences for these threatened species covered in Section 6.1.2.

8.2.3 Impact Calculations

When an Offset Strategy is completed, impact values should be assessed in parallel with a potential offset site to ensure a matching weighting can be used to compare site values. Table 8-3 outlines the ecological attributes that must be used to determine "Habitat Quality" for the EPBC offset calculation spreadsheet, for each of the communities and threatened species habitat to be offset.

Final quality scores for the habitat are to be calculated by the author of the Offset Strategy, these tables can assist in providing a scope for the acquisition of potential offset sites.

Table 8-3. Habitat Quality Assessment

BGW_Moderate – 6.38ha		
	Values	**Reference**
Site Condition (clearing)		
What is the structure and condition of the vegetation on the site?	"moderate" – relatively young regrowth, little fallen timber, weeds and edge effects.	Section 4.1, Appendix A for Vegetation integrity data collected using the NSW Biobanking methodology.
What is the diversity of relevant habitat species present (including both endemic and non-endemic)?	"moderate" diversity of native species. High levels of exotic weeds in ground layer, as recorded in vegetation integrity data.	Appendix A for Vegetation integrity data collected using the NSW Biobanking methodology.
What relevant habitat features are on the site?	Seven hollow bearing trees. Areas of rocky ground (As covered by Pink-tailed Worm-lizard (PTWL) habitat).	Section 6.1.2
Site Context (clearing)		
What is the connectivity with other suitable/known habitat or remnants?	Good - all patches area considered to have connectivity with over 100ha of wooded vegetation in and around the subject site.	Figures 4-3, 4-4
What is the importance of the site in relation to the overall species population or the occurrence of the community?	High - All BGW is considered important to this critically endangered ecological community under national recover plan.	White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland National Recovery Plan (DECC 2010)
What threats occur on or near site?	Significant edge effect from being along roadway and threat from exotic weed encroachment.	Section 4.1

BGW_DNG– 0.3ha		
	Values	**Reference**
Site Condition(clearing)		
What is the structure and condition of the vegetation on the site?	A "moderate" value has been ascribed. The community lacks significant tree cover.	Section 4.1, Appendix A for Vegetation integrity data collected using the NSW Biobanking methodology.
What is the diversity of relevant habitat species present (including both endemic and non-endemic)?	"moderate" diversity of native species. High levels of exotic weeds in ground layer, as recorded in vegetation integrity data.	Appendix A for Vegetation integrity data collected using the NSW Biobanking methodology.
What relevant habitat features are on the site?	Some areas of partially covered in rocky ground (covered by PTWL habitat).	Section 6.1.2
Site Context(clearing)		
What is the connectivity with other suitable/known habitat or remnants?	Low, patches are by definition separate from wooded examples of the community and largely surrounded by exotic grassland.	Figures 4-3, 4-4
What is the importance of the site in relation to the overall species population or the occurrence of the community?	High - All BGW is considered important to this critically endangered ecological community under national recover plan, even Derived Native Grassland (DNG) forms.	White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland National Recovery Plan (DECC 2010)
What threats occur on or near site?	Significant edge effect from being along roadway and threat from exotic weed encroachment.	Section 4.1

BGW_Low– 0.08		
	Values	**Reference**
Site Condition(clearing)		
What is the structure and condition of the vegetation on the site?	A "low" value has been ascribed. Ground layer native species is below 12. The patch contains mostly smaller trees.	Section 4.1, Appendix A for Vegetation integrity data collected using the NSW Biobanking methodology.
What is the diversity of relevant habitat species present (including both endemic and non-endemic)?	"low" diversity of native species. High levels of exotic weeds in ground layer and non-characteristic native shrub layer	Figure 4-1. Detailed floristic data was not taken
What relevant habitat features are on the site?	Trees, shrubs	Section 6.1.2
Site Context(clearing)		
What is the connectivity with other suitable/known habitat or remnants?	Poor, isolated from other patches of this community by exotic areas and the roadway	Figures 4-3, 4-4
What is the importance of the site in relation to the overall species population or the occurrence of the community?	High - All BGW is considered important to this critically endangered ecological community under national recover plan.	White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland National Recovery Plan (DECC 2010)
What threats occur on or near site?	Significant edge effect from being along roadway, highly fragmented and exotic weed encroachment.	Section 4

Hoary Sunray Habitat		
	Values	**Reference**
Site Condition(clearing)		
What is the structure and condition of the vegetation on the site?	Moderate – can grow in disturbed area however perennial exotic grass density reduces suitable areas for establishment	Section 5.4.1

What is the diversity of relevant habitat species present (including both endemic and non-endemic)?	Low relevance to habitat of this species. Grassy woodland, DNG and planted woodland considered suitable.	Section 4.1, Appendix A for Vegetation integrity data collected using the NSW Biobanking methodology.
What relevant habitat features are on the site?	Grassy woodland, DNG and planted woodland considered suitable.	Section 6.1.2
Site Context(clearing)		
What is the connectivity with other suitable/known habitat or remnants?	Good. Proximity to large populations in Kama reserve	Section 5.4.1
What is the importance of the site in relation to the overall species population or the occurrence of the community?	Low. The population in the impact area is a small fraction of the local population in nearby reserves.	Appendix C. Assessment of significance for *Leucochrysum albicans.*
What threats occur on or near site?	Significant density of perennial grasses/weeds.	Section 4.1
Species Stocking Rate(clearing)		
What is the presence of the species on the site? (i.e. confirmed / modelled).	Confirmed. Modelled to occur in other suitable areas of habitat.	Figure 5.3, Section 5.4.1
What is the density of species known to utilise the site?	Low except in cluster of individuals identified in survey.	Figure 5.3
What is the role of the site population in regards to the overall species population?	Low for both the locality and the species nationally. The population in the impact area is a small fraction of the local population in nearby reserves.	Section 5.4.1

Pink Tailed Worm Lizard Habitat		
	Values	**Reference**
Site Condition(clearing)		
What is the structure and condition of the vegetation on the site?	Moderate – As for the condition of the suitable grassy woodland habitat and DNG	Appendix A for Vegetation integrity data collected using the NSW Biobanking methodology.
What is the diversity of relevant habitat species present (including both endemic and non-endemic)?	Moderate - As for the condition of the suitable grassy woodland habitat and DNG. Exotic weed density reducing quality significantly.	Section 4.1, Appendix A for Vegetation integrity data collected using the NSW Biobanking methodology.
What relevant habitat features are on the site?	Areas of partially buried rocks, *Themeda* grasses.	Section 5.3
Site Context(clearing)		
What is the connectivity with other suitable/known habitat or remnants?	Moderate. Proximity to larger suitable habitat in the Pinnacle reserve, although that population is largely cut off to the south by William Hovell Drive. South side of William Hovell Drive has connectivity to known population in Molonglo valley.	Figures 4-3, 4-4
What is the importance of the site in relation to the overall species population or the occurrence of the community?	High. The population in the impact area is a small fraction of the local population in nearby reserves.	Appendix C. Assessment of significance for *Leucochrysum albicans.*
What threats occur on or near site?	Significant density of perennial grasses/weeds.	Section 4.1
Species Stocking Rate(clearing)		
What is the presence of the species on the site? (i.e. confirmed / modelled).	Assumed based on habitat feature and proximity to nearby confirmed habitat in Pinnacle Reserve.	Section 5.3
What is the density of species known to utilise the site?	Unknown but assumed present	Section 5.3
What is the role of the site population in regard to the overall species population?	Low. The population in the impact area is a small fraction of the local population in nearby reserves although unknown	Figure 4-4

Pink Tailed Worm Lizard Habitat		
	Values	Reference
	population density adds some uncertainty.	

9 Conclusion

This biodiversity report was conducted to identify ecological values within the Project study area, minimise impacts through the design process and assess the impacts of the Project. Specifically, this biodiversity report addresses the scoping document requirements relevant to biodiversity including assessment of impacts to threatened species, populations and ecological communities as a result of the Project.

The Project study area consists predominantly of existing road infrastructure, and native and exotic vegetation. The Project study area is surrounded by residential, peri-urban and conservation reserves. Accordingly, while the study area includes some areas of modified biodiversity values, there are significant local habitat values, including for threatened and non-threatened flora, fauna and communities, along with connectivity values. The study area and construction boundary is a mix of remnant vegetation, including the threatened ecological community Box Gum Woodland, and planted native or exotic vegetation types. The native vegetation extent supports some limited but locally valuable habitat features, such as tree hollows, woody debris, leaf litter and connectivity to relatively large patch sizes.

Biodiversity values recorded in the study area include:

- A total of 13.36 hectares of Box Gum Woodland equivalent to the critically endangered communities White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland under the EPBC Act and Yellow Box–Blakely's Red Gum Grassy Woodland under the NC Act
- At least 69 individuals of *Leucochrysum albicans* var. *tricolor* (listed as Endangered under the EPBC Act)
- Habitat for 14 fauna species listed as threatened or migratory under the NC Act and/or EPBC Act.

The Project will require unavoidable vegetation and habitat clearing, including:

- A total of 19.85 hectares of vegetation (including habitat for threatened flora and fauna species), of which 6.49 hectares are considered to be consistent with remnant native vegetation, with 6.41 ha of this being consistent with Box Gum Woodland.

Mitigation measures, including a revegetation plan, will minimise impacts and guide the remediation and revegetation of the Project impact area following construction. Detailed mitigation measures will be incorporated into the Flora and Fauna Management Plan and Construction Environmental Management Plan to further minimise impacts to biodiversity.

Assessments of Significance under the EPBC Act were completed for the threatened ecological community and species listed under the Act. Assessments of Significance under the EPBC Act concluded that the Project is likely to have a significant impact on White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland, as well as a potentially significant impact for Pink-tailed Worm-lizard and Striped Legless Lizard. These species, along with Hoary Sunray, will benefit from the Offset Management Plan which will be prepared in support of the Project and in consultation with the Conservator and the Offsets Working Group.

Impacts to these species and ecological community would be permanent, albeit not irreversible with the appropriate mitigation measures and Offset Management Plan in place. Post-implementation monitoring would review the potentially unknown impacts to Pink-tailed Worm-lizard, as the habits of this species are not entirely understood.

An Offset Strategy document will be required to outlining how potential offset sites can provide appropriate direct offsets associated with the Project. An Offset Management Plan is also expected to be produced with the purpose of providing details on the commitments and management actions that will be undertaken to secure and implement the proposed offsets.

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Appendix A **Recorded flora and fauna**

Recorded flora

Scientific Name	Common Name	Rare Plant	NC Act status	EPBC Act status
Leucochrysum albicans var. *tricolor*	Hoary Sunray		-	E

Recorded fauna

Scientific Name	Common Name	NC Act Status	EPBC Act status	Observation
Birds (49)				
Acanthiza chrysorrhoa	Yellow-rumped Thornbill	-	-	
Acanthiza nana	Yellow Thornbill	-	-	
Acanthiza reguloides	Buff-rumped Thornbill	-	-	
Acanthiza sp.	Unidentified thornbill	-	-	
*Acridotheres tristis**	Common Myna	-	-	
Anas superciliosa	Pacific Black Duck	-	-	
Anthochaera carunculata	Red Wattlebird	-	-	
Aquila audax	Wedge-tailed Eagle	-	-	
Cacatua galerita	Sulphur-crested Cockatoo	-	-	
Calyptorhynchus funereus	Yellow-tailed Black-cockatoo	-	-	
*Carduelis carduelis**	European Goldfinch	-	-	
Chenonetta jubata	Australian Wood Duck	-	-	
*Columba livia**	Rock Dove	-	-	
Coracina novaehollandiae	Black-faced Cuckoo-shrike	-	-	
Corcorax melanorhamphos	White-winged Chough	-	-	
Corvus coronoides	Australian Raven	-	-	
Cracticus tibicen	Australian Magpie	-	-	
Dacelo novaeguineae	Laughing Kookaburra	-	-	
Egretta novaehollandiae	White-faced Heron	-	-	
Eolophus roseicapilla	Galah	-	-	
Eudynamys orientalis	Eastern Koel	-	-	
Falco berigora	Brown Falcon	-	-	
Falco cenchroides	Nankeen Kestrel	-	-	
Falco longipennis	Australian Hobby	-	-	
Fulica atra	Eurasian Coot	-	-	
Grallina cyanoleuca	Magpie-lark	-	-	
Hirundo neoxena	Welcome Swallow	-	-	
Malurus splendens	Superb Fairy-wren	-	-	
Manorina melanocephala	Noisy Miner	-	-	
Microeca fascinans	Jacky Winter	-	-	
Ocyphaps lophotes	Crested Pigeon	-	-	

Scientific Name	Common Name	NC Act Status	EPBC Act status	Observation
Pardalotus punctatus	Spotted Pardalote	-	-	
Pardalotus striatus	Striated Pardalote	-	-	
*Passer domesticus**	House Sparrow	-	-	
Petrochelidon ariel	Fairy Martin	-	-	
Philemon corniculatus	Noisy Friarbird	-	-	
Platycercus elegans	Crimson Rosella	-	-	
Platycercus eximius	Eastern Rosella	-	-	
Polytelis swainsonii	Superb Parrot	V	V	
Psephotus haematonotus	Red-rumped Parrot	-	-	
Ptilonorhynchus violaceus	Satin Bowerbird	-	-	
Rhipidura albiscapa	Grey Fantail	-	-	
Rhipidura leucophrys	Willie Wagtail	-	-	
Smicrornis brevirostris	Weebill	-	-	
Strepera graculina	Pied Currawong	-	-	
Sturnus vulgaris	Common Starling	-	-	
Trichoglossus moluccanus	Rainbow Lorikeet	-	-	
*Turdus merula**	Common Blackbird	-	-	
Zosterops lateralis	Silvereye	-	-	
Mammals (11)				
Chalinolobus gouldii	Gould's Wattled Bat	-	-	
Chalinolobus morio	Chocolate Wattled Bat	-	-	
Falsistrellus tasmaniensis	Eastern False Pipistrelle	-	-	
Macropus giganteus	Eastern Grey Kangaroo	-	-	
Miniopterus orianae oceanensis	Large Bent-winged Bat	-	-	
Mormopterus sp.	Unidentified freetail bat	-	-	
Nyctophilus sp.	Unidentified long-eared bat	-	-	
Tachyglossus aculeatus	Short-beaked Echidna	-	-	
Tadarida australis	White-striped Freetail Bat	-	-	
Vespadelus darligntoni	Large Forest Bat	-	-	
Vespadelus vulturnus	Little Forest Bat	-	-	
Reptiles (1)				
Pseudonaja textilis	Eastern Brown Snake	-	-	

V = vulnerable, * = introduced species

Appendix B **Likelihood of occurrence table**

Likelihood of occurrence	Criteria
Recorded	The species was observed in the study area during the survey process.
High	It is highly likely that a species inhabits the study area and is dependent on identified suitable habitat (i.e. for breeding or important life cycle periods such as winter flowering resources), has been recorded recently in the locality (10 kilometres) and is known or likely to maintain resident populations in the study area. Also includes species known or likely to visit the study area during regular seasonal movements or migration.
Moderate	Potential habitat is present in the study area. The likelihood can reflect a lack of ecological understanding and/or information on an entity. An example includes cryptic flowering flora species that were not seasonally targeted by surveys and that have not been recorded in the study area despite potential habitat occurring. Adequate field survey would likely determine if there is a 'high' or 'low' likelihood of occurrence for the species within the study area.
Low	It is unlikely that the species inhabits the study area and has not been recorded recently in the locality (within 10 kilometres). For fauna species, individuals may be an occasional visitor, but habitat similar to that occurring in the study area is widely distributed in the locality, meaning that the species is not dependent (i.e. for breeding or important life cycle periods such as winter flowering resources) on the impacted habitat.
None	Suitable habitat is absent from the study area.

Scientific Name	Common Name	NC Act status	EPBC Act status	Habitat requirements	Likelihood of occurrence based on desktop assessment	Likelihood of occurrence after site survey
Communities						
Natural Temperate Grassland of the South Eastern Highlands		E	CE	Occurs at altitudes up to approximately 1200 m in and around the South Eastern Highlands. It can also occur as low as 250 m in some parts of its distribution. Occurs on a wide range of topographic positions and on soils derived from a variety of substrates, including granites, basalts, sediments, colluvium and alluvium.	Low – grasslands on site not likely to be natural. ACT Grassland Conservation Strategy (Table 1) shows little primary native grassland near the route	None. Vegetation surveys have excluded the presence of this community from the study area. Non-biotic habitat and ecological processes not present to support natural grasslands. Limitations to wooded communities not present.

