

# Appin Road Upgrade, Mount Gilead to Ambarvale

Addendum Review of Environmental  
Factors

November 2022



# Acknowledgement of Country

Transport for NSW acknowledges the traditional custodians of the land on which we work and live.

We pay our respects to Elders past and present and celebrate the diversity of Aboriginal people and their ongoing cultures and connections to the lands and waters of NSW.

Many of the transport routes we use today – from rail lines, to roads, to water crossings – follow the traditional Songlines, trade routes and ceremonial paths in Country that our nation's First Peoples followed for tens of thousands of years.

Transport for NSW is committed to honouring Aboriginal peoples' cultural and spiritual connections to the land, waters and seas and their rich contribution to society.





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## Executive summary

This document is an addendum Review of Environmental Factors (Addendum REF) for a proposed modification to the 'Appin Road Upgrade, Mount Gilead to Ambarvale' project approval (the Project) required under Division 5.1 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act).

The purpose of the Addendum REF is to describe the proposed modification, to document the likely impacts of the proposed modification on the environment, and to detail the protective measures (safeguards) that would be implemented when constructing and operating the proposed modification.

## The proposed modification

The Appin Road Upgrade, Mount Gilead to Ambarvale is the staged upgrade of a 5.4 kilometre section of Appin Road between Mount Gilead in the south and the intersection with St Johns Road, Ambarvale to the north. The Project includes intersection upgrades, widening part of the road from two to four lanes and the construction of new intersections for access to the proposed (and approved) Mount Gilead residential subdivision.

The *Appin Road Upgrade, Mount Gilead to Ambarvale Review of Environmental Factors* (REF) was prepared for the Appin Road Upgrade on November 2018 (referred to in this Addendum REF as the Project REF). The Project REF was placed on public display between 19 November 2018 and 14 December 2018 for community and stakeholder comment. A submissions report, dated March 2019, was prepared to respond to issues raised.

Transport for New South Wales (Transport for NSW) proposes to modify the Project REF to facilitate the inclusion of two fauna crossings under Appin Road and fauna fencing on the eastern side of Appin Road (proposed modification). Key features would include:

- Glen Lorne (Corridor A) koala/fauna underpass (2.4m diameter pipe)
- Interim Browns Bush (Corridor B) koala/fauna underpass (two x 1.2m diameter pipes)
- Inclusion of fauna furniture and monitoring equipment
- Amended fence type at Beulah Biobank site (fauna fencing) [southern portion]
- Amended fence type at Noorumba Reserve (fauna fencing) [northern portion]
- Construction fencing

Works for the proposed modification would be incorporated into the Project construction staging to ensure minimal disruptions and cumulative impacts.

## Background

Appin Road is a strategically important arterial road. Regionally, it connects motorists travelling between Sydney's southwest region and the Illawarra. It also provides a link between the M1 Princes Motorway and the M31 Hume Motorway (through Wilton Road in the south, and Narellan Road in the north) and is utilised for the transportation of freight via road from Port Kembla to the south-western region of Sydney.

Issues with road safety have been identified for Appin Road, due to the existing road conditions and relatively high volumes of traffic. Roads and Maritime Services (now Transport for NSW) completed a safety review of a section of Appin Road in 2014. A number of safety issues were identified in the audit, including the width of existing lanes and shoulders of the road at a number of locations within the proposal location. The upgrade of Appin Road was recommended to address the safety issues.

The Project REF recognised that the Project would impact the local koala population through the direct loss of a small portion of habitat and increased barrier effects arising from the upgraded road. Without mitigation, this was likely to result in increased koala road-strike and injury.

In April 2020, the NSW Chief Scientist released 'Advice on the protection of the Campbelltown Koala population' (Appendix A), which proposed measures to protect the Campbelltown Koala population. Specific measures were included for the proposed Mount Gilead Stage 2 Development and the draft Cumberland Plain Conservation Plan and includes advice on possible east-west corridors linking the Nepean and Georges Rivers.

Following this advice, this Addendum REF includes mitigation measures to increase the safety and facilitate movement of the local koala population. The impacts of the proposal have now been assessed as 'not significant' under both State and

Commonwealth assessment criteria due to its limited impacts and the size and wide distribution of the local koala population.

## Need for the proposed modification

This Addendum REF seeks modifications which are being proposed following confirmation of the State Government's position on fauna corridors as part of the NSW Chief Scientist's advice (Appendix A A) and the later update to Greater Macarthur 2040 strategy.

The Project, incorporating the amendments sought in this Addendum REF, would deliver the first two fauna crossings under Appin Road. The inclusion of these crossings and associated works would serve to increase mitigation measures required to ensure the separation of local koala populations from traffic and help limit interactions with domestic dogs.

The amendment to the REF makes provision for safe east-west koala movement via the delivery of:

- An underpass crossing of Appin Road to form the Menangle Creek to Noorumba Reserve Corridor (A) (referred to in this document as the Glen Lorne underpass); and
- An underpass crossing of Appin Road to form a interim Woodhouse Creek Beulah Biobank site Corridor (B) (referred to in this document as the Browns Bush corridor).

## Proposal objectives

The proposal objectives of the Addendum REF works are to:

- Improve koala connectivity between Noorumba and Beulah Biobank sites on the western side of Appin Road with Glen Lorne and Browns Bush Reserves on the eastern side of the road to ensure the long-term stability of the local koala population.
- Minimise interaction of koalas with risks such as traffic.
- Minimise social and environmental impacts.

The proposed modifications have been designed based on criteria provided in the NSW Chief Scientist's letter and in consultation with a specialist koala consultant.

## Options considered

In July 2022 Lendlease submitted an irrevocable letter of offer for the inclusion of additional infrastructure to be delivered under the Mount Gilead Planning Agreement to the Planning Minister.

The additional infrastructure included the provision of a permanent underpass on Appin Road adjacent to the Beulah biobank within Corridor B (as identified in the NSW Government Chief Scientist's advice). The timing and extent of this proposal however has not yet been determined and separate approval would be required. The permanent crossing does not form part of this Addendum REF works.

In the interim, approval of the amendments sought by this Addendum REF is required to support the relevant approved Appin Road upgrade works under the Project REF. These works are urgently required to improve safety on the relevant section of Appin Road. To meet the requirements of the NSW Chief Scientist, as well as facilitate the road upgrade, it is proposed to construct a temporary underpass at the southern extent of Mount Gilead Stage 2 land (Browns Bush underpass).

## Statutory and planning framework

This Addendum REF has been prepared on behalf of Transport for NSW, which is the proponent and the determining authority for this assessment under Division 5.1 of the EP&A Act.

This Addendum REF is to be read in conjunction with the Project REF, Appin Road Upgrade, Mount Gilead to Ambarvale, November 2018. The purpose of this Addendum REF is to describe the proposed modification, to document and assess the likely impacts of the proposed modification on the environment, and to detail mitigation and management measures to be implemented.



The description of the proposed work and assessment of associated environmental impacts have been undertaken in context of section 171 of the Environmental Planning and Assessment Regulation 2021 (EP&A Regulation 2021), Environmental Planning and Assessment Regulation 2000 (EP&A Regulation 2000), which the Project REF was determined under, *Guidelines for Part 5.1 of the Environmental Planning and Assessment Act 1979*, Roads and Road Related Facilities EIS Guideline (DUAP, 1996), the *Biodiversity Conservation Act 2016* (BC Act), the *Fisheries Management Act 1994* (FM Act), and the Australian Government's *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

## Community and stakeholder consultation

It is proposed to undertake community and stakeholder consultation in the following way:

- Email to local community stakeholders
- Letterbox drop to local residents and businesses within 400m of the project site
- Geo-targeted social media ads
- Printed copy of the REF and community newsletter will be made available at Campbelltown local library and community noticeboard.
- Provision of a copy of the Archaeological Research Design to the Project Registered Aboriginal Parties (this has already occurred). To date no responses have been received.

Any enquiries or submissions regarding this Addendum REF should be directed to: [figtreehill.development@lendlease.com](mailto:figtreehill.development@lendlease.com)

## Environmental impacts

In order to identify the potential environmental impacts associated with building the proposal and the impacts associated with its operation, a number of specialist assessments have been completed. Potential environmental impacts during the construction and operation of the proposal have been identified which, with the implementation of appropriate safeguards and management measures, are not considered to be significant. Other potentially significant impacts and benefits are outlined in the sections below.

The main environmental impacts of the proposed modification are:

### **Biodiversity**

Koala populations in NSW are declining despite a range of initiatives to protect them (OSCE 2016). Threats to koalas associated with human activity include:

- Habitat loss and fragmentation
- Urban development (including dog attacks, swimming pools, light and noise)
- Vehicle strike
- Bushfires
- Disease (particularly chlamydia)
- Climate change (which increases drought and heatwaves and alters habitat quality).

The main cause of death for koalas in south-western Sydney is vehicle strikes and dog attacks (OSCE 2020). Exposure to other threats including habitat fragmentation and land-use changes in the nominated areas may increase as development proceeds if the threats are not properly managed.

The Department of Planning and Environment's (DPE's) flora and fauna database, Bionet, holds records for 31 koala strikes on the section of Appin Road between Rosemeadow and Appin Township between 2010 and 2021 (Data downloaded August 2021). This figure would underestimate actual koala vehicle strikes as not all incidents would be reported. The modification of the Project REF is being proposed following confirmation of the State Government's position on fauna corridors as part of the NSW Chief Scientist's advice (*Advice on the protection of the Campbelltown Koala population*, Koala Independent Expert Panel, 20 April 2020) and later update to Greater Macarthur 2040.

In addition, *The Cumberland Plain Conservation Plan* (CPCP) was finalised in August 2022. The CPCP protects large areas of regionally important habitat while unlocking delivery of urban growth and development. This includes facilitating the delivery of up to 73,000 homes planned for the Western Parkland City by providing necessary biodiversity approvals. Sub-Plan B of the CPCP outlines the conservation program to protect the group of koalas known in this plan as the 'Southern Sydney koala population'. One of the key commitments of this plan is C7 as follows:

*Koala Commitment C7 - Mitigate impact on Southern Sydney koala population*

- Actions*
- *Install koala exclusion fencing*
  - *Provide safe crossing point*

The proposed modification would have a beneficial impact on the local Koala population, and potentially other native fauna, by facilitating safe passage across Appin Road while having minimal detrimental impacts on local biodiversity values during construction and operation.

An assessment of significance (five-part test) as set out in Section 7.3 of the BC Act is included for all species known, considered likely to occur in the study area. The assessment concluded that it is highly unlikely that there would be a 'significant impact' to any threatened species or listed ecological community by the impact to up to 0.12 ha of CPW and 0.09 ha of STF (and associated threatened fauna habitat) and by the provision of koala underpasses and koala exclusion fencing, which would be fully revegetated following construction within the proposed Browns Bush BSA site, and thus a species impact statement or biodiversity development assessment report is not required. Any loss of potential foraging habitat for Koala would be offset by a significant reduction in existing road mortality that is likely to be impacting the viability of the local population and improved east-west connectivity between the Georges and Nepean River corridor (refer Appendix E for full assessments of significance).

Similarly, an assessment was undertaken to determine whether any Matters of National Environmental Significance (MNES) under the Commonwealth EPBC Act (ie CPW, SSTF, foraging habitat for Greater Glider, Swift Parrot and Grey-headed Flying fox or any potential breeding sites for Gang-gang Cockatoo, Glossy Black Cockatoo and Large-eared Pied-bat) would be significantly affected.

As previously stated, the Addendum REF would result in the clearing and/or pruning of approximately 0.22 ha of native vegetation, comprising of 0.12 ha of moderate condition Cumberland Plain Woodland and 0.09 ha of moderate condition Shale Sandstone Transition Forest (exact areas to be determined in a biodiversity offset strategy), which are identified as Critically Endangered under the NSW *Biodiversity Conservation Act 2016*. In accordance with the Roads and Maritime (2016) 'Guidelines for Biodiversity Offsets', a biodiversity offset strategy will be prepared during the detailed design phase for the small areas of moderate condition vegetation that was not assessed (and offset) under the approved biodiversity certification for Mount Gilead Stage 1 (refer section 6.1.5 for further details).

Overall, it is considered that the proposed underpasses, in association with exclusion fencing, have a strong likelihood of success based on evidence of koalas using similar structures on other road projects, such as the Oxley Highway, Wardell Road and Bonville Bypass projects. Therefore, it is expected that the fencing and underpasses would provide safe passage for koalas and other fauna, rather than the exclusion fences adding to the current barrier effect of Appin Road. In addition, fencing and grids (used to prevent koalas accessing Appin Road at intersecting driveways and/or roads) are proposed on both sides of Appin Road from the northern boundary of Noorumba Reserve to the southern boundary of Beulah from the commencement of construction to minimise the likelihood of koala entrapment within the road corridor.

### **Aboriginal Cultural Heritage**

The proposed modification is contained within the boundaries of the Tharawal Local Aboriginal Land Council (LALC).