Scientific Name	Common Name	NC Act status	EPBC Act status	Habitat requirements	Likelihood of occurrence based on desktop assessment	Likelihood of occurrence after site survey
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland		E	CE	Characterised by the presence or prior occurrence of White Box, Yellow Box and/or Blakely's Red Gum. The trees may occur as pure stands, mixtures of the three species or in mixtures with other trees, including wattles. Commonly co-occurring eucalypts include Apple Box (*E. bridgesiana*), Red Box (*E. polyanthemos*), *E. macrorhyncha*), Coastal Grey Box (*E. moluccana*), Candlebark (*E. rubida*), Bundy (*E. goniocalyx*), Broad-leaved Stringybark (*E. goniocalyx*), Youman's Stringybark (*E. youmanii*) and others.	**High – previously mapped within study area**	**Recorded within the study area.**
Flora						
Ammobium craspedioides	Yass Daisy	Not listed	V	Found from near Crookwell to near Wagga Wagga. Most populations are in the Yass region. Found in moist or dry forest communities, Box Gum Woodland TECs and secondary grassland derived from clearing of these communities. Grows in association with a large range of eucalypts (*Eucalyptus blakelyi*, *E. bridgesiana*, *E. dives*, *E. goniocalyx*, *E. macrorhyncha*, *E. mannifera, E. melliodora*, *E. polyanthemos*, *E. rubida*). Apparently unaffected by light grazing, as populations persist in some grazed sites.	Low. - Some suitable floristic habitat present but outside edge of known range with single record for the western edge of the ACT in 2020	Low - Some suitable floristic habitat present but outside edge of known range with single record for the western edge of the ACT in 2020.
Amphibromus fluitans	River Swamp Wallaby grass	Not listed	V	Grows mostly in permanent swamps. Needs wetlands that are at least moderately fertile and have some bare ground, conditions which are produced by seasonally-fluctuating water levels. Habitats in south-western NSW include swamp margins in mud, dam and tank beds in hard clay and in semi-dry mud of lagoons with Potamogeton and Chamaeraphis species.	Low - Outside of known distribution. No habitat.	Low - Outside of known distribution. No suitable habitat in study area.
Bossiaea grayi	Murrumbidgee Bossiaea	E	Not listed	Typically grows in sandy soil amongst boulders on river banks and adjacent slopes close to rivers.	Low - preferred habitat not likely present	Low - preferred habitat not present
Cupaniopsis tomentella	Boonah Tuckeroo	Not listed	V	Known only from an area between Boonah and Ipswich in south-eastern Queensland. It grows in vine thickets predominantly on fertile clay soils.	None - far outside known spatial and climatic range. No broadly associated vegetation previously mapped on site. Presumed spatial error for record.	None - far outside known spatial and climatic range. No broadly associated vegetation on site. Presumed spatial error for record.

Scientific Name	Common Name	NC Act status	EPBC Act status	Habitat requirements	Likelihood of occurrence based on desktop assessment	Likelihood of occurrence after site survey
Eucalyptus aggregata	Black Gum	V	V	Found in the NSW Central and Southern Tablelands, with small isolated populations in Victoria and the ACT. Has a moderately narrow distribution, occurring mainly in the wetter, cooler and higher parts of the tablelands, for example in the Blayney, Crookwell, Goulburn, Braidwood and Bungendore districts. In the ACT the species occurs to a very minor extent, with only 16 known mature trees in the wild in 2014.	Low - no recent records within locality. Preferred habitat not present within the Project site	Low - no recent records within locality. Preferred habitat not present within the Project site
Lepidium ginninderrense	Ginninderra Peppercress	E	V	Grows in natural temperate grassland, disturbed grassland and remnant Box Gum Woodland TEC. One known population occurs on the flood plain of Ginninderra Creek, especially in locations where grass tussocks and other plant growth are short and open, thus there is little competition for space and light. The soil type over most of the site is a shallow red earth, with patches of colluvium on the footslopes and the population occurs at an altitude of c.580m.	**Moderate – broad floristic habitat occurs in study area**	Low The study area does not support potential habitat for this species and is not one of the known locations. Not identified during current surveys
Lepidium hyssopifolium	Common Peppercress	Not listed	E	Occurs in a variety of habitats including woodland with a grassy understorey and grassland population near Bungendore and Crookwell both on the Southern Tablelands.	Low - not recorded within the Project site and not previously recorded within the locality	Low - not recorded within the study area and not previously recorded within the locality
Leucochrysum albicans var. *tricolor*	Hoary Sunray	Not listed	E	In NSW/ACT, occurs at relatively high elevations in woodland and open forest communities, in an area roughly bounded by Goulburn, Albury and Bega. Occurs in grasslands, grassy areas in woodlands and dry open forests, and modified habitats, on a variety of soil types including clays, clay loams, stony and gravelly soil.	**High – suitable general habitat known in locality. Records immediately adjacent.**	**Recorded within the study area.**
Muehlenbeckia tuggeranong	Tuggeranong Lignum	E	E	Known from the flood terraces on the eastern bank of the Murrumbidgee River south of Canberra. The site is near Pine Island, which occurs in the Murrumbidgee River Corridor.	Low - species known distribution is restricted to Murrumbidgee River. No habitat for species likely within Project site	Low - species known distribution is restricted to Murrumbidgee River. No habitat for species within Project site
Pomaderris cotoneaster	Cotoneaster Pomaderris	Not listed	E	Usually grows on shallow soils with outcropping rock, often associated with clifflines (above, on or below) or riverbanks. Occurs in dry, shrubby open forest on north-west to south-west facing slopes.	Low – preferred broad habitat not likely present	Low - preferred habitat not present.

Scientific Name	Common Name	NC Act status	EPBC Act status	Habitat requirements	Likelihood of occurrence based on desktop assessment	Likelihood of occurrence after site survey
Pomaderris pallida	Pale Pomaderris	V f	V	Has been recorded from near Kydra Trig, north west of Nimmitabel, Tinderry Nature Reserve, and the Queanbeyan River. The main distribution is along the Murrumbidgee in the ACT. Usually grows in shrub communities surrounded by Brittle Gum (*Eucalyptus mannifera*) and Red Stringybark (*E. macrorhyncha*) or *Callitris* spp. woodland.	**Moderate - previously recorded within proximity to Bullen Range and Murrumbidgee River. Marginal floristic associations possible in alignment**	Low. The species is not known to occur in the northern areas of the ACT. The species is reasonably conspicuous. Not recorded in the study area during surveys and floristic associations absent
Prasophyllum petilum	Tarengo Leek Orchid	E	E	Natural populations are known from a total of five sites in NSW. These area at Boorowa, Captains Flat, Ilford, Delegate and a newly recognised population near Muswellbrook. Also occurs at Hall in the ACT. Grows in open sites within natural temperate grassland at the Boorowa and Delegate sites. Also grows in grassy woodland in association with River Tussock *Poa labillardieri*, Black Gum *Eucalyptus aggregata* and tea-trees *Leptospermum* spp. at Captains Flat and within the grassy groundlayer dominated by Kangaroo Grass under Box-Gum Woodland TEC at Ilford (and Hall, ACT). Highly susceptible to grazing.	Low - species only known distribution in the ACT is restricted to Hall.	Low - species only known distribution in the ACT is restricted to Hall. Vegetation within the Project site has been subject to ongoing disturbance, has low species diversity particularly of non-grass groundcover species and is unlikely to support this disturbance sensitive species.
Rutidosis leptorrhynchoides	Button Wrinklewort	E	E	Occurs in box-gum woodland TEC, secondary grassland derived from box-gum woodland TEC or in natural temperate grassland; and often in the ecotone between the two communities. Grows on soils that are usually shallow, stony red-brown clay loams; tends to occupy areas where there is relatively less competition from herbaceous species (either due to the shallow nature of the soils, or at some sites due to the competitive effect of woodland trees). Exhibits an ability to colonise disturbed areas (e.g. vehicle tracks, bulldozer scrapings and areas of soil erosion). Observed flourishing at a site a few years after the area was burnt by a wildfire. Apparently susceptible to grazing, being retained in only a small number of populations on roadsides, rail reserves and other ungrazed or very lightly grazed sites.	**Moderate - recorded within 100m of site. The species can occur in modified habitats, but bare ground and disturbance required.**	Low – planted/direct sown individuals recorded within 100m of site. While some potential habitat occurs on site, it was not recorded during targeted surveys
Swainsona recta	Small Purple Pea	E	E	Found in grassland and open woodland, often on stony hillsides. Grows in association with understorey dominants that include Kangaroo Grass (*Themeda triandra*), poa tussocks (*Poa* spp.) and spear grasses (*Austrostipa* spp).	**Moderate - potential habitat in the form of grassy woodland occurs within the Project site.**	Low - potential habitat in the form of grassy woodland occurs within the Project site, but the species is usually found in relatively undisturbed sites (A. Rowell, pers. comm, February 2021). The species was not recorded during targeted surveys

Scientific Name	Common Name	NC Act status	EPBC Act status	Habitat requirements	Likelihood of occurrence based on desktop assessment	Likelihood of occurrence after site survey
Thesium australe	Austral Toadflax	V	V	Grows in grassland or woodland often in damp sites. It is a semi parasitic herb and hosts are likely to be *Themeda triandra* and *Poa* spp.	**Moderate – broad habitat present within the Project site. Although no recent records in locality, it is a relatively cryptic species.**	Low The species was not identified during recent vegetation surveys. While surveys were limited by the height and density of exotic grasses in the study area, it is typically found on less disturbed sites with few records in Canberra (Pers. comm. A. Rowell, February 2021)
Fauna						
Actitis hypoleucos	Common Sandpiper	Not listed	M	Utilises a wide range of coastal wetlands and some inland wetlands, with varying levels of salinity, and is mostly found around muddy margins or rocky shores and rarely on mudflats. Has been recorded in estuaries and deltas of streams, as well as on banks farther upstream; around lakes, pools, billabongs, reservoirs, dams and claypans, and occasionally piers and jetties. Often associated with mangroves, and sometimes found in areas of mud littered with rocks or snags.	Low - preferred habitat not present	Low - preferred habitat not present

Scientific Name	Common Name	NC Act status	EPBC Act status	Habitat requirements	Likelihood of occurrence based on desktop assessment	Likelihood of occurrence after site survey
Anthochaera phrygia (syn. *Xanthomyza phrygia*)	Regent Honeyeater	CE	CE	Occurs mostly in box-ironbark forests and woodland and prefers wet, fertile sites such as along creek flats, broad river valleys and foothills. Riparian forests with Casuarina cunninghamiana and Amyema cambagei are important for feeding and breeding. Spotted Gum and Swamp Mahogany forests are also important feeding areas in coastal areas. Important food trees include Eucalyptus sideroxylon (Mugga Ironbark), E. albens (White Box), E. melliodora (Yellow Box) and E. leucoxylon (Yellow Gum) (Garnett and Crowley 2000). Within the ACT Regent Honeyeaters movements are complex and usually dependent on the occurrence of blossom resource of several eucalypt species. In the ACT region individuals have regularly been associated with the occurrence of Yellow Box – Red Gum Grassy Woodland along the lower slopes of Mounts Ainslie and Majura, extending through Mulligans Flat Nature Reserve to the Sutton and Lake George areas. The occurrence of large heavily flowering eucalypts on fertile soils are important habitats for individuals. Due to the species rapid decline there has been few records of individuals within the ACT, and majority of sightings have been single birds or occasional pairs. It is perceived that the ACT region acts as an area for rare breeding summer visitors. The most recent breeding records are of four pairs on the lowest western slopes of Mount Majura bordering Antill Street in Watson in early 1996 (ACT Government - Environment and Planning Directorate - Environment 2015). The most recent sighting of the species in the ACT is from January 2020.	**High - within known distribution**	**Moderate - within known distribution and potential foraging and breeding habitat present.**
Apus pacificus	Fork-tailed Swift	Not listed	M	Breeds in the northern hemisphere, wintering south to Australia. Almost exclusively aerial, flying from less than 1 m to at least 300 m above ground. Mostly occurs over inland plains but sometimes above foothills or in coastal areas over cliffs, beaches, islands and well out to sea. Also occurs over towns and cities. Mostly occurs over dry and/or open habitats, including riparian woodland and tea-tree swamps, low scrub, heathland or saltmarsh, grassland, spinifex sandplains, farmland and sand-dunes. Sometimes occurs above forests. Probably roosts aerially but has occasionally been observed to land.	**Moderate - general habitat present, may occasionally forage over the study area**	**Moderate - general habitat present, may occasionally forage over the study area.**

Scientific Name	Common Name	NC Act status	EPBC Act status	Habitat requirements	Likelihood of occurrence based on desktop assessment	Likelihood of occurrence after site survey
Botaurus poiciloptilus	Australasian Bittern	E	E	Occurs mainly in freshwater wetlands and, rarely, in estuaries or tidal wetlands. Favours wetlands with tall dense vegetation. Favours permanent and seasonal freshwater habitats, particularly those dominated by sedges, rushes and reeds or cutting grass growing over a muddy or peaty substrate.	Low	Low
Calidris acuminata	Sharp-tailed Sandpiper	Not listed	M	In Australasia, prefers muddy edges of shallow fresh or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh or other low vegetation. This includes lagoons, swamps, lakes and pools near the coast, and dams, waterholes, soaks, bore drains and bore swamps, saltpans and hypersaline saltlakes inland.	Low	Low
Calidris ferruginea	Curlew Sandpiper	Not listed	M	Mainly occur on intertidal mudflats in sheltered coastal areas, such as estuaries, bays, inlets and lagoons, and also around non-tidal swamps, lakes and lagoons near the coast, and ponds in saltworks and sewage farms. They are also recorded inland, though less often, including around ephemeral and permanent lakes, dams, waterholes and bore drains, usually with bare edges of mud or sand. They occur in both fresh and brackish waters.	Low - preferred wetland habitat not present	Low - preferred wetland habitat not present
Calidris melanotos	Pectoral Sandpiper	Not listed	M	In Australasia, prefers shallow fresh to saline wetlands. The species is found at coastal lagoons, estuaries, bays, swamps, lakes, inundated grasslands, saltmarshes, river pools, creeks, floodplains and artificial wetlands.	Low	Low
Calyptorhynchus lathami	Glossy Black-cockatoo	V	Not listed	Uncommon although widespread throughout suitable forest and woodland habitats, from the central Queensland coast to East Gippsland in Victoria, and inland to the southern tablelands and central western plains of NSW, with a small population in the Riverina. Inhabits open forest and woodlands of the coast and the Great Dividing Range where stands of sheoak occur. In the ACT, they feed almost exclusively on Drooping Sheoaks (*Allocasuarina verticillata*) in larger stands. Major known feeding and breeding areas in Canberra are on Mount Majura and Mount Ainslie although have been sighted through surrounding nature reserves in the ACT. Dependent on large hollow bearing eucalypts for nest sites.	Low	Low- While large hollow bearing trees are present in the study area, no *Allocasuarina verticillata* in the study area Not recorded during surveys

Scientific Name	Common Name	NC Act status	EPBC Act status	Habitat requirements	Likelihood of occurrence based on desktop assessment	Likelihood of occurrence after site survey
Chalinolobus dwyeri	Large-eared Pied Bat	Not listed	V	Found mainly in areas with extensive cliffs and caves, from Rockhampton in Queensland south to Bungonia in the NSW Southern Highlands. It is generally rare with a very patchy distribution in NSW. Roosts in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin, frequenting low to mid-elevation dry open forest and woodland close to these features. Females have been recorded raising young in maternity roosts in roof domes in sandstone caves and overhangs. They remain loyal to the same cave over many years. Found in well-timbered areas containing gullies.	**Moderate – suitable habitat present**	Low Not recorded during surveys
Climacteris picumnus	Brown Treecreeper	V	Not listed	Found in sub-coastal environments and the inland slopes of the Great Dividing Range from the Grampians in western Victoria, through central New South Wales to the Queensland border and north to the Bunya Mountains. In the ACT, the species is found in dry woodlands and open forest below 1000 m, including in the Clear Range and along the Lower Naas River, Campbell Park, Goorooyarroo, Burbong, former quarries south of the airport, and Castle Hill, north of Tharwa. Important habitat includes relatively undisturbed grassy woodland with native understorey; large living and dead trees for nesting and foraging and fallen timber on the ground layer (Office of Environment & Heritage 2014). Unconfirmed reports suggest this species was likely observed in Kama reserve.	**Moderate - suitable habitat present and nearby records**	**Moderate** **Not recorded during surveys, habitat present**

Scientific Name	Common Name	NC Act status	EPBC Act status	Habitat requirements	Likelihood of occurrence based on desktop assessment	Likelihood of occurrence after site survey
Daphoenositta chrysoptera	Varied Sittella	V	Not listed	Inhabits most of mainland Australia except the treeless deserts and open grasslands. Inhabits eucalypt forests and woodlands, especially rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland. Feeds on arthropods gleaned from crevices in rough or decorticating bark, dead branches, standing dead trees, and from small branches and twigs in the tree canopy. Builds a cup-shaped nest of plant fibres and cobwebs in an upright tree fork high in the living tree canopy, and often re-uses the same fork or tree in successive years. In the ACT, it is recorded in Aranda bushland, O'Connor and Bruce Ridges, Black Mountain, the Pinnacle Stringybark forest, Mt Ainslie–Campbell Park, Mulligan's Flat, Bluett's Eucalypt forest, Naas and Orroral valleys, Shepherd's Lookout and the Murrumbidgee River Corridor. In this region, the species has a preference for areas with Red Stringybark (*Eucalyptus macrorhyncha*).	**Moderate - suitable habitat present and nearby records**	**Moderate** **Not recorded during surveys, habitat present**
Dasyurus maculatus	Spotted-tailed Quoll (southeastern mainland population)	E	E	Occurs from the Bundaberg area in south-east Queensland, south through NSW to western Victoria and Tasmania. In the ACT region there are occasional sightings with confirmed occurrences in three locations in Namadgi National Park. Most sightings have occurred in timbered ranges and large remnant reserves. Preferred habitat occurs in wide range of forest types, although appears to prefer moist sclerophyll and rainforest forest types, and riparian habitat. Most common in large unfragmented patches of forest. Has also been recorded from dry sclerophyll forest, open woodland and coastal heathland, and despite its occurrence in riparian areas, it also ranges over dry ridges. Nests in rock caves and hollow logs or trees. Feeds on a variety of prey including birds, terrestrial and arboreal mammals, small macropods, reptiles and arthropods.	Low - preferred habitat not present	Low While some habitat present, it is not that which is regionally preferred.