The proposed modification study areas are positioned on landforms which has not previously been associated with high density expressions of subsurface Aboriginal objects. The study areas have been assessed to have a low potential for Aboriginal objects. Notwithstanding, all Aboriginal objects, known or unknown, have statutory protection under the National Parks and Wildlife (NPW) Act. Therefore, as a mitigation measure, it is proposed to undertake a program of archaeological test excavation, adhering to the *Archaeological Code of Practice*. This work would occur following approval of the Addendum REF but prior to the commencement of any works associated with the proposed underpasses. An Archaeological Research Design (ARD) has been developed to guide the archaeological works for the proposed modification.

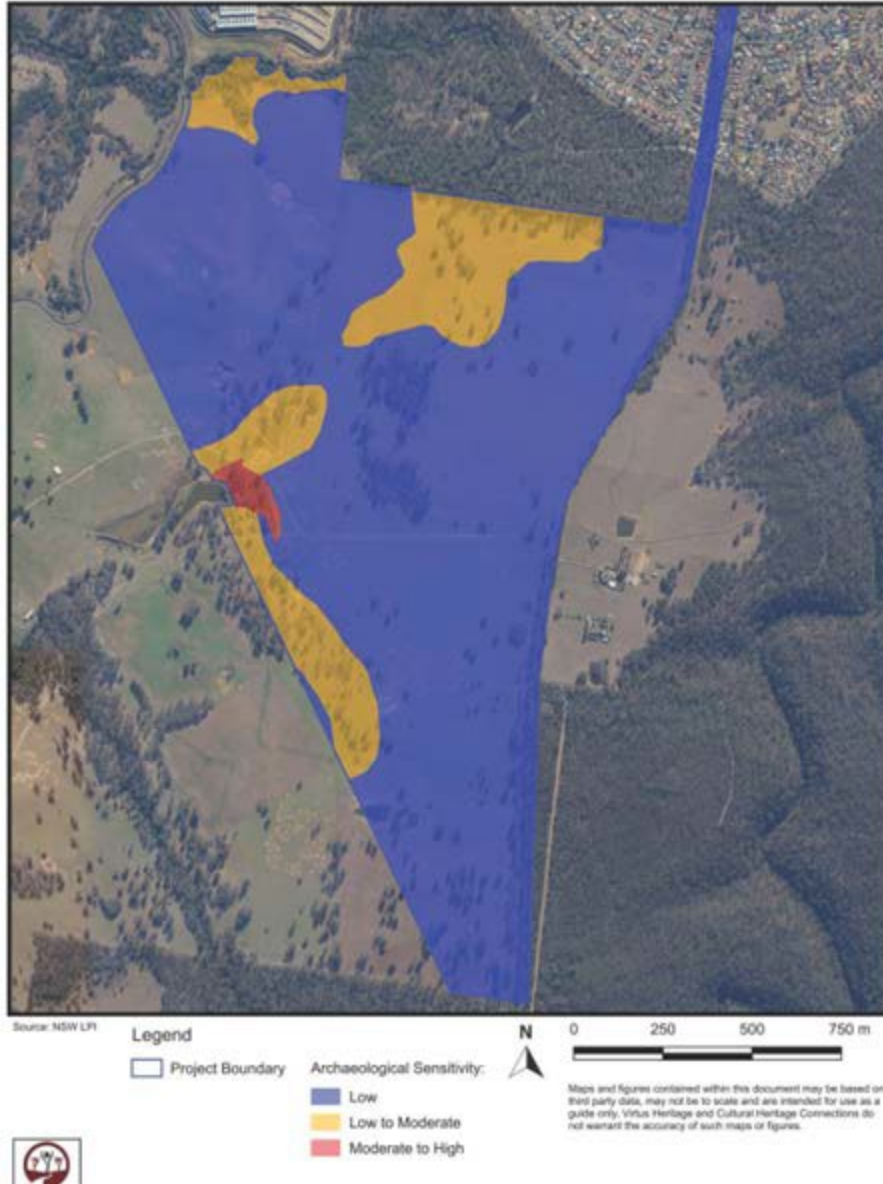
It is noted that the original assessment of the Appin Road corridor identified some landforms with archaeological sensitivity (Virtus Heritage, 2017). Further investigations were undertaken by Ecological Australia (2018) as part of the Appin Road Safety Improvements Stage 2 PACHCI Aboriginal Archaeological Survey Report returned an opposing result concluding that:

*Landscape features that were identified within the PAD area (for example being located on a hill crest within 200 m of a water source) do not continue within the study area it is therefore unlikely that the archaeological potential*



*continues within the study area. As a result of this study, it has been concluded that no further heritage assessment is warranted prior to the commencement of work. (Ecological 2018:31)*

Subsequent investigations by Virtus (2019) involving extensive test excavation of the subject area led to the revised classification that the works area as “Low archaeological sensitivity” as per the figure below. These corroborated the Ecological Australia results reported in 2018.



GML Heritage undertook salvage works as part of the AHIP process within the Stage 1 area as well as detailed surveys and reporting of the stage 2 area. The findings of these studies are summarised in Appendix F. GML noted the following:

*The Mount Gilead Stage 2 lands include the biobanking areas on the east of Appin Road and have been surveyed by GML (July 2022a). This survey work did not identify any Aboriginal stone objects, nor allocate areas with PAD adjacent to the road. The survey did however identify cultural trees in and around the road corridor. These have been entered on AHIMS.*

The stance on sensitivity has been shown to be incorrect given the information contained in the three independent heritage investigations/reports, which all identified the corridor as having low Aboriginal archaeological potential (refer Appendix F). As a result, this Addendum REF resolves to:

1. Remove the 'Additional safeguard AH3' "An AHIP would be obtained prior any works potentially impacting Aboriginal heritage".

2. Add a safeguard 'Undertake investigation works outlined in Appendix F – Aboriginal Cultural Heritage Assessment' prior to any works potentially impacting Aboriginal heritage.

## Justification and conclusion

The Appin Road upgrade, including the proposed fauna crossings and fauna fencing, facilitates important road safety works while providing increased protection for the local koala population. Overall, the proposed amendments would be minor in terms of construction impacts. Operationally, they would have a significant beneficial impact as they would help to provide safe fauna movement across Appin Road that would accommodate the Appin Road Upgrade but also residential development at Gilead and other nearby locations.



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# 1. Introduction

## 1.1 Background

Appin Road is a strategically important arterial road. Regionally, it connects motorists travelling between Sydney's southwest region and the Illawarra. It also provides a link between the M1 Princes Motorway and the M31 Hume Motorway (through Wilton Road in the south, and Narellan Road in the north) and is utilised for the transportation of freight via road from Port Kembla to the south-western region of Sydney.

Issues with road safety have been identified for Appin Road, due to the existing road conditions and relatively high volumes of traffic. Transport for New South Wales (Transport for NSW) (then Roads and Maritime Services) completed a safety review of a section of Appin Road in 2014. A number of safety issues were identified in the audit, including the width of existing lanes and shoulders of the road at a number of locations within the proposal location. The upgrade of Appin Road was recommended to address the safety issues.

The *Appin Road Upgrade, Mount Gilead to Ambarvale Review of Environmental Factors* (REF) was prepared for the Appin Road Upgrade on November 2018 (referred to in this Addendum REF as the Project REF). The Project REF was placed on public display between 19 November 2018 and 14 December 2018 for community and stakeholder comment. A submissions report, dated March 2019, was prepared to respond to issues raised and the REF was approved.

The approved REF permits the staged upgrade of a 5.4 kilometre section of Appin Road between Mount Gilead in the south and the intersection with St Johns Road, Ambarvale to the north. The Project includes intersection upgrades, widening part of the road from two to four lanes and the construction of new intersections for access to the proposed (and approved) Mount Gilead residential subdivision. The approved works also include provision of fauna fencing to the southern extent of Beulah Biobank site, on the eastern side of Appin Road to align with the northern limit of works for the Appin Road Safety Improvement project. The extent of the Project (relevant to this Addendum REF) as shown in the approved REF is shown below in Figures 1 and 2.

The *Appin Road Safety Improvements from Brian Road to Gilead REF* was also prepared and approved in November 2018. The extent of the works approved by this REF are shown in Figure 3. It is noted that where there is a slight overlap with the Project REF in the approved works area, to the north of Beulah Biobank Site. This Addendum REF shows an increase in scope in this area, and further to the south, so that the required fauna fencing can be implemented as part of the overall Project REF works.







## 1.2 Proposed modification overview

Following receipt of advice from the NSW Chief Scientist regarding the local koala population in response to the Project REF (refer Appendix A and Chapter 3 for further detail), Transport for NSW proposes to modify the Project REF to facilitate the inclusion of two fauna crossings under Appin Road and fauna fencing on the eastern side of Appin Road (proposed modification). Key features would include:

- Glen Lorne (Corridor A) koala/fauna underpass (2.4m diameter pipe)
- Interim Browns Bush (Corridor B) koala/fauna underpass (two x 1.2m diameter pipes)
- Inclusion of fauna furniture and monitoring cameras
- Amended fence type at Beulah Biobank site (fauna fencing) [southern portion]
- Amended fence type at Noorumba Reserve (fauna fencing) [northern portion]
- Construction fencing

The location of the proposed modification is shown in Figures 3, while the proposed modification is shown in Figures 4 and 5. Chapter 3 describes the proposed modification in more detail.

## 1.3 Purpose of the report

This Addendum REF has been prepared by EMM Consulting Pty Ltd on behalf of Lendlease in consultation with Transport for NSW. For the purposes of the proposed works for the REF, Transport for NSW is the proponent and the determining authority under Division 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

This addendum REF is to be read in conjunction with the Project REF, Appin Road Upgrade, Mount Gilead to Ambarvale, November 2018. The purpose of this addendum REF is to describe the proposed modification, to document and assess the likely impacts of the proposed modification on the environment, and to detail mitigation and management measures to be implemented.

The description of the proposed work and assessment of associated environmental impacts have been undertaken in context of section 171 of the Environmental Planning and Assessment Regulation 2021 (EP&A Regulation 2021), Environmental Planning and Assessment Regulation 2000 (which the Project REF was determined under and has since been repealed), *Guidelines for Part 5.1 of the Environmental Planning and Assessment Act 1979* (DPE June 2022), Roads and Road Related Facilities EIS Guideline (DUAP, 1996), the *Biodiversity Conservation Act 2016* (BC Act), the *Fisheries Management Act 1994* (FM Act), and the Australian Government's *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

In doing so, the Addendum REF helps to fulfil the requirements of:

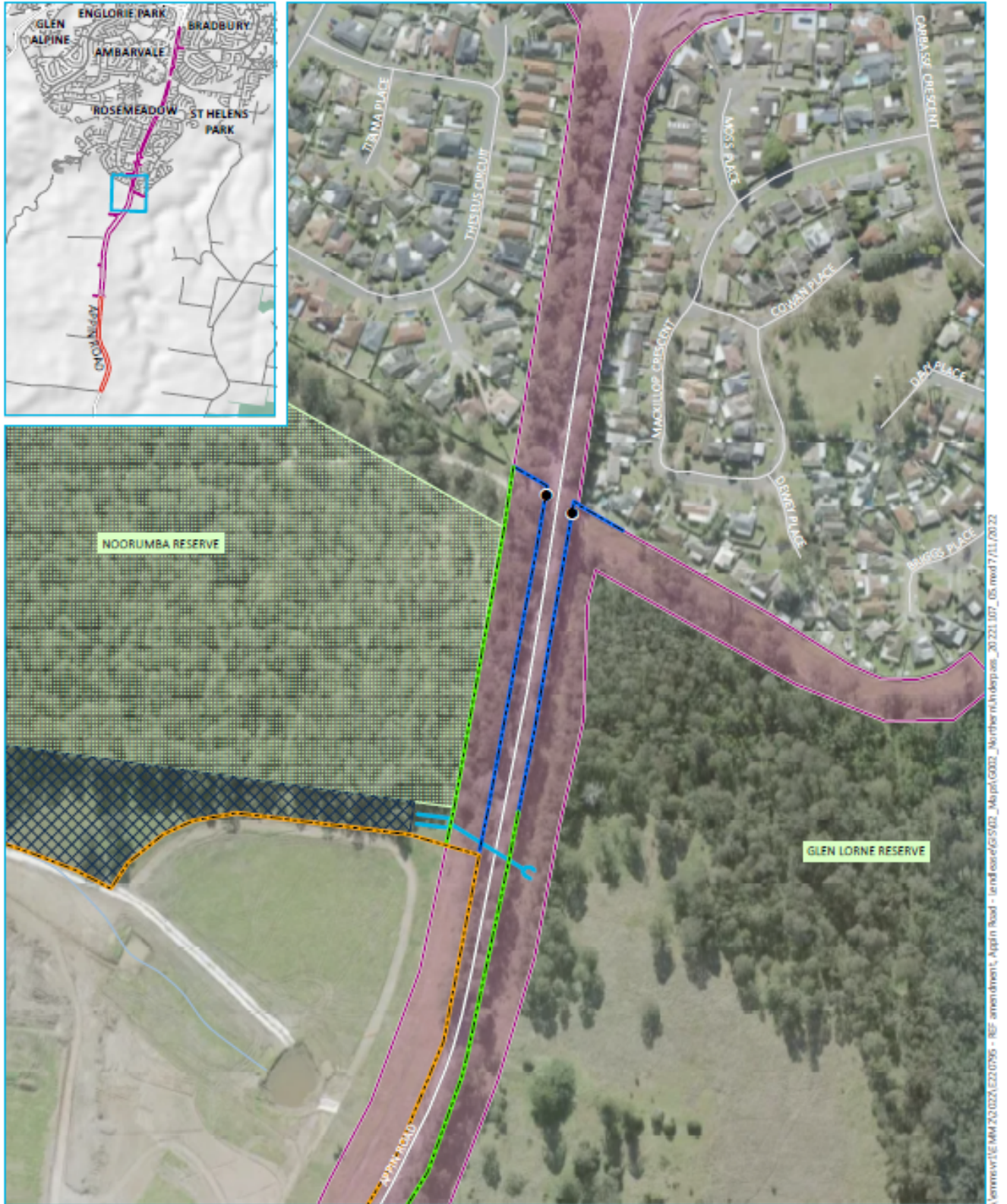
- Section 5.5 of the EP&A Act including that Transport for NSW examine and take into account to the fullest extent possible, all matters affecting or likely to affect the environment by reason of the activity; and
- The strategic assessment approval granted by the Federal Government under the EPBC Act in September 2015, with respect to the impacts of Transport for NSW's road activities on nationally listed threatened species, ecological communities and migratory species.

The findings of the Addendum REF are considered when assessing:

- Whether the proposed modification is likely to result in a significant impact on the environment and therefore the necessity for an environmental impact statement to be prepared and approval to be sought from the Minister for Planning under Division 5.2 of the EP&A Act
- The significance of any impact on threatened species as defined by the BC Act and/or FM Act, in section 1.7 of the EP&A Act and therefore the requirement for a Species Impact Statement or a Biodiversity Development Assessment Report
- The significance of any impact on nationally listed biodiversity matters under the EPBC Act, including whether there is a real possibility that the activity may threaten long-term survival of these matters, and whether offsets are required and able to be secured
- The potential for the proposed modification to significantly impact any other matters of national environmental significance or Commonwealth land and therefore the need to make a referral to the Australian Government

Department of Agriculture, Water and the Environment for a decision by the Australian Government Minister for the Environment on whether assessment and approval is required under the EPBC Act.





Source: EMM (2022); ABS (2021); DFSI (2020, 2021); ESR (2022); GA (2021); Metromap (2022)

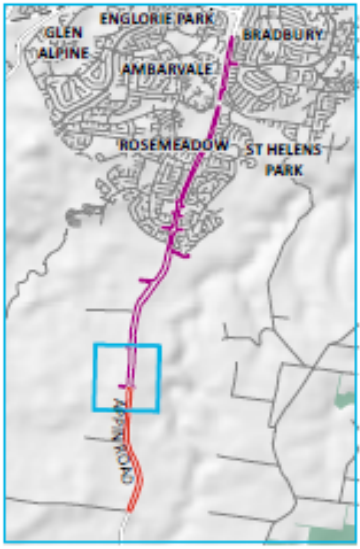
<p><b>KEY</b></p> <ul style="list-style-type: none"> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: #e91e63; border: 1px solid black; margin-right: 5px;"></span> Extent of Gilead to Ambarvale REF</li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: #f4a460; border: 1px solid black; margin-right: 5px;"></span> Extent of Brian Road to Gilead REF (refer to inset)</li> <li><span style="display: inline-block; width: 15px; height: 10px; background: repeating-linear-gradient(45deg, transparent, transparent 2px, black 2px, black 4px); border: 1px solid black; margin-right: 5px;"></span> Approved biobank area</li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: #e8f5e9; border: 1px solid black; margin-right: 5px;"></span> Noorumba Reserve</li> <li><span style="display: inline-block; width: 10px; height: 10px; border: 1px solid black; border-radius: 50%; margin-right: 5px;"></span> Gate</li> <li><span style="display: inline-block; width: 10px; height: 10px; background-color: black; border: 1px solid black; margin-right: 5px;"></span> Grid</li> </ul>		<ul style="list-style-type: none"> <li><span style="display: inline-block; width: 20px; border-bottom: 2px solid #00bcd4; margin-right: 5px;"></span> Proposed piped underpass (2.4 m wide)</li> <li><b>Fencing plan</b></li> <li><span style="display: inline-block; width: 20px; border-bottom: 2px dashed #008000; margin-right: 5px;"></span> Fauna type 1</li> <li><span style="display: inline-block; width: 20px; border-bottom: 2px solid #000080; margin-right: 5px;"></span> Fauna type 2</li> <li><span style="display: inline-block; width: 20px; border-bottom: 2px dashed #ffa000; margin-right: 5px;"></span> Figtree Hill Development Fencing/ Noise Wall (subject to separate approval)</li> <li><span style="display: inline-block; width: 20px; border-bottom: 2px solid #ffff00; margin-right: 5px;"></span> Safety improvement fencing</li> </ul>	<ul style="list-style-type: none"> <li><b>Existing environment</b></li> <li><span style="display: inline-block; width: 20px; border-bottom: 2px solid black; margin-right: 5px;"></span> Major road</li> <li><span style="display: inline-block; width: 20px; border-bottom: 1px solid black; margin-right: 5px;"></span> Minor road</li> <li><span style="display: inline-block; width: 20px; border-bottom: 1px dashed blue; margin-right: 5px;"></span> Watercourse/drainage line</li> </ul>
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**Northern underpass**

Lendlease  
Appin Road REF  
Figure 4

Addendum review of environmental factors





Source: EMM (2022); ABS (2021); DFSI (2020, 2021); ESRI (2022); GA (2011); Metromap (2022)

- KEY**
- Extent of Gilead to Ambarvale REF
  - Extent of Brian Road to Gilead REF
  - Gate
  - Grid
  - Proposed piped underpass (2 X 1.4 m wide)
  - Fencing plan**
  - Fauna type 1
  - Fauna type 2
  - Figtree Hill Development Fencing/ Noise Wall (subject to separate approval)
  - Safety improvement fencing
  - Existing environment
  - Major road
  - Watercourse/drainage line

Southern underpass

Lendlease  
Appin Road REF  
Figure 5



## 2. Need and options considered

### 2.1 Strategic need for the proposed modification

Chapter 2 of the Project REF addresses the strategic need for the Project, the Project objectives and the options that were considered. The proposed modification described and assessed in this Addendum REF is consistent with the strategic need for the Project.

The modification to the REF is being proposed following confirmation of the State Government's position on fauna corridors as part of the NSW Chief Scientist's advice (*Advice on the protection of the Campbelltown Koala population, Koala Independent Expert Panel*, 20 April 2020) and later update to Greater Macarthur 2040.

In addition, the Department of Planning and Environment's (DPE's) flora and fauna database, Bionet, holds records for 31 koala strikes on the section of Appin Road between Rosemeadow and Appin Township between 2010 and 2021 (Data downloaded August 2021). This figure would underestimate actual koala vehicle strikes as not all incidents would be reported.

In addition, *The Cumberland Plain Conservation Plan* (CPCP) was finalised in August 2022. The CPCP protects large areas of regionally important habitat while unlocking delivery of urban growth and development. This includes facilitating the delivery of up to 73,000 homes planned for the Western Parkland City by providing necessary biodiversity approvals. Sub-Plan B of the CPCP outlines the conservation program to protect the group of koalas known in this plan as the 'Southern Sydney koala population'. One of the key commitments of this plan is C7 as follows:

*Koala Commitment C7 - Mitigate impact on Southern Sydney koala population*

- Actions*
- Install koala exclusion fencing
  - Provide safe crossing point

The Project, incorporating the amendments that are the subject of this Addendum REF, presents the opportunity to deliver the first two fauna crossings under Appin Road identified in Greater Macarthur 2040. The inclusion of these crossings and associated works would serve to increase mitigation measures required to ensure the separation of local koala populations from traffic and facilitate safe east-west koala movement under Appin Road.

Regarding land affected by the approved Project REF and adjacent residential development at Mount Gilead, the NSW Chief Scientist's advice made the following recommendations for the Project:

Within the proposed Mount Gilead development:

- The Menangle Creek to Noorumba Reserve corridor (A) should be used for koala movement if:
  - A connectivity structure can feasibly be constructed on Appin Road. The proposed tree-top bridge is not likely to be adequate and would not be used by koalas. A land bridge should be considered to allow koalas and other fauna to cross Appin Road, an example of this is being developed for wallabies at Mona Vale.
  - The crossing is not feasible, the koala habitat at Noorumba would be isolated and not function as connected koala habitat, therefore should be fenced off at Appin Road. In this case, the koalas within this fragmented area would need to be actively managed.
  - The Woodhouse Creek to Beulah Biobank site corridor (B) is an important northern connection for the koala population between the Georges River Reserve and the Nepean Corridor and should be retained. The proposed measures to protect the habitat in the corridor are currently not adequate and should be improved with the measures outlined in c). The underpass near Beulah Biobank site as proposed by Lendlease should be constructed.

The amendment to the REF makes provision for safe east-west koala movement via the delivery of:

- An underpass crossing of Appin Road to form the Menangle Creek to Noorumba Reserve Corridor (A) (referred to in this document as the Glen Lorne underpass); and
- An underpass crossing of Appin Road to form a temporary Woodhouse Creek Beulah Biobank site Corridor (B) (referred to in this document as the Browns Bush corridor),

as shown in Figures 5 and 6 respectively.

The Project REF addresses the strategic need for the project, the project objectives and the options that were considered. The proposed modification described and assessed in this addendum REF is consistent with the strategic need for the project.

The proposed modification is needed to be able to meet the recommendations set out by the NSW Chief Scientist.

## 2.2 Proposal objectives and development criteria

Section 2.3 of the Project REF identifies the proposal objectives and development criteria that apply to the proposed modification which include:

- Improve road safety
- Minimise social and environmental impacts.
- Protect sensitive environments adjacent to the road corridor including endangered ecological communities and local residences as far as practical.

The proposal objectives of the Addendum REF works are to:

- Improve koala connectivity between Noorumba and Beulah Biobank sites on the western side of Appin Road with Glen Lorne and Browns Bush Reserves on the eastern side of the road to ensure the long-term stability of the local koala population.
- Minimise interaction of koalas with traffic.
- Minimise social and environmental impacts.

The proposed modifications have been designed based on criteria provided in the NSW Chief Scientist’s letter and in consultation with a specialist koala consultant.

## 2.3 Alternatives and options considered

This addendum has been developed following confirmation of the State Government’s position on fauna corridors as part of the NSW Chief Scientist’s advice (*Advice on the protection of the Campbelltown Koala population, Koala Independent Expert Panel, 20 April 2020*). Ensuring that the advice is followed has limited the options available for the proposed work. Further information on the considered options is provided in Appendix H.

Table 2-1 Alternatives and options considered

Option	Description
Do nothing	Contrary to advice from the NSW Chief Scientist. Result of doing nothing would lead to koala habitats becoming functionally fragmented. Koala numbers would decline due to reduced connectivity and increased threats.
Noorumba underpass: Corridor A – Menangle Creek to Noorumba (permanent) Option 1	Corridor identified and requested in the NSW Chief Scientist’s advice. Notwithstanding, the most workable concept saw this land in the centre of the biobank site, with significant impacts on existing vegetation.
Glen Lorne underpass: Corridor A – Menangle Creek to Noorumba (permanent) Option 2	Corridor identified and requested in the NSW Chief Scientist’s advice. Proposed option provides work-around to constraints including existing services.
Browns Bush underpass: Corridor B – Woodhouse Creek to Beulah Biobank site (interim)	Corridor identified and requested in the NSW Chief Scientist’s advice as an important northern connection for the koala population between the Georges River Reserve and the Nepean Corridor. The temporary crossing proposed would ensure connectivity is established as soon as possible.
Browns Bush underpass: Corridor B – Woodhouse Creek to Beulah Biobank site (permanent)	Corridor identified in the NSW Chief Scientist’s advice – to be constructed in the future (subject to a separate approval).

The timing and extent of this proposal however has not yet been determined and separate approval would be required. The permanent crossing does not form part of this Addendum REF works.

In the interim, approval of the amendments sought by this Addendum REF is required to support the relevant approved Appin Road upgrade works under the Project REF. These works are urgently required to improve safety on the relevant section of Appin Road. To meet the requirements of the NSW Chief Scientist, as well as facilitating the road upgrade, it is proposed to construct a temporary underpass at the southern extent of Mount Gilead Stage 2 land (Browns Bush underpass), as shown in Figure 4.

## 2.4 Preferred option

The preferred option is to follow the advice of the NSW Chief Scientist and ensure that connectivity and safe passage across Appin Road are achieved. A permanent underpass at Glen Lorne and a temporary underpass at Browns Bush would be constructed, as well as fauna fencing to separate the koalas from external risks such as traffic.