Scientific Name	Common Name	NC Act status	EPBC Act status	Habitat requirements	Likelihood of occurrence based on desktop assessment	Likelihood of occurrence after site survey
Delma impar	Striped Legless Lizard	V	V	Occurs in the Southern Tablelands, the South West Slopes and possibly on the Riverina. Populations are known in the Goulburn, Yass, Queanbeyan, Cooma and Tumut areas. It also occurs in the ACT, Victoria and south-eastern South Australia. In the ACT region, four disjunct populations are recognised: Gungahlin, Yarramundi Reach, Majura Valley and Jerrabomberra Valley. Found mainly in natural temperate grassland but has also been captured in grasslands that have a high exotic component. Also found in secondary grassland near natural temperate grassland and occasionally in open Box-Gum Woodland TEC. Habitat is where grassland is dominated by perennial, tussock-forming grasses such as Kangaroo Grass *Themeda australis*, spear-grasses *Austrostipa* spp. and poa tussocks *Poa* spp., and occasionally wallaby grasses *Austrodanthonia* spp. Sometimes present in modified grasslands with a significant content of exotic grasses. Also sometimes found in grasslands with significant amounts of surface rocks, which are used for shelter.	**Moderate - areas of potential habitat present**	**Moderate - areas of potential habitat present**
Falco hypoleucos	Grey Falcon	Not listed	V	Usually restricted to shrubland, grassland and wooded watercourses of arid and semi-arid regions, although it is occasionally found in open woodlands near the coast. Also occurs near wetlands where surface water attracts prey. Preys primarily on birds, especially parrots and pigeons, using high-speed chases and stoops; reptiles and mammals are also taken.	Low	Low
Gadopsis bispinosus	Two-spined Blackfish	V	Not listed	Only occurs in inland drainages of south-eastern Australia, where it is restricted to cool, clear upland or montane streams with abundant instream cover, usually in the form of boulders and cobble. In the ACT, the species is now found only in the Cotter River catchment upstream of the Cotter Dam.	None – habitat not present	None – habitat not present
Gallinago hardwickii	Lathams Snipe	Not listed	M	In Australia, occurs in permanent and ephemeral wetlands up to 2000 m above sea-level. They usually inhabit open, freshwater wetlands with low, dense vegetation (e.g. swamps, flooded grasslands or heathlands, around bogs and other water bodies). However, they can also occur in habitats with saline or brackish water, in modified or artificial habitats, and in habitats located close to humans or human activity.	Low	Low

Scientific Name	Common Name	NC Act status	EPBC Act status	Habitat requirements	Likelihood of occurrence based on desktop assessment	Likelihood of occurrence after site survey
Grantiella picta	Painted Honeyeater	V	V	Lives in dry forests and woodlands. Primary food is the mistletoes in the genus Amyema, though it will take some nectar and insects. Its breeding distribution is dictated by presence of mistletoes which are largely restricted to older trees. Less likely to be found in in strips of remnant box ironbark woodlands, such as occur along roadsides and in windbreaks, than in wider blocks. In the ACT region, the species has been recorded from a range of woodlands that contain mistletoe, including River Oak (*Casuarina cunninghamiana*) woodland associated with river systems, and Yellow Box–Red Gum Woodlands at locations such as Mulligans Flat and Campbell Park.	**Moderate**	Low Mistletoe not present in the study area.
Hieraaetus morphnoides	Little Eagle	V	Not listed	Distributed throughout the Australian mainland occupying habitats rich in prey within open eucalypt forest, woodland or open woodland. Sheoak or acacia woodlands and riparian woodlands of interior NSW are also used. For nest sites it requires a tall living tree within a remnant patch. Prey includes birds, reptiles and mammals, with the occasional large insect and carrion. Most of its former native mammalian prey species in inland areas are extinct and rabbits now form a major part of the diet. Within the ACT sightings have been recorded across majority of the territory, however, breeding range has been restricted to the lower parts of northern ACT around the Murrumbidgee and Molonglo river corridors.	**Moderate - may forage or fly over area.**	**Moderate - may forage or fly over area. Large, unoccupied, stick nests occur within the study area. Occasional visitor to Pinnacle Reserve.**
Hirundapus caudacutus	White-throated Needletail	Not listed	V, M	Almost exclusively aerial, from heights of less than 1 m up to more than 1000 m above the ground. Occurs in airspace over forests, woodlands, farmlands, plains, lakes, coasts and towns. Breeds in the northern hemisphere and migrates to Australia in October-April. It is widespread in eastern and south-eastern Australia.	**Moderate - likely to forage above the study area and surrounding vegetation**	**Moderate - likely to forage above the study area and surrounding vegetation. Uncommon, non-breeding summer migrant in Pinnacle Reserve.**

Scientific Name	Common Name	NC Act status	EPBC Act status	Habitat requirements	Likelihood of occurrence based on desktop assessment	Likelihood of occurrence after site survey
Lalage sueurii	White-winged Triller	V	Not listed	Found across Australia. It is resident near water in the north, but nomadic and seasonally migratory through central and southern Australia. In the ACT region, the species is an uncommon, breeding, summer migrant, and numbers vary from year to year. In the local area, the species is found in and around grassy woodland areas including Yellow Box–Red Gum, Apple Box, Candlebark. Important habitat includes large living and dead trees and areas of grass and fallen timber for foraging. In the ACT region, records of the species are widespread, but most records are from Hall, Mulligans Flat, Goorooyarroo, the Pinnacle, Campbell Park and the Gigerline–Tharwa area.	**Moderate - uncommon but known to occur in Pinnacle and Kama Reserves.**	**Moderate - uncommon but known to occur in Pinnacle and Kama Reserves.**
Lathamus discolor	Swift Parrot	CE	CE	Breeding occurs in Tasmania, then the majority of the population migrates to mainland Australia in autumn, over wintering in Victoria and central and eastern NSW, but also south-eastern Queensland. In mainland Australia it is semi-nomadic, foraging in flowering eucalypts in eucalypt associations, particularly box-ironbark forests and woodlands. Preference for sites with highly fertile soils where large trees have high nectar production, including along drainage lines and isolated rural or urban remnants, and for sites with flowering *Acacia pycnantha*, is indicated. Sites used vary from year to year. In the ACT region, the Swift Parrot is associated with flowering and lerping eucalypts, particularly box-ironbark communities and Yellow Box – Red Gum Woodlands. Has the potential to occur anywhere below 700m and has also been recorded in suburban environments. Majority of records of the species have been from inner Canberra suburbs, Gungahlin and Hall.	**Moderate - suitable winter foraging habitat in the study area. Known to occur in Kama Reserve.**	**Moderate - suitable winter foraging habitat in the study area. Known to occur in Kama Reserve.**
Litoria aurea	Green and Golden Bell Frog	V	V	Occurs in fragmented patches near coastal locations from Vic to south of the NSW QLD border. The species was previously known from elsewhere in the Southern Tablelands but is now considered to have disappeared from the ACT. For breeding it utilises a wide range of waterbodies, including both natural and man-made structures, such as marshes, dams and stream sides, and ephemeral wetlands. Found in small pockets of habitat in otherwise developed areas and can occur in disturbed sites.	Low - preferred habitat not present. No records nearby	Low- Is regarded as locally extinct in the ACT (ACT Nature Conservation (Green and Golden Bell Frog) Conservation Advice 2019)

Scientific Name	Common Name	NC Act status	EPBC Act status	Habitat requirements	Likelihood of occurrence based on desktop assessment	Likelihood of occurrence after site survey
Litoria castanea	Yellow spotted Tree Frog	CE	CE	Rediscovered in 2011 in the Southern Highlands. It has two separate highland ranges, on the New England Tableland and on the southern highlands. The southern highlands population has a restricted distribution between Canberra, ACT, and Bombala, NSW, at altitudes between 700 and 800m. It requires large permanent ponds or slow flowing streams with plenty of emergent vegetation such as bulrushes.	Low - preferred habitat not present	Low- The Yellow-spotted Bell Frog may be extinct in the wild, however, there is a possibility that some individuals have remained undetected as a result of insufficient survey effort (NPWS 2001; Hero *et al.* 2006 in ACT Nature Conservation (Yellow-spotted Bell Frog) Conservation Advice 2019).
Litoria booroolongensis	Booroolong Frog	Not listed	E	Restricted to NSW and north-eastern Victoria, predominantly along the western-flowing streams of the Great Dividing Range. Live along permanent streams with some fringing vegetation cover such as ferns, sedges or grasses. Adults occur on or near cobble banks and other rock structures within stream margins and shelter under rocks or amongst vegetation near the ground on the stream edge.	Low - preferred habitat not present	Low - preferred habitat not present
Maccullochella macquariensis	Trout Cod	E	E	Once widespread in the south eastern region of the Murray-Darling Basin with records from the Murray, Murrumbidgee and Macquarie rivers in New South Wales/Australian Capital Territory and the Goulburn, Broken, Campaspe, Ovens, King, Buffalo and Mitta Mitta rivers in Victoria. In general, it appears that adults are essentially a pool dwelling, cover-seeking fish. In the ACT the species has been released in the Murrumbidgee River and associated tributaries.	None - no waterways on site	None - no suitable waterways in the study area
Maccullochella peelii	Murray Cod	Not listed	V	Historically distributed throughout the Murray-Darling Basin, with the exception of the upper reaches of some tributaries. Still occurs in most parts of this natural distribution, up to about 1000 m above sea level. Utilises a diverse range of habitats from clear rocky streams, such as those found in the upper western slopes of NSW (including the ACT), to slow-flowing, turbid lowland rivers and billabongs. Preferred microhabitat consists of complex structural features in streams such as large rocks, snags (pieces of large submerged woody debris), overhanging stream banks and vegetation, tree stumps, logs, branches and other woody structures. Known to occur in Lake Ginninderra.	None - no suitable waterways in the study area	None - no suitable waterways in the study area

Scientific Name	Common Name	NC Act status	EPBC Act status	Habitat requirements	Likelihood of occurrence based on desktop assessment	Likelihood of occurrence after site survey
Macquaria australasica	"Macquarie Perch	E	E	Found in the Murray-Darling Basin and parts of south-eastern coastal NSW, including the Hawkesbury/Nepean and Shoalhaven catchments. In the ACT, it is restricted to four rivers; the Murrumbidgee, Molonglo, Paddys and Cotter rivers. Found in both river and lake habitats; especially the upper reaches of rivers and their tributaries. Prefers clear water and deep, rocky holes with lots of cover.	None - no suitable waterways in the study area	None - no suitable waterways in the study area
Melanodryas cucullata	Hooded Robin	V	Not listed	Found in south-eastern Australia, generally east of the Great Dividing Range. Found in eucalypt woodland and mallee and acacia shrubland. Occupies drier eucalypt forest, woodland and scrub, grasses and low shrubs, as well as cleared paddocks with regrowth or stumps. Avoids dense forests and urban areas. Yellow Box–Red Gum Grassy Woodland provides important habitat. Appears unable to survive in remnants smaller than 100-200ha. In the ACT, the species has been recorded at Mulligans Flat Nature Reserve, Goorooyarroo Woodlands, Newline Quarry, Majura Field Firing Range and Tharwa. Black Mountain, Campbell Park, Mt Ainslie and Tuggeranong Homestead may no longer support populations of the species.	**Moderate. Suitable habitat in the study area.**	Low - may temporarily occupy woodland in the study area.
Monarcha melanopsis	Black-faced Monarch	Not listed	M	Widespread in eastern Australia. In NSW and the ACT, the species occurs around the eastern slopes and tablelands of the Great Divide, inland to Coutts Crossing, Armidale, Widden Valley, Wollemi National Park, Wombeyan Caves and Canberra. Mainly occurs in rainforests, but also is known to occur in eucalypt woodlands, coastal scrubs, damp gullies in rainforest, eucalypt forest and in more open woodland when migrating.	Low - may temporarily occupy woodland habitat during migration	Low - may temporarily occupy woodland habitat during migration
Motacilla flava	Yellow Wagtail	Not listed	M	This species occurs in a range of habitats including estuarine habitats such as sand dunes, mangrove forests and coastal saltmarshes. This species also occurs in open grassy areas including disturbed sites such as sports grounds and has been recorded on the edges of wetlands, swamps, lakes and farm dams. This species migrates from Asia to Australia in spring-summer. It has been recorded in the estuarine areas of the Hunter River in Newcastle NSW and in QLD and the north of NT and WA (Higgins, Peter et al. 2006).	Low - marginal habitat occurs near the study area	Low - marginal habitat occurs near the study area

Scientific Name	Common Name	NC Act status	EPBC Act status	Habitat requirements	Likelihood of occurrence based on desktop assessment	Likelihood of occurrence after site survey
Myiagra cyanoleuca	Satin Flycatcher	Not listed	M	Widespread in eastern Australia. In NSW and ACT, they are widespread on and east of the Great Divide and sparsely scattered on the western slopes, with very occasional records on the western plains. Inhabit heavily vegetated gullies in eucalypt dominated forests and taller woodlands, and on migration, occur in coastal forests, woodlands, mangroves and drier woodlands and open forests. Mainly inhabit eucalypt forests, often near wetlands or watercourses. They generally occur in moister, taller forests, often occurring in gullies. They also occur in eucalypt woodlands with open understorey and grass ground cover and are generally absent from rainforest. In the ACT, they occur mainly between 800 m above sea level and the treeline.	**Moderate - known to occur in eucalypt woodlands and in more open woodland when migrating**	**Moderate - known to occur in eucalypt woodlands and in more open woodland when migrating. A very occasional visitor to Pinnacle Reserve in spring or autumn.**
Numenius madagascariensis	Eastern Curlew	Not listed	CE, M	Inhabits coastal estuaries, mangroves, mud flats and sand pits. Its migration route ranges from its wintering grounds in Australia to its breeding grounds in northern China, Korea and Russia.	Low - preferred habitat not present	Low - preferred habitat not present
Pandion haliaetus	Eastern Osprey	Not listed	M	Occur in littoral and coastal habitats and terrestrial wetlands of tropical and temperate Australia and offshore islands. Mostly found in coastal areas but occasionally travel inland along major rivers, particularly in northern Australia. They may occur over atypical habitats such as heath, woodland or forest when travelling to and from foraging sites.	Low - preferred habitat not present, although may be observed flying over the study area	Low - preferred habitat not present, although may be observed flying over the study area
Perunga ochracea	Perunga Grasshopper	V	Not listed	Important habitat for the species appears to be natural temperate grassland dominated by wallaby, kangaroo and spear grasses with forb food plants located in the inter-tussock spaces. Grass tussocks are used also to escape predators. May also occur in open woodland areas with a grassy understorey, including the critically endangered Yellow Box–Red Gum Grassy Woodland community. Records of the species are from Wagga Wagga, Boorowa, Galong, the ACT and adjacent areas of NSW. ACT locality records include Black Mountain, Gungahlin, Majura Valley, Canberra International Airport, Jerrabomberra Valley, Molonglo valley, the Campbell Park paddocks, Belconnen Naval Station, Hall, Kambah Pool, Mt Stromlo, Reid, Weetangera and Tuggeranong.	**Moderate. Habitat present in the study area.** **No known population in the study area.**	**Moderate. Habitat present in the study area.** **No known population in the study area.**

Scientific Name	Common Name	NC Act status	EPBC Act status	Habitat requirements	Likelihood of occurrence based on desktop assessment	Likelihood of occurrence after site survey
Petauroides volans	Greater Glider	V	V	Has a restricted distribution in eastern Australia, from the Windsor Tableland in north Queensland to central Victoria. Restricted to eucalypt forests and woodlands, with a diet comprising of eucalypt leaves and occasional flowers. Found in abundance in montane eucalypt forest with relatively old trees and an abundance of hollows. Also favours forests with a diversity of eucalypts to cater for seasonal variation in food abundance. In the ACT region the species has been recorded in the Namadgi National Park and Tidbinbilla Nature Reserve.	Low - preferred habitat not present	Low - preferred habitat not present
Petrogale penicillata	Brush-tailed Rock-wallaby	E	V	Occurs in inland and sub-coastal south eastern Australia where it inhabits rock slopes. Has a preference for rocks that receive sunlight for a considerable part of the day. Windblown caves, rock cracks or tumbled boulders are used for shelter. Occur in small groups each usually separated by hundreds of metres. Within the ACT the species is presumed to be extinct.	Low - preferred habitat not present	Low - preferred habitat not present
Petroica boodang	Scarlet Robin	V	Not listed	Occupies dry open eucalypt forests and woodlands from the coast to the inland slopes. Prefers an open understorey of shrubs and grasses. Abundant logs and coarse woody debris are important structural components of its habitat. In autumn and winter it migrates to more open habitats such as grassy open woodland or paddocks with scattered trees. In the ACT region, it is widely distributed and during autumn adults and immature birds disperse from forested slopes into more open valleys around Canberra, with odd occurrences in suburban gardens. Found to be absent from remnants surrounded by cereal cropping, less common in isolated patches of 30 ha or less (where there was no tree cover within 200 m and less than 20% cover within 1 km), less common in sites surrounded by cattle grazing and more common in sites with native versus exotic grasses if ungrazed for more than 10 years.	**Moderate.** **Suitable habitat.** **Known to occur in Pinnacle and Kama Reserves.**	**Moderate.** **Suitable habitat.** **Known to occur in Pinnacle and Kama Reserves.**