## 3. Description of the proposed modification

### 3.1 The proposed modification

Transport for NSW proposes to modify the Appin Road Upgrade to facilitate the inclusion of two fauna crossings and fauna fencing on the eastern side of Appin Road. The proposed modification is shown in Figures 3 and 4.

Key features of the proposed modification would include:

- Glen Lorne underpass (Corridor A) underpass (2.4m wide pipe) would be approximately 57m in length with a light well/ grate located in the median strip in the middle of Appin Road to provide light penetration within the underpass. This would likely consist of a large concrete pit (similar to a drainage pit structure) with a grated opening at the surface. It would be raised above the natural ground surface to prevent water flowing into the underpass.
- Browns Bush (Corridor B) underpass (interim) (two x 1.2m wide pipes) would be approximately 27m in length.
- Fauna passage to the underpass, including the use of fauna furniture where necessary to allow access between top of batters and the underpass entry/exit points, as well as through the pipes (where viable) to enhance useability by koalas and other fauna (refer Figures 6 and 7). The fauna furniture would most likely consist of logs placed on ramps and large (300mm to 400mm diameter) logs placed through Glen Lorne underpass (offset to allow use by wallabies and kangaroos). Browns Bush underpass would be furnished with medium (150mm to 300mm diameter) logs placed through the tunnels, with more logs provided on ramps. Further details of fauna furniture would be provided in the detailed design phase. The provision of fauna furniture would be included as an environmental safeguard (refer Table 7-1).
- Tunnels would have a level surface in the bottom, created by lining the pipes with a natural substrate, such as blue metal which allows water drainage, covered with mulch. This would assist in keeping the interior of the pipes relatively dry.
- Underpass entrances would lead to natural habitat, which would be visible from culvert entrances.
- Incorporation of automated cameras with movement sensing infra-red beam at entry points to both Glen Lorne and Browns Bush underpasses, mounted on wingwalls and utilising fauna fencing to mount solar panels and equipment. This would facilitate monitoring of the underpasses and provide useful information on the use of underpasses.
- Fauna fencing would be provided to guide koalas/fauna towards the culvert entrances as required to tie-in with the existing Appin Road Upgrade designs including amended fence type at Beulah Biobank site (southern portion) and Noorumba Reserve (northern portion);
  - 'Type 1' fencing detail (refer Figures 3 and 4) shows concrete footings at 3m spacings. The east side of Appin Road consists of approximately 1.86 km of Type 1 fencing.
  - 'Type 2' fencing detail (refer Figures 3 and 4) consists of driven posts 3m spacings. There is a total of approximately 1.9 km of Type 2 fencing on both the east and west side of Appin Road.
  - Construction fencing on the western side of Appin Road, between Figtree Hill development and the Appin Road upgrade works would be amended to include anti-climb sheeting pm on the existing chain wire fence and temporary fence, to limit fauna from accessing the upgrade works area.
- It is noted that each section of works would be fenced prior to commencement and the fauna fence installation would be scheduled as part of the initial stage of works for the length of Appin Road. These management measures are included as environmental safeguards (refer Table 7-1).
- Inclusion of wing-wall drop-downs (refer Figure 9). A wing-wall drop-down is a hole in the fence along a head wall that is high enough to prevent fauna entering the road corridor but low enough that an animal in the road corridor could drop down into the underpass entrance area without injury.
- Provision of grids at driveways to limit koalas/fauna to Appin Road at these points. Parallel panels would be installed (subject to landowner approval) to stop koalas getting around fence/grid.
- Provision of new drainage lines and channels where the underpass impacts overland flows;
- Adjustments to drainage pits and pipe network where directly impacted by the new fauna underpass;
- Adjustments to existing utilities, relocation and protection, where required; and

- Property adjustments.

The entire drawing package is included in Appendix B.

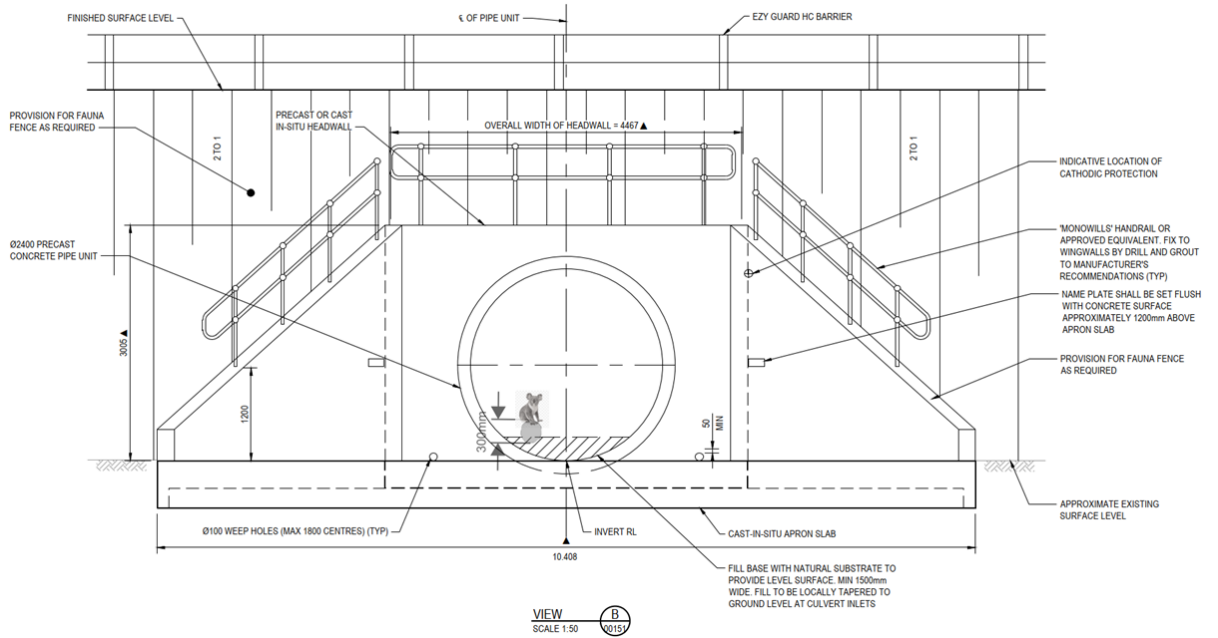


Figure 6 Indicative fauna furniture through Glen Lorne underpass

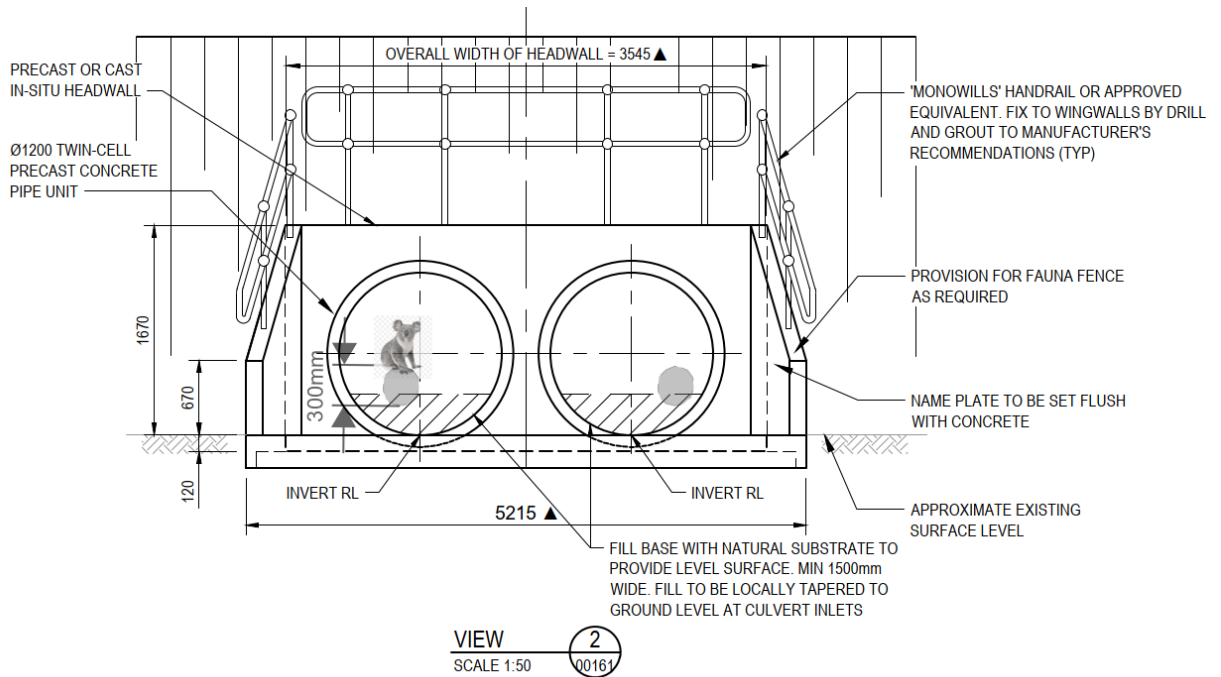


Figure 7 Indicative fauna furniture through Browns Bush underpass



Radio-collared male Koala crossing the Pacific Highway through a designated fauna underpass. Image captured by an automated camera with a movement sensing infra-red beam used to trigger the photograph (positioned by C. Moon).

Figure 8 Fauna monitoring in underpasses



Figure 9 Example of koala/fauna grid with fenced return (left) and wing wall drop-down<sup>21</sup> (right)

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<sup>1</sup> Source: 'How to keep koalas off the road', NSW Department of Planning, Industry and Environment, June 2020

## 3.2 Design

### 3.2.1 Design criteria

The following guidelines and standards have been used to inform and develop the Project design and would be used to develop the proposed modification design:

- Austroads Guide to Road Design (AGRD) (in conjunction with RTA Austroads Guide Supplements);
- Campbelltown City Council’s guideline is adopted as a preferred design guideline (for the side roads);
- QA Specification for Environmental Assessment;
- QA Specification for Detailed Survey and Utility Adjustment;
- QA Specification for Pavement Investigation and Design;
- QA Specification for Road Design;
- QA Specification for Hydrology and Drainage Design;
- Beyond the Pavement – Urban Design Policy Procedures and Design Principles; and
- General design criteria adopted for the road geometry design for Glen Lorne underpass is shown below. Browns Bush temporary underpass consists of the reinstatement of the existing Appin Road only.

Table 3-1 Design Criteria – Glen Lorne

Mainline Carriageways Design Criteria	Minimum Design Requirement
<b>Design Speed</b>	
North bound (NB) side in general	90 km/h
South bound (SB) side	Match to existing Appin Road design speed
<b>Posted Speed</b>	
NB side	80 km/h
SB side	80 km/h
<b>General design parameters</b>	
Average Annual Daily Traffic (AADT)	Approx. 11,000 along Appin Road
Reaction time	1.5 sec
Co-efficient of deceleration	Passenger Car – 0.36
Eye height	Passenger Car – 1.1 m
Object height	SSD – 0.2 m ASD – 0 m SISD – 1.25 m Headlight mounting – 0.65 m
<b>Cross section</b>	
Number of lanes on each carriageway	2
Lane widths	3.5 m – NB side 3.2 m – SB side (matches existing)
Auxiliary lane widths	3.3 m – Right turn lanes

Mainline Carriageways Design Criteria	Minimum Design Requirement
	3.5 m – Left turn lanes
Nearside shoulder width	2 m – NB side Varies – SB side (matches existing)
Offside shoulder width (adjacent to raised median)	1.0 m – NB side 1.0 m – SB side
Nearside verge width	1 m (min) – NB side Varies – SB side (existing to remain)
<b>Design vehicle – turning movement</b>	
Through lane (for lane corrected pavement widening at mainline NB and SB side horizontal curve locations)	B – Double 26 m
Design vehicle – turning movements (at Figtree Hill North and South)	Single Articulated Vehicle (19m)B – Double 26m (Check Vehicle)
<b>Earthwork batters</b>	
Cut batter slope (underpass)	Desirable – 4H:1V Max – 2H:1V
Fill batter slope (underpass)	Desirable – 4H:1V Max – 3H:1V

Table 3-2 Design Criteria – Browns Bush

Mainline Carriageways Design Criteria	Minimum Design Requirement
<b>Design Speed</b>	
<b>North bound (NB) side in general</b>	90 km/h
<b>South bound (SB) side</b>	Match to existing Appin Road design speed
<b>Posted Speed</b>	
<b>NB side</b>	80 km/h
<b>SB side</b>	80 km/h
<b>General design parameters</b>	
<b>Average Annual Daily Traffic (AADT)</b>	Approx. 11,000 along Appin Road
<b>Reaction time</b>	1.5 sec
<b>Co-efficient of deceleration</b>	Passenger Car – 0.36
<b>Eye height</b>	Passenger Car – 1.1 m

Table 3-3 Minimum ARI requirements

Item No.	Item	Minimum ARI
1	Channels and open drains	5 years
2	Piped system (including pits)	10 years
3	Culverts where surcharge is allowable	50 years
4	Structure where surcharge is undesirable	100 years
5	No flow spread onto the traffic lane	10 years
6	Pavement drainage wearing surface	10 years
7	Major storm event check for no property damage	100 years
8	Temporary drainage	2 years

### 3.2.2 Engineering constraints

A number of engineering issues and constraints for the design and construction of the proposed modification have been identified. Table 3-4 identifies the main issues and constraints for the proposed modification. These issues and constraints have informed the development of the concept design as required to tie the in with the existing Appin Road Upgrade designs.