Scientific Name	Common Name	NC Act status	EPBC Act status	Habitat requirements	Likelihood of occurrence based on desktop assessment	Likelihood of occurrence after site survey
Phascolarctos cinereus	Koala	V	V	Has a fragmented distribution throughout eastern Australia from north-east Queensland to the Eyre Peninsula in South Australia. In NSW it mainly occurs on the central and north coasts with some populations in the west of the Great Dividing Range. Inhabits eucalypt woodlands and forests. Feed on the foliage of more than 70 eucalypt species and 30 non-eucalypt species, but in any one area will select preferred browse species. The preferred tree species vary widely on a regional and local basis. The NSW Koala Recovery Plan (2008) list three of the tree species on site, *Eucalyptus melliodora*, *E. bridgesiana* and *E. blakelyi*, as secondary feed trees for the South East Highlands, with *E. macroryncha* listed as a supplementary feed tree.	**Moderate - potential habitat as likely locally preferred feed trees present on site**	Low- species has not been recorded near site as non-captive individuals
Polytelis swainsonii	Superb Parrot	V	V	Found throughout eastern inland NSW and ACT. On the South-western Slopes their core breeding area is roughly bounded by Cowra and Yass in the east, and Grenfell, Cootamundra and Coolac in the west. Birds breeding in this region are mainly absent during winter, when they migrate north to the region of the upper Namoi and Gwydir Rivers. The other main breeding sites are in the Riverina along the corridors of the Murray, Edward and Murrumbidgee Rivers where birds are present all year round. Inhabit Box-Gum, Box-Cypress-pine and Boree Woodlands and River Red Gum Forest. On the South West Slopes nest trees can be in open Box-Gum Woodland TEC or isolated paddock trees. Tree species known to be used are Blakely's Red Gum, Yellow Box, Apple Box and Red Box. Feed in trees and understorey shrubs and on the ground and their diet consists mainly of grass seeds and herbaceous plants. Also eaten are fruits, berries, nectar, buds, flowers, insects and grain. In the ACT region, the Hall area in the northern part of the ACT forms the southern edge of one of the two main centres for breeding distribution of the Superb Parrot. In the ACT region, Yellow Box–Red Gum Grassy Woodlands form the major habitat of the species, with *E. blakelyi* being the main source of nesting hollows. Recent studies found that Superb Parrots nesting at Throsby in northern ACT chose to breed in trees that had: a trunk DBH of at least 75cm; hollows at least 4m above the ground that were in or proximal to the main trunk; and preferred near round entrance hollows about 11cm across and within the range of 8 -18 cm.	**High** **Suitable habitat and several other records nearby**	**Recorded – observed flying over the study area. Potential breeding trees occur within the study area. Several other records nearby**

Scientific Name	Common Name	NC Act status	EPBC Act status	Habitat requirements	Likelihood of occurrence based on desktop assessment	Likelihood of occurrence after site survey
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	Occurs in the coastal belt from Rockhampton in central Queensland to Melbourne in Victoria. Selectively forages where food is available. The species is widespread throughout their range in summer, whilst in autumn it occupies coastal lowlands and is uncommon inland. In winter, the species congregates in coastal lowlands north of the Hunter Valley and is occasionally found on the south coast of NSW. Occurs in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are generally located within 20 km of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy. Feed on the nectar and pollen of native trees, in particular Eucalyptus, Melaleuca and Banksia, and fruits of rainforest trees and vines.	**Moderate - ACT record 1 km away. May occasionally fly over Project site**	**Moderate - ACT record 1 km away. May occasionally forage and fly over the study area.**
Rhipidura rufifrons	Rufous Fantail	Not listed	M	Occurs in a range of habitats including the undergrowth of rainforests/wetter eucalypt forests/gullies, monsoon forests paperbarks, sub-inland and coastal scrubs, mangroves, watercourses, parks and gardens. When migrating they may also be recorded on farms, streets and buildings. Migrates to SE Australia in October-April to breed, mostly in or on the coastal side of the Great Dividing Range.	Low - may migrate through Project site on rare occasions	Low - may migrate through Project site on rare occasions
Rostratula australis (syn. *R. benghalensis*)	Australian Painted Snipe (Painted Snipe)	E	E	Inhabits shallow, vegetated, temporary or infrequently filled wetlands, including where there are trees such as *Eucalyptus camaldulensis* (River Red Gum), *E. populnea* (Poplar Box) or shrubs such as *Muehlenbeckia florulenta* (Lignum) or *Sarcocornia quinqueflora* (Samphire).	Low - preferred habitat not present	Low - preferred habitat not present

Likelihood of occurrence table

Scientific Name	Common Name	NC Act status	EPBC Act status	Habitat requirements	Likelihood of occurrence based on desktop assessment	Likelihood of occurrence after site survey
Synemon plana	Golden Sun Moth	E	CE	The Golden Sun Moth's NSW populations are found in the area between Queanbeyan, Gunning, Young and Tumut. The species' historical distribution extended from Bathurst (central NSW) through the NSW Southern Tablelands, through to central and western Victoria, to Bordertown in eastern South Australia. Occurs in natural temperate grassland and grassy woodlands in which groundlayer is dominated by wallaby grasses (*Austrodanthonia* spp). Grasslands dominated by wallaby grasses are typically low and open - the bare ground between the tussocks is thought to be an important microhabitat feature for the Golden Sun Moth, as it is typically these areas on which the females are observed displaying to attract males. Habitat may contain several wallaby grass species, which are typically associated with other grasses particularly spear-grasses *Austrostipa* spp. or Kangaroo Grass *Themeda australis*.	**Moderate**	Low -The vegetation is all former woodland and the biomass in the road easement is uncontrolled, with little vertebrate grazing and only edge mowing. While very limited areas of habitat structure required for Golden Sun Moth (GSM) occur they would thus only occur in some years, and its life cycle is longer than one year. No records nearby.
Tympanocryptis pinguicolla	Grassland Earless Dragon	E	E	In the ACT region, the species is found only in a small number of sites with suitable native grassland habitat located in the Majura and Jerrabomberra valleys and one adjacent location near Queanbeyan in NSW. Occurs in natural temperate grassland sites dominated by wallaby grasses (*Rytidosperma* spp.), spear grasses (*Austrostipa* spp.), Poa Tussock (*Poa sieberiana*), Red Grass (*Bothriochloa macra*), and occasionally Kangaroo Grass (*Themeda australis*). Introduced pasture grasses occur at many of the sites supporting this species, which has also been captured in secondary grassland. Within its habitat, apparently prefers areas with a more open structure, characterised by small patches of bare ground between the grasses and herbs. In addition to tussocks, partially embedded surface rocks, and spider and insect holes are used for shelter.	Low - marginal habitat present within the Project site	Low–requires primary natural temperate grassland. No previous records in the valley of the study area.

Appendix C **Assessments of significance**

EPBC Act Assessments of significance

White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland – Critically Endangered

Community description

White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland is characterised by the occurrence of White Box (*Eucalyptus albens*), Yellow Box (*E. melliodora*) and Blakely's Red Gum (*E. blakelyi*). These three species can occur as homogenous stands or in mixed stands with other trees. Commonly co-occurring canopy species that can be characteristic of this Box-Gum Woodland TEC include Apple Box (*E. bridgesiana*), Red Box (*E. polyanthemos*), Grey Box (*E. moluccana*), Candlebark (*E. rubida*) and Broad-leaved Stringybark (*E. goniocalyx*). A diverse groundcover assemblage of grasses, herbs and forbs is characteristic of this TEC including species such as Kangaroo Grass (*Themeda triandra*), Poa Tussock (*Poa sieberiana*), wallaby grasses (*Rytidosperma* spp.), spear grasses (*Austrostipa* spp.), Common everlasting (*Chrysocephalum apiculatum*), Blue-bells (*Wahlenbergia* spp.) and *Goodenia pinnatifida* (DPIE 2020). The derived native grassland variant of Box-Gum Woodland TEC recorded on site consisted of groundcover species such as *Poa sieberiana*, *Rytidosperma* sp., *T. triandra*, *Lomandra filiformis*, *Plantago varia* and *Geranium solanderi*.

Threats

Threats to this Box-Gum Woodland TEC include historical and continued clearing. The remaining extent of the ecological community is highly fragmented, occurring in small isolated patches within a cleared environment, or within a landscape of other disturbed woodlands. Weeds, fire, urbanisation, inappropriate disturbance regimes, invasive plants, pest animals, eucalypt dieback, climate change and salinity are also identified as additional or associated threats.

Distribution and habitat

The distribution of this Box-Gum Woodland TEC extends from the NSW-QLD border in the north to the NSW-VIC border in the south. This TEC primarily occurs along the western slopes of the Great Dividing Range and across the tableland regions however there are smaller occurrences in more coastal settings such as the Hunter Valley. The remaining stands of this Box-Gum Woodland TEC usually occur in lower parts of a landscape where soil fertility is comparatively higher than the adjacent hills and ridges (DPIE 2020). Typically, this Box-Gum Woodland TEC occurs in areas where rainfall is between 400 and 1200 mm per annum at altitudes of 170 metres to 1200 metres (NSW Scientific Committee 2002).

An action is likely to have a significant impact on a Critically Endangered Ecological Community if there is a real chance or possibility that it will:
reduce the extent of an ecological community
The Project will directly clear 6.41 hectares of this Box-Gum Woodland TEC therefore reducing its extent.
fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines.
The widening of William Hovell Drive will increase the distance separating stands of this Box Gum Woodland TEC bisected by the existing road such as those occurring on the edges of Kama and The Pinnacle nature reserves. The existing roadway already constitutes a significant fragmentation of such patches. Widening constitutes a relatively marginal increase in fragmentation in those patches which are contiguous with larger areas of the community outside the clearing areas. An increase in fragmentation is more apparent in already less connected patches which are subject to partial or complete clearing. By clearing this Box Gum Woodland TEC, the Project will reduce the community's extent within the locality (a 10-kilometre radius). Partially clearing stands of this Box Gum Woodland TEC or clearing entire stands will increase the fragmentation of the community.
adversely affect habitat critical to the survival of an ecological community.
The Project will clear (and adversely affect) 6.41 hectares of this Box-Gum Woodland TEC habitat for the widening of the road surface and construction of associated road infrastructure. Within the study area, this habitat is likely critical to the survival of the TEC. Under the National Recovery Plan for the community all areas of Box-Gum Grassy Woodland which meet the minimum condition criteria outlined in Section 3 should be considered critical to the survival of this ecological community.
modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns
The impact to these factors is confined to the clearing areas and considered permanent. Outside clearing boundary modification to soils and hydrology is to be minimal as documented in the Hydrological Assessment. No modification of abiotic factors necessary for the community's survival outside of the clearing boundary necessary of the community's survival locally or more broadly in the ACT.

An action is likely to have a significant impact on a Critically Endangered Ecological Community if there is a real chance or possibility that it will:
cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting
The Project will cause a substantial change to the species composition in the occurrence of this Box Gum Woodland TEC within the study area. The Project will change the species composition by directly clearing all vegetation within the clearing boundary. The native species composition outside of the clearing boundary but within the study area may be modified indirectly. Indirect modifications may occur through the spread and promotion of non-native species and weeds, by spread of pathogens and disease and by increasing pollutants.
cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to: **(i) assisting invasive species, that are harmful to the listed ecological community, to become established, or** **(ii) causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community, or**
(i) The potential of increased nutrient levels in runoff, and a potential increase in surface water will favour some invasive species – such as *Phalaris aquatica* – thereby promoting their establishment within the study area. The increased traffic of plant, equipment and people during the construction may spread new non-native flora and weeds into the study area. These weeds may then be spread throughout the study area and into Kama and The Pinnacle nature reserves. (ii) The Project has the potential to spread pollutants and chemicals – such as hydrocarbons and tyre dust from cars – via a modified drainage system. These chemicals and pollutants are also likely to increase with greater traffic on William Hovell Drive.
interfere with the recovery of an ecological community
Directly clearing 6.41 hectares of this Box-Gum Woodland TEC and replacing it with a widened road and associated road infrastructure will interfere with the recovery of the community in the study area and more generally nationally given the currently highly fragmented and degraded state of this ecological community. The first aim of the National Recovery Plan for the community is "achieving no net loss in extent and condition of the ecological community throughout its geographic distribution". In addition, the recovery plan also states that "degraded woodland areas not considered part of the listed ecological community, may also be essential to the long-term conservation of Box-Gum Grassy Woodland, by virtue of their landscape setting (e.g. providing connectivity) or remaining flora/fauna habitat features (e.g. occurrence of rare or threatened species, tree hollows), and should also be considered as potential habitat critical to the survival of this ecological community". As such clearing of remnants of derived grassland, particularly those containing habitat features such as rocks for pin-tailed worm lizards, is also contra to the recovery plan. The impacts associated with the Project will also interfere with the recovery of the ecological community in the locality, particularly across Kama and The Pinnacle nature reserves.
Conclusion
The Project will clear 6.41 hectares of this Box-Gum Woodland TEC. Soil nutrient levels, groundwater and surface water runoff patterns will potentially be impacted, having an adverse effect not only on the native vegetation within the study area but also in downstream stands outside it. Impacts to this Box-Gum Woodland TEC within the study area may indirectly impact occurrences of the community in wider locality, in particular, in Kama and The Pinnacle nature reserves, The Project therefore has the **potential to have a significant impact** on this Box-Gum Woodland TEC.

Hoary Sunray (*Leucochrysum albicans* var. *tricolor*) - Endangered

Description

Leucochrysum albicans var. *tricolor* is a perennial everlasting daisy. This species grows between 10 and 20 centimetres tall and produces yellow disc florets that are surrounded by white bracts. *L. albicans* var. *tricolor* has narrow leaves that are between 2 and 10 centimetres long and are covered in a white cotton-like indumentum (Sinclair 2010). Although perennial, this species will die back over summer where it will survive as a root stock. Individuals are likely to only live for a few years as do the numerous seeds that they produce (Gilfedder and Kirkpatrick 1994). Population sizes have been observed to vary significantly from year to year (Berechree 2003).

L. albicans var. *tricolor* is an obligate out-breeder – that it, it requires the transfer of pollen between individuals to successfully reproduce. Pollination of *L. albicans* var. *tricolor* is known to be conducted by bees (Apidae) and flies (Tephritidae) (Berechree 2003). Seed dispersal is thought to be possible over numerous kilometres with seed being able to germinate over a range of conditions (Gilfedder and Kirkpatrick 1994).

Threats

Historically, the greatest threat to *L. albicans* var. *tricolor* has been habitat clearance associated with agriculture. In the ACT, habitat clearance is still a large threat however now it is usually associated with private and public development. Weeds are also a threat in the ACT as populations are usually restricted to small habitat fragments adjacent to development or in reserves with existing weed infestations. In such reserves, *L. albicans* var. *tricolor* can struggle to persist if biomass (often weeds) is not cleared to allow seed to germinate.

Distribution and habitat

L. albicans var. *tricolor* has a discontinuous distribution across New South Wales, Victoria and Tasmania. In NSW and the ACT, *L. albicans* var. *tricolor* has been recorded in the Southern Tablelands in area bounded by the Sydney Basin, Goulburn, the Southern Highland and the Australian Alps. This taxon was previously more common, occurring on the South West Slopes, in the South East Corner bioregion and in the Brigalow Belt South bioregion (Sinclair 2010).

L. albicans var. *tricolor* habitat includes a range of grasslands, woodlands and dry open forests. This habitat is usually supported by heavier soils such as clays, clay loams and soils with a gravel component. In the ACT, *L. albicans* var. *tricolor* has been recorded in disturbed sites as the bare ground can be favourable for germination and establishment (Sinclair 2010).

Populations

For the purpose of this assessment, the population of *L. albicans* var. *tricolor* encompasses at least all individuals occurring within the study area (both sides of the road). Those occurring in Kama Nature Reserve and likely occurring between the study area and The Pinnacle Nature Reserve are known to have been enhanced through regeneration techniques involving soil scraping and sowing to mimic bare ground for germination. While these plants in Kama Nature Reserve are considered all planted or recruited from planted/direct sown stock, naturalised or natural plants are recorded further within the location across the northern ACT, and as per Department of Environment (2013), the population is considered to at least extend across the Canberra area.