Table 3-4 Main issues and constraints

Constraint	Comment
<b>Utilities</b>	<p>A Telstra national optic fibre (Sydney – Melbourne) runs alongside the eastern edge of Appin Road, however potholing investigation has confirmed that the upgrade does not directly impact the optic fibre.</p> <p>An existing rising sewer main also runs on the western side of the Appin Road. Protection work on the rising main is required prior to construction and temporary staging requirements would be confirmed by the Water Servicing Coordinator.</p>
<b>Concurrent construction activities</b>	In the case of parallel construction either between the Appin Road Upgrade, Southern Section and Appin Road safety improvement works and/or the Figtree Hill residential subdivision, coordination would be required to be address potential clashes and construction sequence issues.
<b>Traffic and access</b>	Road shutdowns would be required to construct the underpasses. Further consultation with Transport for NSW and Traffic Management Centre required.
<b>Installation of fauna crossing pipes</b>	<p>Options are limited in relation to the installation of the underpass pipes. An initial assessment by designers shows that bored pipes (also known as pipejacking) typically require 2.5 times the pipe diameter to what is being proposed. If the pipes were sunk lower to enable pipe jacking, then the earthworks would encroach into the Noorumba/Beulah Biobank sites and would trigger the need for retaining walls to stop the encroachments.</p> <p>For the larger pipe, a mini tunnel boring machine (TBM) would be required which would result in a larger construction footprint to enable use of the TBM.</p>

### 3.3 Construction activities

The likely method, staging, work hours, plant and equipment needed to build the proposed modification are described in this section.

The construction strategy would be further assessed and developed to ensure that construction occurs in a safe and efficient manner while managing constraints and minimising environmental impacts. The actual work method may vary from the description provided in this section due to the identification of additional constraints before work starts, ongoing detailed design refinements, feedback from community and stakeholder consultation, and contractor requirements and limitations.



The general principles of the construction strategy are to:

- Achieve safe and convenient access for construction vehicles and the public, plant, and equipment along the length of the Project to and from public roads while at the same time minimising impacts;
- Ensure construction impacts on Koalas/fauna are mitigated as much as possible through the use of temporary fauna fencing and environmental safeguards (refer Table 7-1);
- Consider impacts on road users, the effect on urban amenity and the suitability of local road pavements;
- Manage impacts on existing infrastructure including local roads, utilities, and services;
- Recognise that modifications to existing infrastructure come with increased safety risks to road users and construction personnel and can result in the need to undertake work at night or to implement traffic switches; and
- Manage community and environmental issues including noise, access, amenity, and general disruption.

### 3.3.1 Work methodology

The proposed modification works would be integrated with work methodology outlined in the Project REF. Table 3-5 and Table 3-6 describe the activities that would be undertaken to build the Glen Lorne and Browns Bush underpasses and fauna fencing.

Table 3-4 Typical work activities – Glen Lorne underpass

Activity	Work description
<b>Site establishment</b>	<ul style="list-style-type: none"> <li>• Setup environmental, safety and traffic management controls</li> <li>• Pre-clearance surveys and obtaining any permits or licences</li> <li>• Site demarcation, exclusion fencing and barrier establishment, identification and protection of sensitive areas (ie habitat zones, trees to be retained)</li> <li>• Installation of erosion and sediment controls</li> <li>• Utility adjustment/protection</li> </ul>
<b>Main works</b>	<ul style="list-style-type: none"> <li>• Excavation and shaping of the approaches to the underpass</li> <li>• Fauna pipe installation</li> <li>• Drainage installation</li> <li>• Subbase placement and compaction</li> <li>• Asphalt placement and compaction</li> <li>• Drainage pipe installation</li> <li>• Headwall installation</li> </ul>
<b>Finalisation, reinstatement and demobilisation</b>	<ul style="list-style-type: none"> <li>• Trenching of eastern side of Appin Road and completion of the eastern half of the fauna underpass installation including headwall construction and the approach works to the underpass</li> <li>• Reinstatement of pavement</li> <li>• Pavement milling</li> <li>• Line-marking</li> <li>• Installation of fauna furniture and fauna protection landscaping within the underpass and underpass entry</li> <li>• Final topsoiling and revegetation</li> <li>• Final verge works</li> <li>• Final connection of drainage works</li> <li>• Concrete infill to splitter islands</li> <li>• Asphalt final wearing courses</li> <li>• Sign posting</li> <li>• Barrier installation</li> <li>• Removal of erosion and sediment controls</li> </ul>

Table 3-5 Typical work activities – Browns Bush underpass

Activity	Work description
<b>Site establishment</b>	<ul style="list-style-type: none"> <li>• Setup environmental, safety and traffic management controls</li> <li>• Pre-clearance surveys and obtaining any permits or licences</li> <li>• Site demarcation, exclusion fencing and barrier establishment, identification and protection of sensitive areas (ie habitat zones, trees to be retained)</li> <li>• Installation of erosion and sediment controls</li> <li>• Utility adjustment/protection</li> </ul>
<b>Main works</b>	<ul style="list-style-type: none"> <li>• Excavation and shaping of the approaches to the underpass</li> <li>• Localised shoulder repairs</li> <li>• Excavation, trenching and staged installation of the twin pipes</li> <li>• Asphalt placement and compaction</li> </ul>
<b>Finalisation</b>	<ul style="list-style-type: none"> <li>• Completion of fauna fencing and fauna underpass landscaping works, including fauna furniture</li> <li>• Site demobilisation</li> </ul>

### 3.3.2 Construction hours and duration

The proposed modification works would be integrated within the main Project works. Indicative timing for the stages listed above are:

Glen Lorne underpass

- Site establishment: 1 weeks
- Main works: 8 weeks
- Finalisation: 2 weeks.

Browns Bush underpass

- Site establishment: 4 weeks
- Main works: 8 weeks
- Finalisation: 2 weeks.

Most of the work would take place within the following standard working hours:

- Monday to Friday, 7 am to 6 pm
- Saturday, 8 am to 1 pm.

However, some construction activities are likely to be required to be undertaken outside of the standard working hours in order to minimise disruption to peak hour traffic and public transport operation, maintain property and pedestrian access during the day and provide a safe working environment for construction workers.

These activities may include:

- Trenching, pipe installation and backfill works that are considered high risk to be undertaken whilst maintaining the operation of all existing traffic lanes
- Pavement upgrade and re-surfacing work
- Traffic switch work to accommodate long-term staging work and maintain property access during the daytime
- Delivery of oversized plants or large prefabricated structures.

Appropriate impact investigation prior to implementation, mitigation measures and community consultation would be undertaken for work proposed outside of the standard working hours. Approval by the relevant road authority (including Road Occupancy Licence (ROL) from the Transport Management Centre) would be obtained prior to the work being undertaken. Licencing and approval requirements are further detailed in section 7.3.

### 3.3.3 Plant and equipment

The plant and equipment needed to build the proposed modification would be typical to any major construction site. It would vary depending on the construction activities. Table 3-8 indicates the plant and equipment that would be likely used to build the proposed modification however this would be finalised by the contractor.

Table 3-6 Indicative plant and equipment

Equipment	Activity	Equipment	Activity
<b>Asphalt truck &amp; sprayer</b>	Paving/asphalting	Generator	Bulk earthworks
<b>Backhoe</b>	Site establishment, drainage, bulk earthworks	Loader	Bulk earthworks
<b>Bulldozer</b>	Bulk earthworks	Mobile crane	Pipe handling – deliveries and installation
<b>Excavator (30t)</b>	<b>Drainage, bulk earthworks</b>	<b>Trucks</b>	<b>Site establishment, bulk earthworks, drainage, deliveries</b>
<b>Wood chipping machinery / chainsaw</b>	Clearing	Grader	Paving / asphalting
<b>Rollers</b>	Bulk earthworks	Watercart	Bulk earthworks
<b>Rock hammer</b>	Bulk earthworks	Concrete hand compaction equipment	Paving / asphalt, footings
<b>Concrete delivery vehicles</b>	Paving / asphalt, footings	Single lane milling machine	Paving
<b>High pressure water jetting equipment</b>	Potholing / utility adjustments	Concrete pump	Paving / asphalt, footings

### 3.3.4 Earthworks

Excavations would be required for trenching, leveling, utilities adjustments and to build batters and verges. The ability to reuse the material would depend on its physical and chemical properties. Uncontaminated material that is not suitable for use as structural fill could be used to line the utility trenches or in areas of landscaping. Material unsuitable for construction use would need to be transported offsite by a licensed contractor for disposal at a licensed waste management facility following testing and classification. Stockpile and waste management would be managed as per the Project REF.

### 3.3.5 Source and quantity of materials

Various standard construction materials that are readily available across the Sydney Metropolitan region would be needed to build the proposed modification. They would be either transported to site as prefabricated units, ready for installation, or the materials would be held at one of the Project compounds.

- Asphalt and base and sub-base pavement materials (stone, aggregate, quarried materials)
- Concrete pipes, pits and drains
- Prefabricated signage, lighting posts, fencing and other road infrastructure
- Trees, logs, seedlings, chippings and turf to support revegetation and underpass fauna furniture.

### 3.3.6 Traffic management and access

The management of construction and traffic considerations would be of importance to local council, government, and the community. This requires the following issues to be considered:

- The development of measures to minimise and/or restrict the use of local roads by heavy vehicles involved in the proposed modification construction.
- Designated vehicle access points from local roads to the site and heavy vehicle routes on local roads.
- Maintaining local and residential access as much as practicably possible.
- Design requirements are to be in accordance with the Traffic Control at Worksites – Version 6

Traffic switches are to be managed to ensure road users are guided through the temporary diversion with signage and advance warning and would require reduced speed limits during construction. The final construction staging adopted by the delivery contractor would need to be developed in accordance with Transport for NSW, *Technical Manual – Traffic control at work sites* and approved by the relevant authorities including Transport for NSW and the Transport Management Centre (TMC) prior to implementation.

## 3.4 Ancillary facilities

The Project ancillary facilities described in the Project REF would be used for the proposed modification works.

## 3.5 Public utility adjustment

The proposed modification may require the relocation of communications and sewer utilities, which would be managed through each of the relevant authorities once service investigations reveal the extent of any relocation required within the Project footprint.

## 3.6 Property acquisition

Property acquisition is not required for the proposed modification.

## 4. Statutory and planning framework

### 4.1 Environmental Planning and Assessment Act 1979

#### 4.1.1 State Environmental Planning Policies

##### **State Environmental Planning Policy (Transport and Infrastructure) 2021**

Chapter 2 (Infrastructure) of SEPP (Transport and Infrastructure) aims to facilitate the effective delivery of infrastructure across the State.

Section 2.109 of SEPP (Transport and Infrastructure) permits development on any land for the purpose of a road or road infrastructure facilities to be carried out by or on behalf of a public authority without consent.

As the proposed modification is related to road infrastructure and is to be carried out on behalf of Transport for NSW, it can be assessed under Division 5.1 of the EP&A Act. Development consent from council is not required.

The proposal is not located on land reserved under the *National Parks and Wildlife Act 1974* and does not require development consent or approval under:

- State Environmental Planning Policy (Precincts – Western Parkland City) 2021.

Section 2.10 to 2.15 of SEPP (Transport and Infrastructure) contains provisions for public authorities to consult with local councils and other public authorities prior to the commencement of certain types of development.

Consultation, including consultation as required by ISEPP (where applicable), is discussed in section 5 of this addendum REF.

##### **State Environmental Planning Policy (Biodiversity and Conservation) 2021**

The *State Environmental Planning Policy (Biodiversity and Conservation) SEPP* includes the requirements of the former *Koala Habitat Protection SEPP* (SEPP 44) and aims to encourage the proper conservation and management of areas of natural vegetation that provide habitat for koalas to ensure a permanent free-living population over their present range and reverse the current trend of koala population decline.

The Biodiversity and Conservation SEPP applies to land which constitutes:

- Potential koala habitat – defined as areas containing native vegetation where the trees of the types listed in Schedule 2 of SEPP 44 constitute at least 15 per cent of the total number of trees in the upper or lower strata of the tree component.
- Core koala habitat – defined as areas of land with a resident population of koalas, evidenced by attributes such as breeding females (that is, females with young) and recent sightings of and historical records of a population.

In accordance with the Transport and Infrastructure SEPP, the proposed modification is permissible without consent and can be assessed under Division 5.1 of the EP&A Act. Subsequently SEPP 44 is not applicable to the proposal.