An action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:
lead to a long-term decrease in the size of a population
Actions associated with the Project will directly clear Thirteen *L. albicans* var. *tricolor* individuals. 56 other individuals were counted in the study area outside the clearing boundary. While this will adversely affect the size of the population, a larger number of plants were observed in the adjacent Kama Nature Reserve and will not be cleared. While the number of individuals occurring in the adjacent nature reserve was not counted, field observation estimated that approximately 1 hectare contained several thousand individuals. or at least 300 times more than within the clearing boundary. The individuals in Kama Nature Reserve also appeared to be larger and more mature, perhaps indicating that the individuals observed in the road reserve were their offspring from windblown seed. Note, it is possible that *L. albicans* var. *tricolor* occurs in areas of The Pinnacle Nature Reserve that were not visited during the survey period.
reduce the area of occupancy of the species
Actions associated with the Project will clear 10.9 hectares of potential habitat, including 6.46 hectares of Grassy Woodland, 0.03 hectares of Native Grassland and 4.41 of Planted Native habitat. All these communities have been assessed as the 'area of occupancy' for *L. albicans* var. *tricolor* within the study area.
fragment an existing population into two or more smaller populations
The population of *L. albicans* var. *tricolor* has been defined as those individuals occurring within the study area and in Kama Nature Reserve and further across Canberra. The Project will remove 13 individuals occurring in the study area with those occurring in Kama Nature Reserve remaining uncleared. Currently, those individuals occurring on different sides of William Hovell Drive are able to interact with each other as pollinators and the dispersal of seed is likely able to cross the existing alignment. The widening of the road corridor is unlikely to completely

An action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:
prevent seed dispersal and pollinators crossing the road. As such, the Project is unlikely to fragment the existing population in to two or more smaller populations.
adversely affect habitat critical to the survival of a species
The 10.9 hectares of habitat (area of occupancy) within the study area, and the 13 individuals known to be removed as part of the Project, are unlikely to be critical to the survival of the species or the population.
disrupt the breeding cycle of a population
The widening of William Hovell Drive will adversely affect seed disposal and the frequency of cross-road pollination. These processes are unlikely to completely stop or even slow to the extent that the population of *L. albicans* var. *tricolor* is greatly impacted.
modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline
The clearing of 10.9 hectares of potential habitat, including 6.46 hectares of Grassy Woodland, 0.03 hectares of Native Grassland and 4.41 of Planted Native habitat will permanently decrease the extent of available habitat for the *L. albicans* var. *tricolor* population. The loss of this available habitat will cause the population to decline.
result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat
L. albicans var. *tricolor* is adversely impacted from the competition of non-native and invasive flora species. Non-native grasses such as *Phalaris aquatica* and *Festuca arundinacea* (Tall Fescue) were commonly observed throughout the study area. It is unlikely that the Project will further increase the occurrence of these species. It is also important to note that the individuals recorded in the study area were growing along a ridge line with thinner soils. The recorded invasive grasses are less likely to become established in this type of habitat, preferring wetter habitat with higher nutrient levels and deeper soil.
introduce disease that may cause the species to decline, or
Plant diseases such as root rot caused by *Phytophthora cinnamomi* are not known to affect *L. albicans* var. *tricolor*. The Project is unlikely to result in the introduction of any plant diseases.
interfere substantially with the recovery of the species.
The National Recovery Plan for the species recognise that more information is needed on this species, and 'critical' habitat is yet to be determined. The objectives of the Recovery plan are; 1. Determine distribution, abundance and population structure 2. Determine habitat requirements 3. Ensure that key populations and their habitat are protected, monitored and managed appropriately 4. Manage threats to populations 5. Identify key biological characteristics 6. Determine growth rates and viability of populations 7. Build community support for conservation Clearing 13 individuals and 10.9 hectares of habitat, the Project clearly is not aligned with the recovery of the species. The Recovery Plan does acknowledge that some disturbance is required for successful establishment and seedlings often appear on areas that have been scraped. The species has been observed recruiting on scraped road edges in the ACT. Monitoring of newly created road verges as created by the Project and adaptive management to limit mowing or encourage recruiting specimens could have the potential to align with Recovery Plan if implemented.
Conclusion
The Project will not fragment the population into two or more smaller populations, introduce disease or facilitate the spread of exotic species that may impact *L. albicans* var. *tricolor*. The Project will directly clear 13 *L. albicans* var. *tricolor* individuals and 10.9 hectares of potential habitat, including 6.46 hectares of Grassy Woodland, 0.03 hectares of Native Grassland and 4.41 of Planted Native habitat hectares of habitat. These impacts will lead to a decline in the population and a reduction in available habitat. However, in context of the size of the population, these impacts are unlikely to lead to a local extinction. The Project is therefore unlikely to have a significant impact on *L. albicans* var. *tricolor*.

Superb Parrot (*Polytelis swainsonii*) - Vulnerable

Description

The Superb Parrot is a medium-sized, mostly green parrot with a long tail (EPSD 2019a). They nest between September and December in tree hollows, sometimes in loose colonies. During nesting, males flock together to travel between foraging and nesting sites to collect food for the females (Baker-Gabb 2011). Superb Parrots feed on a range of plant species including grasses, Acacias, eucalypts, mistletoes as well as lerps from eucalypt foliage. Feeding is mostly on the ground, but also occurs in trees.

Threats

The major threats to the Superb Parrot have been identified as loss and degradation of habitat, climate change, changes to irrigation of major rivers, firewood collection, timber production, disturbance by people, illegal capture of birds, road mortality, poisoning and competition for tree hollows (Baker-Gabb 2011; EPSD 2019a).

Distribution and habitat

Superb Parrots are endemic to inland south-eastern Australia, occurring in Box-Gum Woodland TECs in tablelands and slopes (EPSD 2019a). Regular, seasonal movements between breeding and non-breeding areas are undertaken by most birds, although some remain in the breeding range throughout the year. Movement are likely to be in response to changes in food supply (Baker-Gabb 2011). Core breeding locations in the ACT occur in open woodland in Mulligans Flat and Goorooyarroo Nature Reserves and in the central and lower Molonglo Valley (EPSD 2019a).

Populations

The National Recovery Plan for the Superb Parrot does not identify any important populations of the species (Baker-Gabb 2011). However, with an entire population of only an estimated 5,000-8,000 birds it is considered that any population will be important. While Davey (1997) noted that of the entire population, only 50-100 birds were then estimated to occupy the ACT, Superb Parrot have become much more numerous in the ACT in recent years, breeding, occurring in quite large flocks and a few are overwintering. Canberra Bird Notes 45:1 (April 2020, Annual Bird Report 2018-2019) calls the species 'common, breeding summer migrant', and says 'Now widespread in the ACT after extending its range into the ACT from western woodlands.' Reporting rate in 2018-19 was 67% above 30 year long term average, with 20 breeding records, including a flock of 50 at Federal Golf Course that year, and elsewhere in succeeding years. The species is seen in a number of Canberra suburbs now, with several roosts known such as Belconnen Golf Course. The Superb Parrot was observed flying over the study area during surveys undertaken in December 2020.

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:
lead to a long-term decrease in the size of an important population of a species
Superb Parrots that have been observed flying over the study area, are likely to be part of the important population that occurs in the ACT. No individuals were observed utilising the study area for foraging, although suitable habitat is present in the Grassy Woodland and planted woodland. Despite the presence of hollow-bearing trees, some of which may have suitably sized hollows, the Superb Parrot is unlikely to breed within the study area. The Project is unlikely to result in the long-term decrease in the size of an important population of Superb Parrots.
reduce the area of occupancy of an important population
The Project will require the removal of 10.87 hectares of potential Superb Parrot habitat along a major road. The removal of this habitat is not expected to reduce the area of occupancy of the ACT population of Superb Parrots.
fragment an existing important population into two or more populations
The Superb Parrot is a highly mobile species capable of movements greater than nine kilometres between breeding and foraging areas (Baker-Gabb 2011). Although the widening of William Hovell Drive may increase collision risk, it is unlikely to fragment any important population of the species.
adversely affect habitat critical to the survival of a species
Habitat critical to the survival of the Superb Parrot has been identified as breeding and foraging habitat (Baker-Gabb 2011). No breeding habitat for the Superb Parrot is known to occur in the study area. The Project will require the removal of 10.87 hectares of potential foraging habitat for the Superb Parrot.
disrupt the breeding cycle of an important population
The Superb Parrot breeds in tree hollows with specific dimensions, most often in Blakely's Red Gums. The Project will require the removal of [tba] hollows with a suitable entrance size, but it is not expected that any of these hollows will be used as nesting sites. The increase in width of William Hovell Drive is also unlikely to create a barrier to movement of Superb Parrot individuals between breeding and foraging habitat.
modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:
The Project will require the removal of 10.87 hectares of vegetation that provides suitable foraging habitat for the Superb Parrot. [tba] hollow-bearing trees containing [tba] hollows that may provide suitable breeding habitat for the Superb Parrot will also be removed. The majority of the hollow-bearing trees to be removed are Blakely's Red Gum that have been observed to be particularly important for Superb Parrot breeding in the Canberra region (Davey 1997).
result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat
Ground foraging activities of the Superb Parrot make them susceptible to predation by introduced predators such as cats (*Felis catus*) and foxes (*Vulpes vulpes*). Given the proximity to urban developments and farmland, it is likely that both these species already occupy the study area. It is unlikely an invasive species that are harmful to the Superb Parrot will be introduced by the Project.
introduce disease that may cause the species to decline, or
Psittacine Beak and Feather Disease (PBFD) is a disease affecting Australian parrot species and listed as a key threatening process under the EPBC Act. Threatened parrots, including the Superb Parrot, are at risk of contracting the disease. Increased competition for nesting habitat by the removal of hollow-bearing trees increases interactions between birds and therefore increase the risk of spread of PBFD (DoE 2015). It is unknown if the disease is present within local populations of parrots that occupy the study area. It is unlikely that the Project will result in the introduction of PBFD to the study area. No other diseases are known to affect the Superb Parrot.
interfere substantially with the recovery of the species.
A National Recovery Plan has been prepared for the Superb Parrot (Baker-Gabb 2011). Specific objectives outlined in the recovery plan are: • Determine population trends in the Superb Parrot • Increase the level of knowledge of the Superb Parrot's ecological requirements • Develop and implement threat abatement strategies • Increase community involvement in and awareness of the Superb Parrot recovery program. The Project is not expected to interfere with any objectives of the recovery plan.
Conclusion
The Project will require the removal of potential foraging habitat for the Superb Parrot. It is not expected to affect any breeding habitat for the species due to the proximity to an existing major road. Given the mobility of the Superb Parrot, it is not expected that the widening of the William Hovell Drive alignment will prevent individuals from moving between areas of breeding and foraging habitat. Therefore, the Project is unlikely to have a significant impact on the Superb Parrot.

Grey-headed Flying-fox (*Pteropus poliocephalus*) - Vulnerable

Description

The Grey-headed Flying-fox is a large (600 – 1000 g) flying mammal. It has grey fur with an orange/brown neck collar. They roost in large aggregations called camps, typically in moist vegetation types near water, sometime including mangroves. The diet consists of nectar and fleshy fruits, including cultivated species, which have complex patterns of temporal and spatial availability across the landscape (Eby 1991; Eby and Law 2008).

Threats

The major threats to the Grey-headed Flying-fox are habitat loss and fragmentation of, death due to crop protection measures, electrocution on powerlines and pollutants, and competition and hybridisation with the Black Flying-fox (DAWE 2021).

Distribution and habitat

The Grey-headed Flying-fox generally occurs south of Rockhampton in Queensland to west of Melbourne (DECC 2009; DAWE 2021). Its northern distribution limit has drifted south due to competition with the Black Flying-fox (Pteropus alecto). Habitats include rainforest, wet and dry Eucalypt forest and woodland, swamp forest and Banksia heath. The species is highly mobile, tracking the seasonal availability of food resources and there is regular movement between camps, which suggests that the species is comprised of a single population across its range.

Populations

The estimated total population size of the Grey-headed Flying-fox generally ranged between 350,000 and 650,000 from 2013 to 2019 and was higher in May counts than in August (Westcott 2019). However, the complex movement behaviour of the Grey-headed Flying-fox makes counts subject to poor precision (DAWE 2021). The Draft National Recovery Plan for the Grey-headed Flying-fox defines foraging habitat critical to the survival of the species as:

- Productive during winter and spring, when food bottlenecks have been identified (Parry-Jones and Augee 1991, Eby et al. 1999)
- Known to support populations of > 30 000 individuals within an area of 50 km radius (the maximum foraging distance of an adult)
- Productive during the final weeks of gestation, and during the weeks of birth, lactation and conception (September to May)
- Productive during the final stages of fruit development and ripening in commercial crops
- Affected by Grey-headed Flying-foxes (months vary between regions)
- Known to support a continuously occupied camp.

The most productive foraging areas in winter are mostly in the coastal lowlands north of the Hunter Valley, NSW. The Grey-headed Flying-fox become more dispersed in spring and by summer may be present across most of their range before contracting towards to coast in autumn. However, they persist around the year in larger urban areas (DECC 2009).

A definition of roosting habitat critical to the survival of the Grey-headed Flying-fox is also defined by DECC (2009). However, they are unlikely to roost in or near the Project study area due to the low tree cover, indicating that these criteria are not relevant. The nearest known roost is in Commonwealth Park along the northern shore of Lake Burley Griffin where relatively consistent counts of small (<500 individuals) to moderate (several thousand individuals) aggregations were made during the period 2012 to 2019 (DAWE 2021b). This camp is 8 km from the Project study area.

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:
lead to a long-term decrease in the size of an important population of a species
The Grey-headed Flying-fox is part of a large, mobile population, making the definition of an important population difficult. Critical habitat may be used as a surrogate for an important population. The Project study area, or the Locality in general, is not critical habitat for the Grey-headed Flying-fox because it is not highly productive during winter and spring, there are not >30,000 individuals within a 50 kilometre radius. The Grey-headed Flying-fox will only be present in the Locality during flowering events. Important foraging resources in the Project study area are likely to include Blakely's Red Gum (Eucalyptus blakelyi) and Yellow Box (E. melliodora) typical of Box-Gum Grassy Woodlands. The Project will entail the loss of 6.4 hectares of this habitat in an area of generally low tree density. There are 12.7 hectares of this habitat type in the Project study area. This will area of habitat (which represents the maximum possible impact) will only support a small number (<10) individuals even during significant flowering events. Thus, the Project is unlikely to result in the long-term decrease in the size of an important population of the Grey-headed Flying-fox.
reduce the area of occupancy of an important population

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:
The Project will require the removal of 6.4 hectares of Grey-headed Flying-fox foraging habitat along a major road. The removal of this habitat is not expected to reduce the area of occupancy of the ACT population of Grey-headed Flying-fox.
fragment an existing important population into two or more populations
The Grey-headed Flying-fox is a highly mobile species capable of extensive landscape-scale movements. The Project is not likely to cause the population to fragment.
adversely affect habitat critical to the survival of a species
Habitat critical to the survival of the Grey-headed Flying-fox is not present in the study area.
disrupt the breeding cycle of an important population
While it is likely that lactating females are sometimes likely to feeding in the study area, the Project is not likely to disrupt the breeding cycle of the Grey-headed Flying-fox.
modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline
The Project will require the removal of 13.75 hectares of vegetation that provides suitable foraging habitat for the Grey-headed Flying-fox. This small area of habitat in a marginal part of its range is not sufficient to cause the species to decline.
result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat
The Project will not result in the establishment of invasive species harmful to the Grey-headed Flying-fox.
introduce disease that may cause the species to decline, or
The Project will not introduce disease harmful to the Grey-headed Flying-fox.
interfere substantially with the recovery of the species.
A National Recovery Plan has been prepared for the Grey-headed Flying-fox (DAWE 2021). Specific objectives outlined in the recovery plan are: • To identify, protect and increase native foraging habitat that is critical to the survival of the Grey-headed Flying-fox . • To identify, protect and increase roosting habitat of Grey-headed Flying-fox camps. • Determine trends in the Grey-headed Flying-fox population so as to monitor the species' national distribution, habitat use and conservation status. • Build community capacity to coexist with flying-foxes and minimise the impacts on urban settlements from new and existing camps while avoiding interventions to move on or relocate entire camps. • Increase public awareness and understanding of Grey-headed Flying-foxes and the recovery program, and involve the community in the recovery program where appropriate. • Improve the management of Grey-headed Flying-fox camps in areas where interaction with humans is likely. • Significantly reduce levels of licenced harm to Grey-headed Flying-foxes associated with commercial horticulture. • Support research activities that will improve the conservation status and management of Grey-headed Flying-foxes. • Reduce the impact on Grey-headed Flying-foxes of electrocution on power lines, and entanglement in netting and on barbed-wire. The Project is not likely to interfere with the recovery of the Grey-headed Flying-fox because it does not affect critical foraging or roosting habitat.
Conclusion
The Project will require the removal of a small area potential foraging habitat for the Grey-headed Flying-fox. The Project is not likely to impact on critical foraging or roosting habitat nor interfere with breeding. Therefore, the Project is unlikely to have a significant impact on the Grey-headed Flying-fox.

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Pink Tailed Worm Lizard (*Aprasia parapulchella*) – Vulnerable

Species description

Aprasia parapulchella Kluge, 1974 (pink-tailed worm-lizard) is listed as Vulnerable under the Environment Protection and Biodiversity Conservation Act 1999.

The Pink-tailed Worm-lizard is a member of the family Pygopodidae. It is a small, legless and very slender lizard that lives underground, growing to about 25 cm in length, nearly half of which is tail. The snout and the tail are rounded and blunt. The presence of small hind-limb flaps distinguishes it from a juvenile snake. Colouration is predominantly grey-brown to pale grey, with a slightly darker head and nape and a paler underside. The end part of the tail is pinkish to reddish-brown. Each dorsal scale has a short dark mark, forming indistinct, broken, longitudinal stripes that often come together on the tail. There are no external ear openings (Description from Cogger 2000 and Wong et al. 2011).

Threats

Threats to the species include habitat loss and fragmentation, habitat degradation, removal of rocks, inappropriate fire regimes and predation.

Distribution and Habitat

The Pink-tailed Worm-lizard occurs in NSW, VIC and the ACT where it is widely but patchily distributed along the foothills of the western slopes of the Great Dividing Range between Bendigo in Victoria and Gunnedah in NSW (Wong et al. 2011). The species' distribution is highly fragmented across this range (Department of the Environment 2013) and occurs on a variety of land tenures. The species is known from many sites in the ACT, mainly along the Murrumbidgee and Molonglo River corridors as well as some of the nearby hills of the Canberra Nature Park (Osborne and Jones 1995; Wong et al. 2011) including The Pinnacle (ACT Government 2017), with detailed habitat mapping undertaken at The Pinnacle, Kama and Lower Molonglo River Nature Reserves (ACT Government 2017). Confirming occupation of suitable habitat is difficult as monitoring and surveying causes disturbance of habitat.

The Pink-tailed Worm-lizard's habitat includes primary and secondary grassland, grassy woodland and woodland communities, and the species usually inhabits sloping sites that contain rocky outcrops or scattered, partially buried rocks (Robertson and Heard 2008; Wong et al. 2011). These rocky habitats tend to be well-drained mid-slope or ridge-top sites with loosely embedded rocks on soil substrate with ant galleries present (Osborne and Jones 1995; Roberston and Heard 2008). Individuals are most commonly found sheltering under these rocks and spend considerable time in ant burrows below these rocks, which are considered important foraging and shelter sites (Wong et al 2011; Department of the Environment 2013; NSW OEH 2014).