Chapter 13 of the Biodiversity and Conservation SEPP enabled the preparation of the CPCP, which was finalised in August 2022, including Sub-Plan B which outlines the conservation program to protect the group of koalas known in this plan as the 'Southern Sydney koala population'.

In addition, Chapter 8 (Sydney Drinking Water Catchment) of the State Environmental Planning Policy (Biodiversity and Conservation) 2021 relates to the use of land within the Sydney drinking water catchment. Section 8.11 of the SEPP requires consideration of whether or not an activity to which Division 5.1 of the EP&A Act applies would have a neutral or beneficial effect on water quality before carrying out the activity. A neutral or beneficial effect assessment is included in Appendix D. The assessment concludes that the proposed modification would have a neutral effect on water quality.



## 4.2 Other relevant NSW legislation

### 4.2.1 Biodiversity Conservation Act 2016

The *Biodiversity Conservation Act 2016* (BC Act) replaced the *Threatened Species Conservation (repealed) Act 1995* (TSC Act), *Native Vegetation Act 2003* and part of the *National Parks and Wildlife Act 1974* from 25 August 2017.

The BC Act provides for a strategic approach to conservation in NSW whilst supporting improved farm productivity and sustainable development. It includes provisions for a risk-based assessment of native plant and animal impacts, and a Biodiversity Assessment Method (BAM) to assess the impact of actions on threatened species, threatened ecological communities and their habitats, and the impact on biodiversity values.

The proposed modification would not lead to a significant impact on communities and species protected under the BC Act (refer to section 6.1 and Appendix C and E). Therefore, a species impact statement or Biodiversity Development Assessment Report was not required.

### 4.2.2 Heritage Act 1977

The *Heritage Act 1977* (Heritage Act) provides for the conservation of buildings, works, archaeological relics and places of heritage value. It principally achieves this by listing, and therefore protecting, heritage values under a number of registers. This includes the State heritage register (SHR), the heritage and conservation register (HCR), LEP heritage schedules, public authority heritage and conservation registers (termed section 170 registers), and interim heritage orders (IHOs).

The Heritage Act requires Transport for NSW to assess the proposal's impact on historic buildings, places, objects, works, relics and archaeological sites, and to ensure their cultural heritage value is protected (refer to section 6.6 and 6.7). The Heritage Act sets out provisions that require a statement of heritage impact to be prepared where the proposal has the potential to impact on any values that are protected under the Heritage Act. Finally, the Heritage Act sets out a process for obtaining permission from the NSW Heritage Council, as administrators of the Heritage Act, to investigate, excavate and/or impact on a heritage-listed item. The proposed modification would not directly affect any state or local heritage item (listed under the Campbelltown LEP). A report has been undertaken by GML (heritage consultants) that assesses the proposal against these requirements (refer Appendix F).

### 4.2.3 Roads Act 1993

Under the *Roads Act 1993* (Roads Act) the consent of the relevant roads' authority is required to dig up, erect a structure or carry out work in, on or over a road (refer to Section 138 of the Roads Act). A licence (a road occupancy licence) would be obtained from the Transport Management Centre under Section 138 of the Roads Act in order to build the proposal as it would impact the operation of Appin Road, a classified road.

### 4.2.4 Protection of the Environment Operations Act 1997

Environmental protection is provisioned under the *Protection of the Environment Operations Act 1997* (POEO Act). The underlying objective of the Act is to reduce pollution and manage the storage, treatment and disposal of waste. A key feature of the Act is the issuing of environmental protection licences (EPLs) for certain (scheduled) activities. Transport for NSW would be required to obtain an EPL for the project, as described in the Project REF and this Addendum REF, as the works are defined as a scheduled activity (widening of an existing road) under Schedule 1, cl 35(a).

The Act requires Transport for NSW to manage the proposed modification to limit its potential to cause water, noise and/or air pollution, while managing its waste streams. This would be achieved through implementing the safeguards and management measures identified in Chapter 7 of this Addendum REF. A number of regulations have also been prepared in parallel to the Act. This includes the Protection of the Environment Operations (Waste) Regulation 2014 that allows Transport for NSW to use excavated (natural) material under a resource recovery exemption as engineering fill, instead of disposing of it. Transport for NSW would also be required to notify the NSW EPA, which is responsible for administering the provisions of the Act, in instances where any pollution incident has the potential to 'cause or threaten material harm to the environment' (refer to Section 148 of the Act).

## 4.3 Local Environmental Plans

The proposed modification is located within the Campbelltown City Council local government area (LGA). The operation of the Transport and Infrastructure SEPP means that the local environmental plans (LEPs) would not apply where they impose controls that are inconsistent with the Transport and Infrastructure SEPP.

## 4.4 Commonwealth legislation

### 4.4.1 Environment Protection and Biodiversity Conservation Act 1999

Under the EPBC Act a referral is required to the Australian Government for proposed 'actions that have the potential to significantly impact on matters of national environmental significance or the environment of Commonwealth land. These are considered in Appendix C and chapter 6 of the Addendum REF.

A Transport for NSW EPBC Act strategic assessment approval has not been triggered for proposed road actions that may affect nationally listed threatened species, endangered ecological communities and migratory species. This is because requirements for considering impacts to these biodiversity matters are the subject of a strategic assessment approval granted under the EPBC Act by the Australian Government in September 2015. Potential impacts to these biodiversity matters are also considered as part of chapter 6 of the Addendum REF and Appendix E.

#### **Findings – matters of national environmental significance (other than biodiversity matters)**

The assessment of the proposed modification's impact on matters of national environmental significance and the environment of Commonwealth land found that there would be no change to the findings of the determined activity and would be unlikely to cause a significant impact on matters of national environmental significance or the environment of Commonwealth land. A referral to the Australian Department of Climate Change, Energy, the Environment and Water is not required.

#### **Findings – nationally listed biodiversity matters**

The assessment of the proposed modification's impact on nationally listed threatened species, populations, endangered ecological communities and migratory species found that there is unlikely to be a significant detrimental impact on relevant matters of national environmental significance. Chapter 6 of the Addendum REF describes the safeguards and management measures to be applied.

## 4.5 Confirmation of statutory position

The proposed modification is categorised as development for the purpose of a road and is being carried out by or on behalf of a public authority. Under the Transport and Infrastructure SEPP the proposal is permissible without consent. The proposed modification is not State significant infrastructure or State significant development. The proposed modification can be assessed under Division 5.1 of the EP&A Act.

Transport for NSW is the determining authority for the proposed modification and this Addendum REF fulfils Transport for NSW's obligation under Division 5.5 of the EP&A Act to examine and take into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of the activity.

## 5. Consultation

### 5.1 Consultation strategy

A Community and Stakeholder Engagement Plan has been prepared to guide communications and consultation activities during the preparation and public exhibition of the REF (a 21-day consultation period will occur). The Plan would be updated following the REF exhibition period.

Initial communication and consultation activities have been focused on informing landowners about environmental or technical investigations that needed to occur on or near their properties.

It is proposed to undertake community and stakeholder consultation in the following way:

- letterbox drop group notification to impacted and adjacent landholders
- provision of a copy of the Archaeological Research Design to the project Registered Aboriginal Parties (this has already occurred). To date no responses have been received.

### 5.2 Aboriginal community involvement

Consultation with the Aboriginal community would occur following the Transport for NSW *Procedure for Aboriginal Cultural Heritage and Consultation Investigation (PACHCI)* guidelines. The proposal is located within the Campbelltown LGA, the Parish of Menangle, and the County of Cumberland. It is contained within the boundaries of the Tharawal Local Aboriginal Land Council (LALC).

Section 6.2 details the Aboriginal cultural heritage assessments, following the Transport for NSW procedures for Aboriginal and Cultural Heritage consultation and investigation. Table 5-1 provides a summary of the stages of this procedure.

Table 5-1: Summary of Roads and Maritime Procedure for Aboriginal Cultural Heritage Consultation and Investigation

Stage	Description
Stage 1	Initial Transport for NSW assessment.
Stage 2	Site survey and further assessment.
Stage 3	Formal consultation and preparation of a cultural heritage assessment report.
Stage 4	Implement environmental impact assessment recommendations.

### 5.3 Consultation outcomes

Consultation outcomes would be reported if any submissions are made following the consultation set out in section 5.1 above.

Appendix D contains a consultation checklist that documents how the consultation requirements under SEPP (Precincts – Western Parkland City) would be identified.

Issues that are raised as a result of this consultation would be reported should any relevant submissions be received.

Various government agencies and stakeholders would be consulted about the proposed modification including:

- Campbelltown City Council

## 6. Environmental assessment

This section of the addendum REF provides a detailed description of the potential environmental impacts associated with the construction and operation of the proposed modification of the Project REF. All aspects of the environment potentially impacted upon by the proposed modification are considered. This includes consideration of the guidelines *Roads and Related Facilities EIS Guideline* (DUAP, 1996), *Guidelines for Division 5.1 assessments* (DPE, June 2022) and the factors specified in section 171 of the EP&A Regulation 2021. The factors specified in section 171(2) of the EP&A Regulation 2021 are also considered in Appendix B.

The environmental factors assessed within this section includes:

- Biodiversity
- Soils and geology
- Hydrology and flooding
- Traffic and transport
- Noise and vibration
- Aboriginal heritage
- Non-Aboriginal heritage
- Waste management and resource use
- Other impacts (including hazards and risk, air quality and greenhouse gas emissions)
- Cumulative impacts.

Technical study reports for some of these environmental factors are appended to this REF and can be referred to for detailed information. This includes:

- Biodiversity – Appendix E
- Aboriginal heritage – Appendix F
- Groundwater – Appendix G.

Site-specific safeguards and management measures are provided to ameliorate the identified potential impacts (Table 7-1).

### 6.1 Biodiversity

This section summarises the assessed impacts on biodiversity values that are likely to occur when building and operating the proposal. A biodiversity assessment was undertaken by Eco Logical Australia (ELA) to support the Addendum REF, and is included as Appendix E.

#### 6.1.1 Methodology

The biodiversity assessment was based on desktop review of available documents and past ecological studies in the Project area. ELA have undertaken extensive ecological studies of the Mt Gilead and Noorumba Reserve since 2013, in addition to the surveys undertaken for the Project REF and have used this information and an updated review of BioNet threatened species records within 5km of the study area, to undertake this assessment of the likely impacts to biodiversity values. The biodiversity assessment has been prepared in accordance with the *Biodiversity Conservation Act 2016*.

#### 6.1.2 Existing environment

This database review and the results of previous investigations have found the following:

- The presence of two ecological communities (Cumberland Plain Woodland (CPW) (EPBC Condition Category A) and Shale Sandstone Transition Forest (SSTF) (0.05 of which meets EPBC Condition Category D), which are listed on both the NSW *Biodiversity Conservation Act* (BC Act 2016) and Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) as critically endangered ecological communities

- The site comprises 0.12 ha of highly degraded, young regrowth CPW (slashed powerline corridors and previously grazed paddock) that meets the definition of CPW under the BC Act (presence of tree canopy) and the condition thresholds for CPW Category A under the EPBC Act. There are no hollow bearing trees (HBTs) in the footprint.
- 0.09ha of degraded/modified SSTF comprising advance regrowth (no hollows) and an access track to an existing powerline (meets SSTF Condition Category D under the EPBC Act).
- Potential foraging habitat for Koala (the area is mapped as “Core Habitat” in Campbelltown Councils approved Comprehensive Koala Management Plan (CCC 2018), although the Biodiversity and Conservation SEPP 2021 does not apply to Part 5 Activities),
  - The 0.16 ha area of regrowth at Glen Lorne (the northern underpass) is young Forest Red Gum (*Eucalyptus tereticornis*) which is classified as a ‘koala food tree’ (KFT) species in the Campbelltown Comprehensive Koala Plan of Management (BioLink 2018).
- The 0.05 ha at Browns Bush is predominantly Narrow and Broad-leaved Ironbark (*Eucalyptus fibrosa* and *crebra*) which are not recognised as ‘koala food tree’ (KFT) species in the Campbelltown Comprehensive Koala Plan of Management (BioLink 2018) but are classified as Koala ‘use’ trees in SEPP 2020/2021).
- The regrowth is young Forest Red Gum (*Eucalyptus tereticornis*) at Browns Bush which is classified as a ‘koala food tree’ (KFT) species in the Campbelltown Comprehensive Koala Plan of Management (BioLink 2018).
- Potential foraging habitat for the Squirrel Glider, threatened owl species including Powerful and Barking Owls, Glossy-Black and Gang-gang Cockatoos (Gang-gang Cockatoos were recorded breeding at St Helens Park in 2020 and 2021) and potential foraging habitat for the Swift Parrot (although the area is not mapped by DPE as “important Habitat” for the Swift Parrot. As there are no hollows present, the area is not regarded as breeding habitat for Squirrel Glider, threatened owl or Cockatoo species.
- There were no raptor nests observed in the impact areas.
- Whilst there are records of the Cumberland Plain Land Snail (CPLS) in Browns Bush to the north of the northern underpass, there is little deep litter present in the impact areas and the habitat is considered marginal for CPLS.
- A number of threatened plants may also occur (*Pomaderris brunnea* (recorded along Woodhouse Creek in Mt Gilead Stage 2 between 2015-2018 and the Georges River corridor)), *Pimelea spicata* (recorded on the eastern side of Appin Rd opposite Noorumba Reserve, and north of the proposed koala underpass in 2020) and *Pterostylis saxicola* (recorded on the western side of the Nepean River at Menangle in 2019).
- No threatened plants species have been observed in the impact areas.