In the Canberra region, sites where the species occurs are characterised by: a cover of predominately native grasses (particularly kangaroo grass Themeda triandra); sparse or no tree cover; little or no leaf litter; and scattered small rocks lightly embedded in the soil surface or resting on soil on top of more deeply buried rocks (see Osborne et al. 1991). It was found only in areas underlain by Mid–Late Silurian acid to intermediate volcanics and appeared to be most abundant where the surface rocks were well weathered with a considerable amount of fracturing, resulting in a high density of broken surface rock material. Small burrows were located under most rocks from which the species was recorded.

Key habitat requirements in the ACT

- Known along Murrumbidgee and Molonglo River corridors.
- Primary and secondary grassland, grassy woodland and woodland communities.
- Cover of predominately native grasses (particularly kangaroo grass Themeda triandra).
- Sparse or no tree cover.
- Little or no leaf litter.
- Sloping sites.
- Well-drained mid-slope or ridge-top sites.
- Areas underlain by Mid–Late Silurian acid to intermediate volcanics.
- Rocky outcrops or scattered, loosely embedded rocks.
- Most abundant where the surface rocks were well weathered with a considerable amount of fracturing, resulting in a high density of broken surface rock material.
- Ant galleries present.

Significant impact guidelines (EPBC Act) - *Does my site support the Pink-tailed Worm-lizard?*

Table 2. Likelihood of occurrence and assessment of significance

Mapped cover	Site observations	Likelihood of occurrence	Significant Impact?
Rocky outcrops	The sites' proximity to the Molonglo River corridor, as well as its slope and drainage qualities increase its candidacy for PTWL habitat. Much of the study area falls into vegetation categories including primary and secondary grassland, or grassy woodland communities. Two very small patches of treeless rocky outcrop, likely to support scattered, loosely embedded rocks, were mapped on site (0.044 ha, 0.005 ha). The larger patch fell within Box Gum Woodland where native grasses (notably kangaroo grass *Themeda triandra*) were present. The smaller patch was surrounded by dense exotic grassland. No assessment of associated ant activity was carried out. Within the locality, significant patches of suitable habitat have been identified.	Moderate	Potentially
Road Cuttings	Precautionarily, the exposed rock created by the road cuttings, has been assessed as potential habitat for PTWL. While there is very limited vegetation directly associated with the road cuttings, and the rock does not show clear significant weathering, and may have limited loosely embedded rock, the habitat has been precautionarily assessed as marginal	Moderate	Potentially

Referral

The William Hovell Drive Duplication Project prescribes actions that may potentially have a significant impact, based on precautionary habitat assessment. Pink-tail Worm-lizard habitat will be discussed during this referral process. Measures will be taken to reduce impact on Pink-tail Worm-lizard habitat, including avoiding known patches where possible. No Pink-tail Worm-lizard surveys have been carried out yet. If surveys are recommended to determine if populations exist within the habitat the methods follow.

Survey guidelines

The Pink-tail Worm-lizard can be found throughout the year by searching under rocks, however, it appears to be more difficult to detect during hot dry periods (Osborne et al. 1991). Peak activity is likely to be late spring and early summer under warm, but not overly dry, conditions. It is not active on the ground surface by day and will only be active between sheltering sites at night. The following survey methodology was adopted by Osborne and colleagues (1991):

- Searches restricted to an area of relatively homogeneous habitat within each site and a search beneath all rocks that can be turned is made.
- Rock cover density rather than fixed area size determines a plot, and 150–200 rocks need to be turned to be reasonably confident of determining the species' presence.
- Search success appears to be highest in spring and early summer on warm but not hot days, after a period of rainfall extending over several days.
- During summer months surveys are carried out in the mornings or on cloudy days when soil temperatures beneath the rocks are not too high.
- During late autumn and winter surveys are carried out on clear sunny days as warming of the rocks appears to attract individuals to the soil surface beneath the rocks.

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:
lead to a long term decrease in the size of an important population of a species
The Pink-tailed Worm-lizard has a patchy distribution, with most sites of a known population being within nature reserves notably of moderate - large areas of suitable habitat (ACT Government 2017). The species occurs along the Molonglo river corridor, and The Pinnacle and Kama nature reserves are also identified as known to support populations of the species. Detailed habitat mapping for the species has been undertaken at The Pinnacle and Kama nature reserves, with The Pinnacles noted as a moderate area of habitat (ACT Government 2017). The mobility of the species is uncertain. In 2014 a habitat restoration project was undertaken in the Molonglo Valley that provided about 800m of habitat (rock) refuges to connect two separate and genetically distinct populations of the lizard to redress fragmentation effects, with later investigations showing occupation of those rack refuges (ACT Government 2020) This indicates that the worm-lizard may be limited in mobility particularly where a barrier or lack of suitable habitat connectivity exists.

The Project study area is located between these two nature reserves and the road duplication will increase the intensity of the existing habitat fragmentation by creating a wider corridor.

The Project has the potential to directly reduce the size of this important population due to habitat clearing (by 0.16ha), and indirectly by further fragmenting habitat as affected by the existing road corridor.

reduce the area of occupancy of an important population

The area of occupancy of the Pink-tailed Worm-lizard is not confirmed, although suitable habitat is located in the study area and populations have been known in the lower Molonglo River valley and The Pinnacle and Kama nature reserves (ACT Government 2017.

The Project will require the permanent removal of potentially suitable habitat along a major road. Therefore, the Project has the potential to reduce the area of occupancy for an important population of the Pink-tailed Worm-lizard.

fragment an existing important population into two or more populations

The existing road would form a barrier to and fragment any populations within the Kama and The Pinnacle Reserves, with the road duplication increasing the intensity of the existing habitat fragmentation by creating a wider road corridor.

The Project is unlikely to create new fragmentation of a population.

adversely affect habitat critical to the survival of a species

Habitat critical to the survival of the Pink-tailed Worm-lizard is present in the Project study area, being grasslands, grassy woodlands and (sparse) woodlands with surface rocks / rocky outcrops on well draining sites. Exposed rock adjacent to the road corridor may also provide habitat for the species.

The Project will result in direct impacts to 0.16ha of this habitat within the construction footprint.

disrupt the breeding cycle of an important population

While it is possible that the Pink-tailed Worm-Lizard will breed in the Project study area, the Project is not likely to disrupt the breeding cycle of the species.

It is thought the species lays its eggs in ant nets (ACT Government 2017) and so are not likely to have fidelity of laying place but will be related to the ant food source.

modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

The Project will require the removal of 0.16ha of grasslands to woodlands that provides suitable foraging and living habitat for the species. This small area of habitat, within the overall extent of The Pinnacle and Kama nature reserves, the latter having a connection to the Molonglo River corridor, is unlikely to cause the species to decline.

result in invasive species that are harmful to a vulnerable specie becoming established in the vulnerable species habitat

Predation is identified as a threat to the Pink-tailed Worm-lizard. Introduced predators such as foxes and feral cats are already present in the locality. Rabbits are also present in the area and these animals may disturb and reduce vegetation cover of the Worm-lizard habitat.

Therefore the Project would not result in the establishment of invasive species harmful to the worm-lizard.

introduce disease that may cause the species to decline, or

The Project is unlikely to introduce a disease that may cause the Pink-tailed Worm-lizard to decline.

interfere substantially with the recovery of the species

There is no draft or current adopted National Recovery Plan for the Pink-tailed Worm-lizard.

The ACT Government has prepared a Conservation Advice for the species (ACT Government 2020). The conservation priorities as given in that advice and as related to the 2017 Action Plan, including to:

- "*conserve all populations in medium to large habitat areas and in defined landscape corridors that comprise important linking habitat*
- *Protect all other sites from unintended impacts*
- *Manage the species and its habitats to maintain and foster genetic diversity*
- *Enhance the long-term viability of populations through management of buffer zones that surround occupied habitat and through rehabilitation of habitat in corridor areas that will increase connectivity between populations*."

The Project will impact on an area of medium size, and other, suitable habitat of the Pink-tailed Worm-lizard.

As such, the Project may interfere with the stated objectives for the conservation of the species.

Conclusion

The Project will require the removal of an area (0.16ha) of habitat, within a fragmented area of the Reserves within an overall patchy species distribution and limited mobility, important to the survival of the Pink-tailed Worm-lizard

Therefore the project has the potential to cause a significant impact on the Pink-tailed Worm-lizard.

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Regent Honeyeater (*Anthochaera phrygia*) – Critically Endangered

Description

The Regent Honeyeater is a distinctive medium-sized, black and yellow honeyeater with a red patch of skin around the eyes. The species feeds primarily on nectar, but also consumes invertebrates and their exudates (lerp and honeydew) (Ford et al. 1993). The Regent Honeyeater is highly mobile and although there are regularly-used foraging areas, its movements are also highly variable in response to spatial and temporal variation in nectar availability (Commonwealth of Australia 2016).

Threats

The major threats to the Regent Honeyeater are habitat loss, degradation and fragmentation, aggressive exclusion by Noisy Miners (Manorina melanocephala) (which is exacerbated by habitat fragmentation and degradation), competition from other nectarivores including introduced European Honey Bees (Apis mellifera), and small population size (vulnerability to stochastic population processes and inbreeding) (Commonwealth of Australia 2016). Low nesting success is also contributing to its decline, with nest predation a significant cause of failure (Crates et al. 2018).

Distribution and habitat

The Regent Honeyeater was formerly distributed from near Adelaide, through coastal and inland slopes of Victoria and NSW to the Sunshine Coast in Queensland (Commonwealth of Australia 2016). The current distribution of the Regent Honeyeater is very patchy. The western range limit is now about Bendigo in central Victoria. Moreover, it is now regarded as primarily using only four key breeding areas: Bundarra-Barraba, Capertee Valley and Hunter Valley in NSW and around Chiltern in Victoria (Commonwealth of Australia 2016). A small breeding population was present near Warwick in south-east Queensland, but recent evidence suggest that this area is now infrequently used (NESPTSRH 2019). Important active breeding habitat has been recently identified near Lake Burragorang west of Sydney, and an isolated breeding habitat in NW Sydney (Ross Crates, pers. comm. 2020). Breeding has also been recorded in the ACT (Commonwealth of Australia 2016), but it is not known how regular this is.

Most Regent Honeyeater records come from the box-ironbarks woodlands of the western slopes of the Great Dividing Range. Drier coastal Eucalypt forest and swamp forest (e.g. containing Swamp Mahogany Eucalyptus robusta) are also used (Commonwealth of Australia 2016). Key tree and mistletoe species for the regent honeyeater include:

- Mugga (or Red) Ironbark, *Eucalyptus sideroxylon*
- Yellow Box, *E. melliodora*
- White Box, *E. albens*
- Yellow Gum, *E. leucoxylon*
- Spotted Gum, *Corymbia maculata*
- Swamp Mahogany, *E. robusta*
- Needle-leaf Mistletoe, *Amyema cambagei* on River Sheoak, *Casuarina cunninghamiana*
- Box Mistletoe, *A. miquelii*
- Long-flower Mistletoe, *Dendropthoe vitellina*

However, a range of other species may be used during significant flower events (Commonwealth of Australia 2016).

Populations

The Regent Honeyeater occurs as a single, highly mobile population with some exchange of individuals between remain core areas. The estimated population size of 1,500 individuals existed in the late 1980s. By 2010 the estimated size was 350-400 adults (Commonwealth of Australia 2016).

The National Recovery Plan for the Regent Honeyeater (Commonwealth of Australia 2016) defines habitat critical to the survival of the Regent Honeyeater as:

- Any breeding or foraging areas where the species is likely to occur
- Any newly discovered breeding or foraging locations.

Therefore, all known and potential foraging habitat for the Regent Honeyeater must be regarded as critical habitat.

The objectives of this recovery plan are to:

- Reverse the long-term population trend of decline and increase the numbers of regent honeyeaters to a level where there is a viable, wild breeding population, even in poor breeding years; and to

- Enhance the condition of habitat across the regent honeyeaters range to maximise survival and reproductive success, and provide refugia during periods of extreme environmental fluctuation.

An action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:
lead to a long-term decrease in the size of a population
The Regent Honeyeater occurs as a single population across its range. Small numbers of the Regents Honeyeater are known to regularly occur in the ACT. The Project study area supports known foraging resources (Yellow Box and likely Blakely's Red Gum) at a low tree density due to previous partial clearing. While the Regent Honeyeater is known to breed, at least occasionally, in the ACT, it is unlikely that the timid Regent Honeyeater will breed in the Project study area due to current levels of disturbance arising from the operation of the existing road. However, the definition of habitat critical to the survival of the Regent Honeyeater merely requires the presence of foraging habitat; there is no threshold for the intensity of foraging activity (i.e. frequency of use or numbers present). Given that the species could potentially forage in the Project study area, it is therefore critical habitat. Despite the potential presence of critical habitat, the Project will result in the loss of a relatively small area (10.88 ha) of low quality (i.e. low tree density) foraging habitat as Grassy Woodland (6.46 ha), Planted Native (4.41 ha) and Planted River She-oak Riparian Forest (0.01 ha). This extent of non-breeding habitat clearing in a marginal part of its range will not cause the Regent Honeyeater population to decline.
reduce the area of occupancy of the species
The Project will require the removal of 10.88 hectares of Regent Honeyeater foraging habitat along a major road. The removal of this habitat is not expected to reduce the area of occupancy of the Regent Honeyeater population.
fragment an existing population into two or more populations
The Regent Honeyeater is a highly mobile species capable of extensive landscape-scale movements. The Project is not likely to cause the population to fragment.
adversely affect habitat critical to the survival of a species
Habitat critical to the survival of the Regent Honeyeater is present in the Project study area. The Project will result in the removal of 10.88 ha of this habitat.
disrupt the breeding cycle of a population
It is unlikely that the Regent Honeyeater will breed in the Project study area. The Project will not, therefore, impact on the breeding cycle of the Regent Honeyeater.
modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline
The Project will require the removal of 10.88 hectares of vegetation that provides suitable foraging habitat for the Regent Honeyeater. This small area of habitat in a marginal part of its range is not sufficient to cause the species to decline.
result in invasive species that are harmful to a critically endangered or endangered species becoming established in the critically endangered or endangered species' habitat
Habitat fragmentation is known to alter habitats in a way that favours the Noisy Miner, a recognised threat to the Regent Honeyeater. Due to existing levels of habitat fragmentation and partial canopy removal, it is likely that the Noisy Miner is already present in the Project study area. While the Project will cause further clearing, in light of the preceding it is unlikely that the Project will result in the establishment of invasive species harmful to the Regent Honeyeater.
introduce disease that may cause the species to decline, or
The Project will not introduce disease harmful to the Regent Honeyeater.
interfere substantially with the recovery of the species.
A Draft National Recovery Plan has been prepared for the Regent Honeyeater (Commonwealth of Australia 2016). Specific objectives outlined in the recovery plan are: The objectives of this recovery plan are to: • Reverse the long-term population trend of decline and increase the numbers of regent honeyeaters to a level where there is a viable, wild breeding population, even in poor breeding years • Enhance the condition of habitat across the regent honeyeater range to maximise survival and reproductive success, and provide refugia during periods of extreme environmental fluctuation. • The strategies to achieve the plans' objectives are: • Improve the extent and quality of regent honeyeater habitat • Bolster the wild population with captive-bred birds until the wild population becomes self-sustaining • Increase understanding of the size, structure, trajectory and viability of the wild population • Maintain and increase community awareness, understanding and involvement in the recovery program The Project is not likely to interfere with the recovery of the Regent Honeyeater because it will only require the clearing of a small amount (6.4 ha) of low quality (reduced tree density) along an existing road. Thus, the Project will not cause the population size to decline and it will not prevent improvements in the quantity and quality of foraging habitat.
Conclusion

The Project will require the remove of a small area potential foraging habitat for the Regent Honeyeater that will not lead to a reduction in population size, it will not interfere with breeding and it will not restrict the creation of additional foraging habitat. Therefore, the Project is unlikely to have a significant impact on the Regent Honeyeater.

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Striped legless lizard (*Delma impar*) – Vulnerable

Description

The Striped Legless Lizard is placed within the Family Pygopodidae (flap-footed lizards). Its front limbs are absent and it only has rudimentary (or reduced) hind limbs. It is pale-grey and grows up to about 30 cm long. It has a series of stripes on their sides and the sides of their back, becoming diagonal bands on the tail, from which the species derives its common name (DAWE 2021).

The diet of the Striped Legless Lizard is primarily spiders, crickets, grasshoppers, Lepidopteran larvae and cockroaches. It uses both ambush and active searching methods to obtain prey. The Striped Legless Lizard enters torpor during winter, with activity peaking in spring and summer (DAWE 2021).

Threats

Habitat loss, degradation and fragmentation are the major threats to the Striped Legless Lizard. It is estimated that 99.5% of its former habitat is no longer suitable for occupancy. While it has some tolerance to disturbance, grazing, pasture improvement, ploughing and drought and other significant disturbance can cause local extinction. Fire may cause direct mortality and reduce cover, making habitat temporarily suitable and recovery dependent on nearby colonising sources. Predation is also likely to be a threat, but its impact is not clearly established (Smith and Robertson 1999).

Distribution and habitat

The Striped Legless Lizard formerly occurred from the ACT and adjacent parts of NSW, south through the NSW south-western slopes, central and southern Victoria and into the south-east corner of South Australia. While most of this range appears to still be occupied, it has become locally extinct at many locations and its distribution has become highly fragmented (DAWE 2021). While it formerly occurred throughout much of the Act, it is now restricted to four locations: Gungahlin, the lower Majura Valley (including the suburb of Lawson), the lower Jerrabomberra Valley and Yarramundi Reach. However, it apparently no longer occurs at Yarramundi Reach (DAWE 2021).