### 6.1.3 Potential impacts

The proposed modification would have minimal detrimental impacts on local biodiversity values during construction and operation.

The combined footprints would impact an additional 0.25 ha of land, comprising 0.22 ha of native vegetation (0.12 ha of low condition Cumberland Plain Woodland (CPW) and 0.09 ha of modified Shale Sandstone Transition Forest (SSTF) that was not assessed in the Project REF and that is not within the Biodiversity Certified land within the Figtree Hill development area. Once the underpasses have been constructed, the disturbed area would be revegetated back to CPW and SSTF and managed as part of the proposed 28 ha Browns Bush Biodiversity Stewardship site that is adjacent to the proposed Georges River Koala National Park.

### 6.1.4 Conclusion on significance of impacts

The proposed modification is not likely to significantly impact threatened species, populations or ecological communities or their habitats, within the meaning of the BC Act.

An assessment of significance (five-part test) as set out in Section 7.3 of the BC Act is included for all species known, considered likely to occur in the study area. The assessment has concluded that it is highly unlikely that there would be a ‘significant impact’ to any threatened species or listed ecological community by the temporary impact to up to 0.12 ha of CPW and 0.09 ha of STF (and associated threatened fauna habitat), which would be fully revegetated following construction within the proposed Browns Bush BSA site, and thus a Species Impact Statement or biodiversity development assessment report is not required. Any loss of potential foraging habitat for Koala would be offset by a significant reduction in existing road mortality that is likely to be impacting the viability of the local population.



Similarly, an assessment of whether any Matters of National Environmental Significance (MNES) under the Commonwealth EPBC Act (i.e CPW, SSTF, foraging habitat for Greater Glider, Swift Parrot and Grey-headed Flying fox or any potential breeding sites for Gang-gang Cockatoo, Glossy Black Cockatoo and Large-eared Pied-bat) was undertaken. The assessment has concluded that it is highly unlikely that there would be a 'significant impact' to any threatened species or listed ecological community on the EPBC Act by the temporary impact to up to 0.12 ha of CPW and 0.05 ha of STF (and associated threatened fauna habitat), and by the provision of koala underpasses and koala exclusion fencing which would be fully revegetated following construction within the proposed Browns Bush BSA site, and therefore the Transport for NSW EPBC Act strategic assessment approval has not been triggered. Any loss of potential foraging habitat for Koala would be offset by a significant reduction in existing road mortality that is likely to be impacting the viability of the local population and improved east-west connectivity between the Georges and Nepean River corridors.

By providing koala connectivity under Appin Rd, this Addendum REF provides an important update to the Project REF which, while addressing koala vehicle strike through a fencing strategy, did not adequately support the ongoing management of relevant koala habitat corridors through Beulah Biobank site and Noorumba Reserve by providing safe passage across Appin Road. The importance of these corridors for the ongoing viability of the local koala population has since been confirmed by the Office of the NSW Chief Scientist and DPE have announced their intention to protect them through strategic planning frameworks such as the *Greater Macarthur Growth Plan 2040*. By addressing connectivity, the conclusion is that neither the impacts anticipated by Project REF or the minor additional impacts arising from this Addendum REF are likely to have a significant impact on the koala or any other NSW or Commonwealth listed species. Overall, it is considered that the proposed underpasses, in association with exclusion fencing, have a strong likelihood of success based on evidence of koalas using similar structures on other road projects, such as the Oxley Highway, Wardell Road and Bonville Bypass projects. Therefore, it is expected that the fencing and underpasses would provide safe passage for koalas and other fauna, rather than the exclusion fences adding to the current barrier effect of Appin Road. In addition, fencing and grids (used to prevent koalas accessing Appin Road at intersecting driveways and/or roads) are proposed on both sides of Appin Road from the northern boundary of Noorumba Reserve to the southern boundary of Beulah from the commencement of construction to minimise the likelihood of koala entrapment within the road corridor.

All safeguards and management measures that would address environmental impacts are identified in Table 7-1.

### 6.1.5 Biodiversity offsets

The Project REF biodiversity assessment addressed the study area shown in Figures 1 and 2 and identified that 7.28 ha of remnant native vegetation would require removal (Table 6.4, RAM 2018). Since this time, the Figtree Hill Biodiversity Certification has been approved, thereby approving the removal of 7.28ha and offsets are being delivered as part of this approval.

The proposed koala/fauna underpasses sought under this Addendum REF would result in some impacts on existing vegetation resulting from clearing/pruning of 0.22 ha of native vegetation, comprising 0.12 ha of moderate condition Cumberland Plain Woodland and 0.09 ha of moderate condition Shale Sandstone Transition Forest (exact areas to be determined in a biodiversity offset strategy). This 0.22 ha of native vegetation was not assessed under the Project REF and was therefore included in the calculations for the approved Figtree Hill biodiversity certified land.

It is noted that the conservation status of Cumberland Plain Woodland and Shale Sandstone Transition Forest is Critically Endangered under the NSW *Biodiversity Conservation Act 2016*. These impacts have been reviewed against the Roads and Maritime (2016) 'Guidelines for Biodiversity Offsets'. This identifies that works involving any clearing of Critically Endangered vegetation in moderate or good condition will require consideration of offsets. As some small areas of moderate condition vegetation that are identified as 'Critically Endangered vegetation communities' would require clearing, a biodiversity offset strategy will need to be prepared. The requirement for this strategy is included in the environmental safeguards and management measures for the Project (refer Table 7-1).

## 6.2 Aboriginal cultural heritage

This section summarises the assessed impacts on Aboriginal cultural heritage values that are likely to occur when building and operating the proposed modification. An aboriginal cultural heritage assessment was undertaken by GML Heritage (GML) to support the Addendum REF. In addition to the assessment, GML has produced an Archaeological Research Design (ARD) for the proposed modification works.

This document can be found in Appendix E. GML's 2022 report is part of the larger package of Aboriginal cultural assessment for the Mt Gilead Stage 2 project, which would lead to an eventual application for a 'whole of area' Aboriginal Heritage Impact Permit (AHIP), under Section 90 of the *National Parks and Wildlife Act 1974*.

It is noted that the original assessment of the Appin Road corridor identified some landforms with archaeological sensitivity (Virtus Heritage, 2017). Further investigations undertaken by Ecological Australia (2018) as part of the Appin Road Safety Improvements Stage 2 PACHCI Aboriginal Archaeological Survey Report returned an opposing result concluding that:

- Landscape features that were identified within the PAD area (for example being located on a hill crest within 200 m of a water source) do not continue within the study area it is therefore unlikely that the archaeological potential continues within the study area.
- As a result of this study it has been concluded that no further heritage assessment is warranted prior to the commencement of work. (Ecological 2018:31)
- Subsequent investigations by Virtus (2019) involving extensive test excavation of the subject area led to the revised classification that the work corroborated the Ecological Australia results reported in 2018.

GML Heritage undertook salvage works as part of the AHIP process within the Stage 1 area as well as detailed surveys and reporting of the stage 2 area. The findings of these studies are summarised in Appendix F. GML noted the following:

*The Mount Gilead Stage 2 lands include the biobanking areas on the east of Appin Road and have been surveyed by GML (July 2022a). This survey work did not identify any Aboriginal stone objects, nor allocate areas with PAD adjacent to the road. The survey did however identify cultural trees in and around the road corridor. These have been entered on AHIMS.*

The stance on sensitivity has been shown to be incorrect given the information contained in the three independent heritage investigations/reports, which all identified the corridor as having low Aboriginal archaeological potential (refer Appendix F). As a result, this Addendum REF resolves to:

- Remove the safeguard “An AHIP would be obtained prior any works potentially impacting Aboriginal heritage”.
- Add a safeguard ‘Undertake investigation works outlined in Appendix F – Aboriginal Cultural Heritage Assessment’ prior to any works potentially impacting Aboriginal heritage.

### 6.2.1 Methodology

The land on the eastern side of Appin Road is associated with a designed biobanking area positioned within the larger Mount Gilead Stage 2 (MGS2) project area. GML is in the process of undertaking Aboriginal community consultation, heritage assessment and reporting for the wider MGS2 area. A program of Aboriginal archaeological test excavations (subject of a separate report—Mount Gilead, Stage 2, Appin Road Koala Crossing Archaeological Research Design, GML September 2022 (Appendix F)) is to be conducted within the proposed area of works within MGS2 at both the Glen Lorne and Browns Bush koala crossings.

Previous historical archaeological assessment of the Browns Bush site (Mount Gilead Stage 2, Historical Archaeological Assessment, GML October 2021) included an area with a former c1880s cottage—Site 27 (Figure 1.4). There was an identified moderate level of potential for historical archaeological remains associated with the cottage site—such as post holes, wall footings, paths, subfloor surfaces, water management structures, yard surfaces and garden beds. Following review of the draft Review of Environmental Factors (REF) Addendum documents—and given the potential for historical archaeological remains within the Browns Bush site—it is recommended that a program of historical archaeological test excavations be undertaken concurrent to the Aboriginal archaeological testing program.

A HARD has been prepared to support an application for a program of historical archaeological testing under s139(4) of the Heritage Act 1977 (NSW) (Heritage Act) at the Browns Bush site. This would include a research framework and methodology to guide the archaeological investigations. The testing program has been designed to understand the nature, extant and significance of the potential historical archaeological resource.

### 6.2.2 Existing environment and potential impacts

The proposed modification is located within the Campbelltown Local Government Area, the Parish of Menangle, and the County of Cumberland. It is contained within the boundaries of the Tharawal Local Aboriginal Land Council (Tharawal LALC).

A search of the AHIMS database was undertaken on 16 September 2022. The search of Glen Lorne area identified no Aboriginal registered sites, while the search of Browns Bush identified three previously recorded Aboriginal sites, all located outside the Browns Bush investigation area.

Further surveys have identified two ring trees within the wider Browns Bush area, and no Aboriginal objects within the Glen Lorne area. No surface expressions of stone artefacts were observed, and no areas of Potential Archaeological Deposits (PAD) were identified. Areas of disturbance were observed but were not sufficient to have impacted all ground surfaces. Both study areas are positioned on landform which have not previously been associated with high density expressions of subsurface Aboriginal objects. The synopsis of the three latest heritage investigations is that the Appin Road corridor holds low Aboriginal archaeological potential for Aboriginal objects. This opinion is shared by all three separate studies.

### 6.2.3 Safeguards and management measures

Although the level of assessed archaeological potential is low, all Aboriginal objects, known or unknown, have statutory protection under the NPW Act. Therefore, as a mitigation measure, it is proposed to undertake a program of archaeological test excavation, adhering to the *Archaeological Code of Practice*. This work would occur following approval of the REF, but prior to the commencement of any works associated with the proposed underpasses. The Archaeological Research Design (ARD) has been developed to guide the archaeological works for the proposed modification and the outcome of the investigations would define whether an Aboriginal Heritage Impact Permit (AHIP) is required for either Glen Lorne and/or Browns Bush underpasses. As described above, this would form part of a 'whole area' AHIP if required.

A Fauna Fencing Installation Methodology has been prepared GML to limit any heritage impacts (Appendix F) and additional management measures are described in the Project REF and Table 7-1 of this report.