The Striped Legless Lizard is a grassland specialist. It is known to occur in grasslands dominated by native (e.g. Spear Grass Stipa bigeniculata, Kangaroo Grass Themeda triandra) and introduced (e.g. Phalaris aquatica, Nasella trichotoma, Hypocharis radicata) species. There is some evidence they also occasionally occur in grassy woodlands. Grassland structure (dense and continuous) appears to be more important than species composition (Smith and Robertson 1999). The Striped Legless Lizard shelters within grass tussocks, thick ground cover, soil cracks, spider burrows, and under rocks and fallen timber (DAWE 2021).

Populations

There are few population size estimates for the Striped Legless Lizard. They may reach densities of 10 – 40 per hectare. However, less than 1000 individuals were estimated from 90 sites in 1995, but this was considered to be an under-estimate (DAWE 2021). Due to the extent of its decline, all remaining populations of the Striped Legless Lizard are considered to be important for its recovery. Thus, all populations of the Striped Legless Lizard are important populations (Threatened Species scientific Committee 2016).

Habitat critical to the survival of the Striped Legless Lizard is habitat that possess more than one of the following characteristics: provides foraging habitat, provides breeding habitat, provides refuge from disturbance events, provides long-term protection from development, has connectivity value or contributes to its evolutionary development across its range. Given the relatively low mobility of the Striped Legless Lizard, habitats where it is found are highly likely to support foraging and breeding habitat. If it is assumed the Striped Legless Lizard is present in the Project study area, then it must also be concluded that habitat critical to its survival is present. This habitat will be considered to support an important population of the Striped Legless Lizard unless: it is less than 0.5 hectares, a small and isolated area of habitat currently under pressure (e.g. the habitat is within an urban area – the Project study area is bounded by two nature reserves) or a small site with marginal or low quality habitat (e.g. due to a high density of high threat weeds).

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:
lead to a long-term decrease in the size of an important population of a species
The Striped Legless Lizard was subject to a habitat assessment rather than directly surveying for the species. Suitable habitat was deemed present, consisting of box-gum woodland with a low tree density, native grassland and exotic grassland. This habitat meets the definition of habitat critical to the survival of the Striped Legless Lizard. Furthermore, the Project study area is located between two nature reserves and the road duplication will increase the intensity of the existing habitat fragmentation by creating a wider road corridor. The Project has the potential to directly reduce the size of this important population due to habitat clearing and indirectly by exacerbating habitat fragmentation.
reduce the area of occupancy of an important population

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:
The area of occupancy of the Striped Legless Lizard is not known. The Project will require the permanent removal of 15.43 hectares of Striped Legless Lizard habitat along a major road. Thus, the Project has the potential of reduce the area of occupancy of an important population of the Striped Legless Lizard.
fragment an existing important population into two or more populations
The Project study area supports habitat critical to the survival of the Striped Legless Lizard. While there is already habitat fragmentation due to the existing road, the road duplication will increase the intensity of the existing habitat fragmentation by creating a wider road corridor. It is unknow whether the species will use fauna underpasses.
adversely affect habitat critical to the survival of a species
Habitat critical to the survival of the Striped Legless Lizard is present in the study area. This consists of a mixture of box-gum grassy woodland with a low tree density, native grassland and exotic grassland totalling 15.43 hectares within the construction footprint.
disrupt the breeding cycle of an important population
While it is likely that the Striped Legless Lizard will breed in the Project study area, the Project is not likely to disrupt the breeding cycle of the Striped Legless Lizard.
modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline
The Project will require the removal of 15.43 hectares of vegetation that provides suitable foraging habitat for the Striped Legless Lizard. This small area of habitat in a marginal part of its range is not sufficient to cause the species to decline.
result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat
Predation is regarded as a potential threat to the Striped Legless Lizard. Introduced predators (e.g. foxes, cats and dogs) are already be present in the Locality. Thus, the Project will not result in the establishment of invasive species harmful to the Striped Legless Lizard.
introduce disease that may cause the species to decline, or
The Project will not introduce disease harmful to the Striped Legless Lizard.
interfere substantially with the recovery of the species.
The National Recovery Plan for the Striped Legless Lizard (Smith and Robertson 1999) states that the primary recovery objective is to ensure the long-term survival of D. impar throughout its range. Ten specific objectives are listed: • Establish and maintain national forums for the discussion and organisation of the conservation of D. impar across its natural distribution • Determine the distribution of potential D. impar habitat • Determine the current distribution and abundance of D. impar in Victoria, New South Wales, the Australian Capital Territory and South Australia • Establish a series of reserves and other managed areas such that viable populations are maintained across the known distribution of the species (described as the most important objective) • Determine the habitat use and ecological requirements of D. impar • Identify the nature and extent of the threatening processes affecting D. impar • Undertake a program of monitoring to provide a basis for adaptive management of D. impar • Increase community awareness and involve the community in aspects of the recovery program • Assess the need for salvage and translocation, determine their feasibilities, develop protocols and undertake a trial translocation if appropriate • Ensure that captive population(s) are used to support education and research elements of the Recovery Plan. Many of these recovery objectives focus on finding basic ecological information on the Striped Legless Lizard, undertaking population monitoring, translocation and captive populations. None of these objectives are relevant to the Project and the Project will not interfere with their implementation. However, the Project study area falls between two nature reserves that provide potential habitat for the Striped Legless Lizard and the Project study area itself provides suitable habitat for this species. By increasing the physical barrier posed by the road upgrade and exacerbating population fragmentation, the Project may interfere with the recovery of the Striped Legless Lizard by removing suitable habitat and reducing the conservation value of these reserves.
Conclusion
The Project will require the removal of a small area (15.43ha) of habitat critical to the survival of the Striped Legless Lizard and increase the intensity of the existing habitat fragmentation. Therefore, the Project is likely to have a significant impact on the Striped Legless Lizard.

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Swift Parrot (Lathamus discolor) – Critically Endangered

Description

The Swift Parrot is a medium-sized, mostly green parrot with a blueish crown, red facial markings and a long tail. The entire population breeds in Tasmania in spring. There is a migration to mainland Australia in autumn, where they remain for winter. The diet is based mostly on nectar with lerps from eucalypt foliage also used. Yellow Box (Eucalyptus melliodora) is a known foraging species (Saunders and Tzaros 2011) and it is likely that Blakely's Red Gum (Eucalyptus blakelyi) will also be used. Larger, more mature trees are preferred as they are larger and more reliable foraging patches relative to small trees (e.g. Law et al. 2000).

Threats

The major threats to the Swift Parrot are habitat loss and alteration of, forestry, residential and industrial development, tree senescence and dieback in rural area, suppression of regeneration by grazing, frequent fire, climate change, collision mortality, competition from native (e.g. Noisy Miner Manorina melanocephala) and introduced birds, European Honey Bees and Bumble Bees, Psittacine Beak and Feather Disease, illegal capture and trading (Saunders and Tzaros 2011), and predation and nest destruction by introduced Sugar Gliders (Petaurus breviceps) in Tasmania (Stojanovic et al. 2014).

Distribution and habitat

The Swift Parrot breeds exclusively in Tasmania during summer. The entire population migrates to the mainland, where they forage along the east coast south from about Hervey Bay, Qld, along the adjacent inland slopes of the Great Dividing Range and west to about the Victoria/South Australia border (Saunders and Tzaros 2011; DAWE 2021). Preferred habitats are Eucalypt woodland and drier forests, particularly along the inland slopes of NSW and Victoria. Coastal habitats are used with greater intensity when there are inland droughts. Small numbers of Swift Parrot regularly forage in the ACT (Saunders and Tzaros 2011).

Populations

The Swift Parrot occurs as a single, migratory population. The species declined from an estimated 1,320 pairs in 1988 to 940 pairs in 1995. A population monitoring program was then established, which indicates that the decline may have stabilised (Saunders and Tzaros 2011).

The National Recovery Plan for the Swift Parrot (Saunders and Tzaros 2011) defines priority habitat (assumed to be an analogue of important habitat) as habitat used:

- For nesting
- By large proportions of the Swift Parrot population
- Repeatedly between seasons (site fidelity)
- For prolonged periods of time (site persistence).

Priority habitat is defined for State jurisdictions (Tasmania, Victoria, NSW, Qld), but not for the ACT where small numbers regularly occur (Saunders and Tzaros 2011).

An action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:
lead to a long-term decrease in the size of a population
The Swift Parrot occurs as a single population across its range. Small numbers of Swift Parrots are known to regularly occur in the ACT. The Project study area supports known foraging resources (Yellow Box and likely Blakely's Red Gum) at a low tree density due to previous partial clearing. However, the Project study area is not recognised as priority habitat for the species. The Project will result in the loss of a relatively small area of low quality (i.e. low tree density) foraging habitat (10.87 ha). This extent of non-breeding habitat clearing in a marginal part of its range will not cause the Swift Parrot population to decline.
reduce the area of occupancy of the species
The Project will require the removal of 10.87 hectares of Swift Parrot foraging habitat along a major road. The removal of this habitat is not expected to reduce the area of occupancy of the Swift Parrot population.
fragment an existing population into two or more populations
The Swift Parrot is a highly mobile species capable of extensive landscape-scale movements. The Project is not likely to cause the population to fragment.
adversely affect habitat critical to the survival of a species
Habitat critical to the survival of the Swift Parrot (the analogue of Priority Habitat) is not present in the Project study area.
disrupt the breeding cycle of a population

All Swift Parrots breed in Tasmania. The Project will not, therefore, impact on the breeding cycle of the Swift Parrot.
modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline
The Project will require the removal of 10.87 hectares of vegetation that provides suitable foraging habitat for the Swift Parrot. This small area of habitat in a marginal part of its range is not sufficient to cause the species to decline.
result in invasive species that are harmful to a critically endangered or endangered species becoming established in the critically endangered or endangered species' habitat
The Project will not result in the establishment of invasive species harmful to the Swift Parrot.
introduce disease that may cause the species to decline, or
The Project will not introduce disease harmful to the Swift Parrot.
interfere substantially with the recovery of the species.
A Draft National Recovery Plan has been prepared for the Swift Parrot (Saunders and Tzaros 2011). Specific objectives outlined in the recovery plan are: • Habitat loss and alternation due to forestry, firewood harvesting, residential and industrial development, agricultural tree senescence and dieback, regeneration suppression, and frequent fire • Climate change • Collision mortality • Competition from large, aggressive honeyeaters and introduced birds and bees • Psittacine beak and feather disease Illegal wildlife capture and trading The overall recovery objectives for the Swift Parrot are to i) prevent further decline of the Swift Parrot population and ii achieve a demonstrated, sustained improvement in the quantity and quality of Swift Parrot habitat to increase carrying capacity. The Project is not likely to interfere with the recovery of the Swift Parrot because it does not affect Priority Habitat, it will not cause the population size to decline and it will not prevent improvements in the quantity and quality of foraging habitat.
Conclusion
The Project will require the remove of a small area potential foraging habitat for the Swift Parrot. The Project is not likely to impact on Priority Habitat nor interfere with breeding. Therefore, the Project is unlikely to have a significant impact on the Swift Parrot.

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White-throated Needletail (*Hirundapus caudacutus*) – Vulnerable

Description

The White-throated Needletail is a large swift with a stubby tail tipped with short spines, a dark green/grey colouration, a white patch on the throat and long, pointed wings. All White-throated Needletails breed in the northern hemisphere and over-winter in Australia during the southern summer. When in Australia, they generally form small to large flocks and are rarely seen singly. They sometimes occur in mixed flocks with Fork-tailed Swifts (Apus pacificus) and Fairy Martins ((Hirundo ariel) (Threatened Species Scientific Committee 2019).

The White-throated Needletail is an aerial insectivore, foraging at heights from 1 m up to more than 1000 m altitude. It consumes a wide range of prey, including beetles, cicadas, flying ants, bees, wasps, flies, termites, moths, locusts and grasshoppers.

Threats

One overall threat to the White-throated Needletail may be that its migration takes it over areas of high human population density in south-east Asia where food may be becoming limiting. It was previously hunted at its breeding areas and more recently logging in Siberia may be reducing the availability of tree hollows used for breeding. Similarly, the loss of roosting sites in Australia due to land clearing and forestry may be having an impact and may also result in a reduction in invertebrate abundance. The use of pesticides may also reduce prey availability and result in secondary poisoning. In Australia, other threats are generally limited to individual birds rather than the population and include collisions with overhead electrical wires, windows and lighthouses (DAWE 2021). There is also evidence that collisions at windfarms pose a threat (Hull et al. 2013).

Distribution and habitat

The White-throated Needletail generally arrives in Australia during September and departs from mid-March into April. It occurs over most of eastern and south-eastern Australia, inland to the western slopes of the Great Dividing Range. It may occur as a vagrant across most of the continent.

While they can forage over most habitat types, including urbanised areas, White-throated Needletails are most frequently observed foraging above treed habitats. They often forage along the edges of low pressure systems that both assist their flight and lift their insect prey, making them highly mobile across the landscape. They also forage around cliffs and other areas with strong updraughts. Although an aerial insectivore, terrestrial habitats remain important to the White-throated Needletail as they host the larval stages of their flying insect prey and may explain the preference for foraging over treed habitats (Threatened Species Scientific Committee 2019; DAWE 2021).

Populations

There are two recognised breeding populations of the White-throated Needletail, defining two sub-species. The combined size of these sub-species is not known (DAWE 2021). Only the nominate sub-species, H.c. caudatus, migrates to Australia. The migratory behaviour and widespread movements when in Australia suggest that a single population is present during the southern summer (Threatened Species Scientific Committee 2019). This suggests that an important population is highly mobile within a large Australian range. Habitat critical to the survival of the White-throated Needletail has not been defined.

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:
lead to a long-term decrease in the size of an important population of a species
It is likely that the White-throated Needletail will occasionally to rarely forage over the Project study area. Given the presence of two nature reserves near this area, it is likely that the terrestrial habitat provides some flying insects that will be consumed by the White-throated Needletail. However, the amount of habitat in the Project study area is not likely to be a limiting factor for the White-throated Needletail population and this habitat is not regarded as habitat critical to the survival of the White-throated Needletail. It is unlikely that the Project will directly or indirectly reduce the size of the Australian White-throated Needletail population.
reduce the area of occupancy of an important population
The area of occupancy of the White-throated Needletail is estimated to be 126,200 kilometres squared. The vegetated (native and exotic) area of the Project clearing footprint is 19.85 hectares (i.e. 0.198 kilometres squared). Thus, the Project will not reduce the area of occupancy of an important population of the White-throated Needletail.
fragment an existing important population into two or more populations
The White-throated Needletail is a migratory species capable of very long distance movements and can forage over a range of habitat types. The Project will not fragment the White-throated Needletail population.

adversely affect habitat critical to the survival of a species
Habitat critical to the survival of the White-throated Needletail is not specified. Given its use of a broad range of habitat types, it is unlikely that habitat critical to the survival of the White-throated Needletail could be defined.
disrupt the breeding cycle of an important population
The White-throated Needletail breeds in Asia and Siberia. The Project will not affect breeding by this species.
modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline
The Project will require the removal of 19.85 hectares of vegetation that may be a minor source of flying insects consumed by the White-throated Needletai. This small area of habitat is not sufficient to cause the species to decline.
result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat
No invasive species are known to be harmful to the White-throated Needletail.
introduce disease that may cause the species to decline, or
The Project will not introduce disease harmful to the White-throated Needletail.
interfere substantially with the recovery of the species.
There is no National Recovery Plan for the White-throated Needletail. The species SPRAT profile (DAWE 2021) states "Due to the limited nature of any threats to the species and its mobility, there are no threat abatement or recovery actions either underway or proposed." Thus, the Project is not likely to interfere with the recovery of the White-throated Needletail.
Conclusion
The Project will require the removal of a small area of habitat that will provide a limited source of flying insects consumed by the White-throated Needletail. This is unlikely to reduce the size of the White-throated Needletail population or its area of occupancy and there will be no habitat fragmentation. Habitat critical to the survival of the White-throated Needletail is not present in the Project study area. Therefore, the Project is not likely to have a significant impact on the White-throated Needletail.

References

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Golden Sun Moth (*Synemon plana*) - Critically Endangered

Species description

Synemon plana (golden sun moth), family Castniidae, is a medium-sized day-flying moth with green eyes, clubbed antennae and no functional mouthparts. The species has a wingspan of about 3 - 3.5 cm and a tapered abdomen with males being slightly larger than females. The sexes can be distinguished by their wing colours with only the females having the characteristic golden hind wings (NSW OEH, 2012). The golden sun moth can be distinguished from other *Synemon* species by the distinct coloration and reduced hind wings of the female (NSW OEH, 2012).

Research into dietary specialisation in the golden sun moth revealed that larvae feed almost exclusively on wallaby grasses (*Austrodanthonia* species (now largely placed in *Rytidosperma*), spear grasses (*Austrostipa* species) and exotic Chilean needle grass (*Nassella* species) (Richter et al., 2011).

Table 4. Life stages of Golden Sun Moth

Form	Description
Larvae	• Feed on the roots of native, and more recently exotic, grasses. • Pupate into adult moths and emerge to breed between mid-October and early January (depending on climate and geography). • Are particularly vulnerable to: soil disturbance, such as ploughing, heavy grazing and compaction, frequent or intense fire and removal or degradation of grass plants. • The length of the larval period is unknown but is probably two to three years (Edwards 1994 cited in O'Dwyer & Attiwill 2000).
Adults	• Emerge continuously across the breeding season. • Are active during the warmest part of the day (1000 to 1400 h) (possibly up to 1700 h for females). • Adult males are capable of active and prolonged flights and fly about one metre above the ground on hot, sunny and still days searching for females displaying in the grass below. • Adult females are poor fliers, and most likely walk between tussocks. • Are unlikely to travel more than 100 m away from suitable habitat patches. Populations separated by distances greater than 200 m can therefore be considered effectively isolated, and sites from which the species has gone extinct are unlikely to be naturally recolonised. • Are particularly vulnerable to: removal of grass plants, loss of inter-tussock space, fire, shading and predation.

Threats

The main identified threats to the golden sun moth are: loss, fragmentation and degradation of habitat, isolation of populations, agricultural practices, and weed invasion (NSW OEH, 2012). The species relies on a very specialised habitat of *Austrodanthonia*-dominated grasslands, which have been removed or significantly altered by agriculture and urban expansion over much of its original distribution. The sites at which golden sun moths occur are now generally small and fragmented and threatened by ongoing habitat disturbance, destruction from urban and industrial development and inappropriate burning programs and weed invasion (TSSC, 2002).

Distribution and Habitat

Suitable habitat for the Golden Sun Moth includes native temperate grassland and open grassy woodlands dominated by wallaby grass (DEC 2007). While previous studies suggested that the species prefers grasslands which have a greater than 40% coverage of wallaby grass over a given area (O'Dwyer & Attiwill 1999), more recent studies show a broader tolerance for other species compositions, including degraded grasslands dominated by exotic Chilean Needlegrass (Nassella neesiana) (Braby & Dunford 2006; Gibson 2006; Gilmore et al. 2008).

Density and quality of Wallaby Grass at a site may be of importance in Golden Sun Moth larval development, as a larva may need to feed on more than one Wallaby Grass tussock (Edwards 1993). The area of Wallaby Grass at a site does not need to be extensive. On sites that have low moth numbers, this is typically related to grassland quality rather than size. It is likely that two ACT populations have become extinct because of degradation of grassland quality rather than their small size (DEC 2007).

Sites supporting Golden Sun Moth populations have generally been subject to light grazing. Several populations occur in paddocks alongside sheep and cattle grazing. These sites have not undergone extensive pasture improvement or fertiliser usage and contain areas of primary Wallaby Grass cover. These sites can often be found in the corners of paddocks or areas along fence lines and gateways (DEC 2007).

Sloping sites (at 3º or less), particularly those with a northerly aspect, are well-represented in extant populations and indicate a preferred site characteristic, although several populations are known from flat sites (DEC 2007).

Golden Sun Moth distribution is known to overlap with the following EPBC Act-listed threatened ecological communities which occur in the ACT:

- White Box - Yellow Box - Blakely's Red Gum Grassy Woodlands and Derived Native Grasslands
- Natural Temperate Grassland of the Southern Tablelands of NSW and the Australian Capital Territory

Key general habitat requirements

- native temperate grassland OR open grassy woodlands
- dominated by (>40%) wallaby grass OR Chilean Needlegrass (*Nassella neesiana*)
- light grazing acceptable
- no pasture improvement
- north facing, slightly sloped
- minimal shading
- areas of bare or sparsely covered ground between grass tussocks (inter-tussock space) are thought to be important in helping males locate females.

Native Temperate Grassland habitat requirements

- dominated by native grasses and/or herbs,
- few shrubs
- no trees (less than one tree per hectare)
- mid-high, open tussock grassland
- well drained
- shallow soils
- low phosphorus
- The most common native grasses in these systems are (Barlow 1998):
    - Wallaby Grasses (Rytidosperma spp.)
    - Spear Grasses (Austrostipa spp.)
    - Tussock Grasses (Poa spp.)
    - Weeping Grass (Microlena spp.)
    - Wire-grasses (Aristida spp.)
    - Kangaroo Grass (Themedaspp.)
- Golden Sun Moth have been shown to prefer (Braby & Dunford 2006):
    - Short Wallaby Grass (Rytidosperma carphoides)
    - Bristly-Wallaby Grass (R. setacea)
    - Wallaby Grass (A. eriantha)
    - Lobed Wallaby Grass (R. auriculata)
    - Clustered Wallaby Grass (R. racemosa)
    - Chilean Needle Grass (Nassella neesiana)
    - Redleg Grass (Bothriochloa macra).

Grassy Box Gum Woodland habitat requirements

- Trees generally widely spaced with canopies that do not overlap
- Dominated by Red Gum (Eucalyptus blakelyi), swamp gum, Manna Gum (E. viminalis), Grey Box (E. microcarpa), Yellow Box (E. melliodora), Yellow Gum (E. leucoxylon), Black Box (E. largiflorens), Silver Banksia (Banksia marginata), Buloke (Allocasuarina luehmannii) or native pines.
- Typically, only one or two species of tree are present.
- Shrubs may be present, but they will be sparsely distributed over a grassy ground layer (Barlow 1998).
- Grassland component resembling above description

Significant impact guidelines (EPBC Act) - *Does my site support the golden sun moth?*

Table 5. Likelihood of occurrence in each community mapped on site

Mapped Community	Site observations	Likelihood of occurrence	Significant Impact?
Native Riparian, Planted Native, Cleared, Infrastructure	Observations of these communities did not indicate appropriate Golden Sun Moth (GSM) habitat. There were sharp boundaries between all mapped communities and no observable ecotone into appropriate habitat.	Nil/ Very Low	No
Native Grassland	Only three small patches of native grassland were found within the study area. The two larger patches were moderately sloping (greater than 10 degrees), with no shading from other vegetation layers, although their aspects was south-west and south. The smaller of the three patches was broadly flat with no shading from other vegetation layers. All three patches were dominated by native species: at least two *Rhytidosperma spp (*syn. *Austrodanthonia spp), Austrostipa sp, Microlaena stipoides, Themeda triandra (syn. T. australis), Bothriochloa macra* and occasionally *Poa labilllardieri* and *Sorghum leicladum*. All but the last of these species listed are known to be associated with GSM habitat. *Rytidosperma sp*. and *Bothriochloa macra* are known to be preferential feeding species. Large recent rain fall has stimulated significant understorey growth across the patches, with little evidence of recent grazing, indicating the current condition displays likely maximum percent cover. The patches broadly conform to the preferred habitat description of 'open tussock grassland'. Surveys found areas of bare or sparsely covered ground between grass tussocks (inter-tussock space). These are thought to be important in helping males locate females. The three small patches found covered 0.29, 0.32, 0.06 Ha respectively and are confined to the study area.	Moderate-High	Yes. The significant impact thresholds for the golden sun moth advise that <u>any</u> habitat loss, degradation or fragmentation of small or fragmented habitat (less than 10 ha) equates to a significant impact. It is noted that extremely small, isolated and degraded habitat patches (for example <0.25 ha) may support populations of golden sun moth but are unlikely to contribute to the overall ecological health of the species.
Box Gum Grassy Woodland	There are large contiguous extents of BGGW within the study site. With various levels of shading, slope and drainage. The groundlayer of all patches are dominated by native species of grasses and sub-dominant by native forbs. The dominant grass species include: at least two *Rhytidosperma spp (*syn. *Austrodanthonia spp), Austrostipa sp, Microlaena stipoides, Themeda triandra (syn. T, australis), Bothriochloa macra* and occasionally *Poa labilllardieri* and *Sorghum leicladum*. All but the last of these species listed are known to be associated with GSM habitat. *Rytidosperma sp*. and *Bothriochloa macra* are known to be preferential feeding species.	Moderate-High	Yes. The significant impact thresholds for the golden sun moth advise that <u>any</u> habitat loss, degradation or fragmentation of small or fragmented habitat (<10 ha) equates to a significant impact. If the patches were considered cumulatively and the patch classified as large or contiguous (>10) the impact would still be considered significant as

	Large recent rainfall events have stimulated significant understorey growth across the patches, indicating the current condition displays maximum percent cover. The patches conform to the preferred habitat description of 'open tussock grassland'. Surveys found areas of bare or sparsely covered ground between grass tussocks (inter-tussock space). These are thought to be important in helping males locate females. The small patches found were 3.68, 0.74, 1.02, 0.44, 0.42, 0.38,1.84, 0.13, 0.80, 0.14, 0.14, 2.98, 0.38, 0.58 Ha– cumulatively totalling 13.74 Ha.		the threshold is habitat loss, degradation or fragmentation >0.5 ha, which is likely.
Exotic Grassland	Dense, uniform, exotic grassland dominated by *Phalaris aquatica, Festuca arundinaceae, Avenasp., Eragrostis curvula.* Neither the dominant species or the apparent structure are preferable habitat.	Low	No

Table 3: Significant impact thresholds for the golden sun moth

Ecological element affected	Impact threshold	Comment
Large or contiguous habitat area (>10 ha)	Habitat loss, degradation or fragmentation >0.5 ha	Habitat is a similar or connected area within which the golden sun moth is found during surveys or known from records. The function of the area may include, but is not limited to: feeding, breeding, dispersal.
Small or fragmented habitat area (<10 ha)	Any habitat loss, degradation or fragmentation	Small areas of habitat are more likely to suffer significant impacts from loss, degradation and fragmentation than larger areas. The limited dispersal ability of the golden sun moth means habitat areas separated by >200 m are effectively isolated and should be considered as separate habitat areas. Extremely small, isolated and degraded habitat patches (for example <0.25 ha) may support populations of golden sun moth but are unlikely to contribute to the overall ecological health of the species.
Habitat connectivity	Fragmentation of a population through the introduction of a barrier to dispersal	Barriers to dispersal could include: breaks in habitat of >200 m; structures that prohibit movement (for example buildings, solid fences).

Notes:

The elements and thresholds in the table above give guidance to the level of impact that is likely to be significant for the species at a site. They are not intended to be exhausive or prescriptive, but rather to highlight those actions that threaten the persistence and recovery of the golden sun moth (see Section 3).

Habitat and/or populations may, and often will, extend beyond the site boundaries. If the amount of golden sun moth habitat adjoining the site of the action cannot be determined the area of habitat will be considered to be the same as that identified within the site.

Referral

The William Hovell Drive Duplication Project prescribes actions that are likely to have a significant impact. This triggers referral to the minister before commencing action. Measures should be taken to reduce impact on golden sun moth habitat including avoiding known patches where possible. No golden sun moth surveys have been carried out yet. If surveys are recommended to determine if populations exist within the habitat the methods follow.

Survey guidelines

The Department of the Environment has prepared survey guidelines for *Synemon plana*. The survey guidelines are intended to provide guidance for stakeholders on the effort and methods considered appropriate when conducting a presence/absence survey for species listed as threatened under the EPBC Act. The guidelines can be found at:

- http://www.environment.gov.au/epbc/publications/pubs/background-paper-golden-sunmoth.pdf
- http://www.environment.gov.au/system/files/resources/b945f32e-3f75-4739-a793-9f672893f3bb/files/golden-sun-moth.pdf

Item	Description
Aim	To detect flying males, but also to detect laying females/eggs and/or pupal cases to confirm that reproduction is taking place on the site.
Timing	During the local flying season (late October to early January). Flight season timing is variable and reference sites are the best indicator of ideal survey timing. Alison Rowel is the local expert.
Effort	Surveys aiming to detect the presence of the Golden Sun Moth at a site should be undertaken over at least four suitable days during the flying season of the species. The very short adult life-span and the variable timing of adult emergence mean that surveys conducted only a few days apart can differ appreciably from each other. It is therefore recommended that detection surveys be staggered at least a week apart to increase the likelihood that at least some members of the population are observed (Gibson & New 2007). If detection is the aim of the survey, surveying can be stopped once the species is identified. However, information on the distribution and relative

	density of the species on the site, as well as indications of breeding such as the presence of pupal cases or laying females can also be important.
Conditions required	• Warm to hot day (above 20 degrees Celsius by 1000 hrs) • warmest part the day (that is, 1000 to 1400 hrs) • clear or mostly cloudless sky • still or relatively still wind conditions during the survey period, and • at least two days since rain
Methods	Fixed point method Best suited to very small sites or sites which harbour a small population (DEC 2007). Observer chooses a reference point typically on the edge of the site (or area of activity) from which the whole site can be observed. Using a hand counter and stopwatch the observer records the number of moths seen in a given time period (typically three to six minutes) taking care not to record the same individual twice. Repeat point count as many times as necessary (e.g. three to five) with a five-minute interval between counts. If the whole area cannot be surveyed from a single position the observer may alternate positions between successive counts (DEC 2007). Transect method Most commonly used method for monitoring butterfly populations (Pollard 1997 cited in DEC 2007). Particularly suited to large sites with extensive populations (DEC 2007). This method has been trialled with success at a large site in the ACT (Clarke & Dunford 1999), and was the chosen method for recent surveys around Melbourne (Gilmore et al. 2008). Observer walks a number of transects recording all individuals seen using a hand counter and a recording device (e.g. a portable electronic note taker). Transects are typically marked along the long axis of the site, and should be between 5 and 100 m apart, depending on the size and topography of the site. At very large sites 200 m intervals may be needed in order to cover the whole site in a reasonable time (i.e. while moths are active). Observer walks for 100 m, recording the number of moths seen per 100 m, taking care not the count the same individual twice. On large sites multiple observers may be required starting at opposite sides of the site. Two observers walking transects 200 m apart would require about two hours to survey a 100 ha site (Clarke & Dunford 1999). Surveys conduced using the fixed point or transect method can also be used to estimate the relative abundance of the species on a site, although this may require an increase in search effort (see Gibson & New 2007). Other survey techniques Area or transect surveys may also be undertaken outside the flying season to look for the pupal casings of Golden Sun Moths. These can often be found protruding out of the soil amongst grass tussocks (Braby & Dunford 2006). The presence of pupal casings may be used to indicate the presence of the Golden Sun Moth, however the lack of casings does not indicate its absence from a site. Large scale larval surveys are not considered an appropriate survey technique for determining the presence of the species on a site due to the large search effort required and the potential for damage to the soil, plants and larvae. However, where small amounts of soil are disturbed (e.g. in installing pit-fall traps for other grassland fauna) soil could be inspected for Golden Sun Moth larvae. Larval surveys may also be incorporated into monitoring programs to assess the effectiveness of management or experimental practices (e.g. burning, experimental translocation).

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:
lead to a long-term decrease in the size of a population of a species
The Project will result in the removal of 0.06 hectares of marginal habitat immediately adjacent to the existing road. This habitat is unlikely to be occupied by the Golden Sun Moth due to the infrequent mowing and absence of grazing to control growth of grasses (unpublished observations, A. Rowell 2021). Native grasses mostly occurred amongst eucalypts, where GSM are generally not found. The nearest known population of GSM occurs approximately 750 metres west of the study area. The Project is unlikely to have any indirect impacts on this population due to the distance between the sites. Given that no areas of known habitat will be removed as a result of the proposal, and GSM are considered not likely to occur within the small areas of marginal habitat adjacent to the existing road, the Project is considered unlikely to lead to a long-term decrease in the size of a population.
reduce the area of occupancy of the species
Potential habitat within the study area is unlikely to be occupied by the Golden Sun Moth, therefore the Project will not reduce the area of occupancy of the species as a result of the removal of 0.06 hectares of marginal habitat.
fragment an existing population into two or more populations

A population of GSM is known to occur 750 metres west of the study area. No GSM habitat is mapped to the north-east of the study area in the habitat bounded by William Hovell Drive, Coulter Drive and residential suburbs and the species is not known to occur in the Pinnacle Nature Reserve. The maximal movement distance of a male GSM is 200 metres, therefore it is unlikely individuals from this population occupy the study area. Given that no GSM are expected to occupy the study area and the Project will not introduce any new barriers between known populations of GSM, it is unlikely to result in the fragmentation of any existing population.
adversely affect habitat critical to the survival of a species
No critical habitat has been specified for GSM within significant impact guidelines for the species. It is considered that habitat enabling breeding is critical to its survival. Vegetation within the study area does not constitute suitable breeding habitat for the GSM and is unlikely to be occupied. The nearest mapped area of habitat for the GSM occurs about 750 metres to the west of the study area near the Molonglo River.
disrupt the breeding cycle of a population
This habitat within the study area is unlikely to be provide suitable breeding habitat due to the infrequent mowing and absence of grazing to control growth of grasses. The nearest population occurs 750 metres west of the study area and the maximal movement distance for a male is 200 metres. Therefore removal of potential habitat in the study area is unlikely to disrupt the breeding cycle of a population.
modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline
The Project will result in the removal of 0.06 hectares of marginal quality habitat that is unlikely to be occupied by the GSM. Therefore, it is considered unlikely that the Project will modify, destroy, remove or reduce the availability or quality of habitat to the extent the species would decline.
result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat
It is unlikely that the Project will result in an increase in the presence and/or establishment of invasive species which may impact the GSM. Weeds that negatively affect GSM habitat are already present and will be subject to mitigation strategies to avoid spread. No invasive fauna species are considered a threat to the GSM.
introduce disease that may cause the species to decline, or
The proposal is unlikely to introduce disease that may lead to declines of this species. The Significant Impact Guidelines for the species do not reference any diseases that affect the GSM.
interfere substantially with the recovery of the species.
No Recovery Plan has been prepared for the GSM and the site is not subject to any targeted recovery actions. The Project is unlikely to interfere with the recovery of the species.
Conclusion
The proposal is considered unlikely to have a significant impact on the Golden Sun Moth given that no areas of occupied habitat will be directly or indirectly impacted by the proposal.

References

New South Wales Office of Environment and Heritage (NSW OEH) (2012). Golden sun moth — profile. Available on the Internet at: http://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10791

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