## 6.3 Other impacts

### 6.3.1 Existing environment and potential impacts

Table6-1: Issues raised through stakeholder consultation

Environmental factor	Existing environment	Potential impacts
Soil and geology	<p><b>Soils</b> A review of the 1:100,000 Soil Landscapes of Wollongong-Port Hacking Sheet (9029-9129) indicates the study area is underlain by the Blacktown soil landscape comprising gently undulating rises, with local relief to 30 metres and slopes usually less than 5 per cent. Soils range from shallow (&lt;1 metre) red brown podzolic soils – comprising mostly clayey soils on crests and upper slopes – to deep (1.5–3 metres) yellow-brown clay soils on lower slopes and areas of poor drainage. These soils are typically moderately reactive with low fertility, poor soil drainage and highly plastic subsoil.</p> <p><b>Geology</b> A review of the 1:100,000 Wollongong Map (NSW Department of Minerals, 1985) indicates the proposal area is underlain by Ashfield shale from the Wianamatta group, comprising laminate and dark grey siltstone. Weathered Bringelly Shale is known to contain a high proportion of smectite clays which are typically expansive.</p> <p>Geotechnical investigations undertaken in this area identified silty clay extending to depths between 0.9–1.2 metres. From these depths at around 1.5 metres, the material turned to bedrock consisting of extremely low strength shale. This generally increased with strength and decreased in weathering with depth. The shale and sandstone bedrock encountered was generally thinly bedded and often exhibited clay seams along the bedding boundaries (WSP, 2017a).</p>	<p>There is a negligible increase for the potential of encountering, disturbing and mobilising contaminants within the proposal location during construction.</p> <p>Potential impacts on soil from construction activities would be primarily associated with soil loss from erosion of exposed soils and stockpiles, and potential sedimentation of surrounding land and waterways. Construction activities with the potential to expose soils may lead to erosion and sedimentation. These construction activities include:</p> <ul style="list-style-type: none"> <li>• Vehicle movements</li> <li>• Stockpiling</li> <li>• Excavation</li> <li>• Importation of fill material</li> <li>• Vegetation removal</li> <li>• Grubbing processes</li> <li>• Landscaping.</li> </ul> <p>Environmental safeguards to mitigate any impacts are provided in Table 7-1 and appropriate mitigation measures will be included in the Project Construction Environmental Management Plan (CEMP).</p>
Hydrology and flooding – flood risk	<p>The proposed modification is located along a ridgeline bordering the Nepean River and Georges River catchments. No section of the proposed modification location is at or below the level of a 1-in-100-year ARI flood event, plus 0.5 metre freeboard, and subsequently not considered to be flood prone land from regional flooding.</p>	<p>It is not anticipated that the proposal will result in any additional flooding impacts. Consideration be given to the detailed design of the tunnels to ensure that the levels will not result in localised flooding in and around the tunnel, which would impact the useability during rain events.</p>

Hydrology and flooding – surface water	<p>Glen Lorne: Surface water is collected in swales, crossing the road from the southbound side via the culvert and discharging to a farm dam to the west of Appin Road. Surface water then drains through Noorumba Reserve and towards Menangle Creek, eventually discharging to the Nepean River.</p> <p>Browns Bush: Located between two crests, surface water from Appin Road to an existing floodway on the eastern side of Appin Road, draining via a culvert beneath Kellerman Drive to Mansfield Creek. Oswald Reserve, to the west of Appin Road, acts as a detention basin for stormwater collected from the surrounding residential area.</p>	<p>Potential construction impacts to water quality could arise if activities are not appropriately managed.</p> <p>No major surface waters intersect the study area, and drainage from the study area flows intermittently and any potential risk would be limited to periods of rainfall.</p>
Groundwater	Refer Soil and Geology above.	<p>The fauna underpass groundwater inflow assessment concludes there is a low potential for groundwater interaction and ingress into the fauna underpasses. The permanent groundwater table is below the culvert levels based on drilling observations but could be confirmed with follow-up groundwater measurements at the Project bores.</p> <p>The culvert structures will be constructed using solid concrete structures, which are not susceptible to groundwater ingress. Potential interaction of throughflow, which is not regarded as groundwater, at the fauna passages can be negated by the use of hard material such as shotcrete, or soft material in combination with vegetation plantings. Evapotranspiration via plantings will presumably prevent throughflow accumulation at the fauna passages, however this could be confirmed with field measurements of throughflow inflow rates, especially following high and sustained rainfall events.</p>
Traffic and transport	Appin Road is a classified State Road (gazetted road number 177) which travels in a north-south direction linking the townships of Campbelltown and Appin. The road has a posted speed limit of 70 kilometres per hour and 80 kilometres per hour.	Traffic impacts associated with the proposed amendment will be minimal and restricted to associated construction traffic movements.
Noise and vibration	Both Glen Lorne and Browns Bush are within noise catchment area NCA01 and consists of 39 residential receivers. The closest residential receiver is over 200m away from the Glen Lorne underpass site.	Noise impacts associated with the amendment will be minimal and restricted to associated construction noise and vibration.
Non-Aboriginal heritage	The proposed Glen Lorne Underpass landing on the eastern side of Appin Road may be within approx. 100m of the Glen Lorne Landscaping and Archaeological site.	No impacts are anticipated as the heritage site is avoided, and works will be managed with the mitigation measures outlined in section 7 and the Project REF.
Waste management and resource use	Excavation will be required for the installation of the underpasses, generating spoil and construction waste.	The proposed amendment would have a negligible additional impact to the Project REF. Impacts will be managed by the mitigation measures outlined in section 7 and the Project REF.



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Hazards and Risks - Bushfire	The proposed modification is adjacent to bushland. Therefore, the area may be prone to bushfires.	The proposed amendment would have a negligible additional impact to the Project REF. Impacts will be managed by the mitigation measures outlined in section 7 and the Project REF.
Hazards and Risks - Greenhouse gas emissions	Transport emissions are currently the second largest component of NSW greenhouse gas emissions. The major source of transport emissions is road transport which accounts for 86 per cent of all NSW transport emissions (DoEE, 2014). Road transport includes private passenger vehicles (cars and motorcycles), light commercial vehicles, rigid trucks, articulated trucks and buses. This reflects the importance of motor vehicles for both passenger and freight transport within the state.	The proposed amendment would have a negligible additional impact to the Project REF. Impacts will be managed by the mitigation measures outlined in section 7 and the Project REF.
Air quality	Existing ambient air quality of the proposal area based on Campbelltown regional data indicates relatively consistent and 'good-to-very-good' air quality (Office of Environment and Heritage, 2016). Likely contributions to poorer air quality in the region are road traffic emissions evident through peak-hour air quality reductions, the surrounding industry in Campbelltown and natural effects such as bushfires throughout summer.	Minor impacts due to the small number of additional construction plant and vehicles associated with the works and the potential for a small amount of additional dust produced by the works. These impacts will be managed by the mitigation measures outlined in section 7 and the Project REF.
Cumulative impact	Cumulative impacts are described in the Project REF.	The proposed amendments will be minor in terms of cumulative construction impacts. It is noted that in December 2021, DPE released Greater Macarthur 2040 Update which confirmed DPE's commitment to the protection of the Ousedale Creek corridor for koalas along with other koala corridors at Menangle Creek (through Noorumba Reserve) and Woodhouse Creek (through Beulah) (the koala/fauna underpasses for which are the subject of this Addendum REF). The cumulative impact of the protection of Ousedale Creek Corridor in addition to the two other Reserves, and underpasses to facilitate connectivity, is expected to have a positive impact on the local koala population. It is also acknowledged that additional koala/fauna fencing associated with Transport for NSW's Appin Road Safety Improvement Project (further to the south of the Project REF) would also be beneficial for the local koala population.

## 7. Environmental management

### 7.1 Environmental management plans

A number of safeguards and management measures have been identified to minimise adverse environmental impacts, including social impacts, which could potentially arise as a result of the proposed modification. Should the proposed modification proceed, these management measures would be addressed if required during detailed design and incorporated into the Construction Environmental Management Plan (CEMP) and applied during the construction and operation of the proposed modification.

A CEMP would be prepared to describe the safeguards and management measures identified for the Project and would include mitigation and management required for the works associated with the proposed modification. The CEMP would provide a framework for establishing how these measures would be implemented and who would be responsible for their implementation.

The CEMP would be prepared prior to construction of the Project and must be reviewed and certified by the Transport for NSW Environment Officer, Sydney Region, prior to the commencement of any on-site works. The CEMP would be a working document, subject to ongoing change and updated as necessary to respond to specific requirements. The CEMP would be developed in accordance with the specifications set out in the: Specification G36 – Environmental Protection (Management System), QA Specification G38 – Soil and Water Management (Soil and Water Plan), QA Specification G40 – Clearing and Grubbing, QA Specification G10 – Traffic Management].

## 7.2 Summary of environmental safeguards and management measures

Environmental safeguards and management measures for the Project are summarised in Table 7-1. Additional safeguards and management measures identified in this addendum REF are included in **bold** and *italicised* font. The safeguards and management measures would be incorporated into the detailed design phase of the proposed modification, the CEMP and the PEMP and implemented during construction and operation of the proposed modification, should it proceed. These safeguards and management measures would minimise any potential adverse impacts arising from the proposed works on the surrounding environment.

It is noted that environmental safeguards and management measures which are no longer relevant (as a result of this Addendum REF or further investigations that have occurred since the Project REF was approved) have been deleted (shown as ~~strike-through~~ text).

Table 7-1: Summary of safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Reference
Biodiversity	<p>A Flora and Fauna Management Plan will be prepared in accordance with Transport for NSW's Biodiversity Guidelines: Protecting and Managing Biodiversity on RTA Projects (RTA, 2011c) and implemented as part of the CEMP. It will include, but not be limited to:</p> <ul style="list-style-type: none"> <li>Plans showing areas to be cleared and areas to be protected, including exclusion zones, protected habitat features and revegetation areas</li> <li>Requirements set out in the Landscape Guideline (RMS, 2008)</li> <li>Pre-clearing survey requirements</li> <li>Procedures for unexpected threatened species finds and fauna handling</li> <li>Procedures addressing relevant matters specified in the Policy and guidelines for fish habitat conservation and management (DPI Fisheries, 2013)</li> <li>Protocols to manage weeds and pathogens.</li> </ul>	Contractor	Pre-construction / detailed design	Core standard safeguard B1 Section 4.8 of QA G36 Environment Protection
Biodiversity	Measures to further avoid and minimise the construction footprint and native vegetation or habitat removal will be investigated during detailed design and implemented where practicable and feasible.	Contractor	Pre-construction / detailed design	Core standard safeguard B2
<del>Native vegetation removal and re-establishment</del>	<del>A Biodiversity Offset Strategy would be prepared during the detailed design phase. This strategy would be prepared in accordance with the Guidelines for Biodiversity Offsets (Roads and Maritime, 2011a) and the NSW BioBanking Assessment Methodology 2014.</del>	<del>Contractor</del>	<del>Detailed design</del>	<del>Additional safeguard B3</del>
<b><i>Native vegetation removal and re-establishment</i></b>	A Biodiversity Offset Strategy would be prepared during the detailed design phase for areas impacted by the Project REF and Addendum REF, excluding those areas already offset under the Figtree Hill biodiversity certification.	<b><i>Contractor</i></b>	<b><i>Detailed design</i></b>	<b><i>Additional safeguard B3</i></b>

	This strategy would be prepared in accordance with the Guidelines for Biodiversity Offsets (Roads and Maritime, 2016).			
General ecological mitigation	Ensure any fauna encountered onsite would be managed in accordance with Biodiversity Guidelines, Guide 9 (fauna handling) (Roads and Maritime, 2011).	Contractor	Pre-construction	Additional safeguard B4
General ecological mitigation	In addition to the requirements of Core standard safeguard B1, the Flora and Fauna Management Plan would also include: <ul style="list-style-type: none"> <li>• A site walkover to confirm clearing boundaries and sensitive locations before starting work</li> <li>• Identify, in toolbox talks, where biodiversity controls would be included.</li> </ul>	Contractor	Pre-construction	Additional safeguard B5
Invasive and noxious weed management	Develop a weed management plan (WMP) in accordance with Biodiversity Guidelines, Guide 6 (Roads and Maritime, 2011) to include: <ul style="list-style-type: none"> <li>• Identification of the weeds on site (confirm during ecologist pre-clearing inspection)</li> <li>• Weed management priorities and objectives</li> <li>• Sensitive environmental areas within or adjacent to the site</li> <li>• The location of weed infested areas</li> <li>• Weed control methods</li> <li>• Measures to prevent the spread of weeds, including machinery hygiene procedures and disposal requirements</li> <li>• A monitoring program to measure the success of weed management</li> <li>• Communication with local Council noxious weed representative.</li> </ul>	Contractor	Pre-construction	Additional safeguard B6
Risk of pathogen and pest species	If hygiene procedures are required onsite, ensure the Flora and Fauna Management Plan includes hygiene protocols to prevent the introduction and spread of such pathogens as specified in Biodiversity Guidelines: (Roads and Maritime, 2011). Manage all pathogens (e.g. Chytrid, myrtle rust and phytophthora) in accordance with the Biodiversity Guidelines, Guide 7 (Roads and Maritime, 2016b).	Contractor	Pre-construction	Additional safeguard B7
Unexpected discovery of threatened species	If unexpected flora or fauna are discovered stop work immediately and implement the Roads and Maritime Unexpected Threatened Species Find Procedure in the Biodiversity Guidelines, Guide 1 (Roads and Maritime, 2016b).	Contractor	Construction	Additional safeguard B8
Injury and mortality impacts while building the proposal	Implement the following controls: under the Flora and Fauna Management Plan:	Contractor	Construction	Additional safeguard B9

	<ul style="list-style-type: none"> <li>Manage fauna in accordance with Biodiversity Guidelines, Guide 9 (Roads and Maritime, 2016b)</li> <li>Remove any habitat in accordance with Biodiversity Guidelines, Guide 4 (Roads and Maritime, 2016b).</li> </ul>			
Native vegetation removal and re-establishment Threatened species habitat and habitat features	<p>Implement the following controls under the Flora and Fauna Management Plan:</p> <ul style="list-style-type: none"> <li>Undertake pre-clearance checks in accordance with Biodiversity Guidelines, Guide 1 (Roads and Maritime, 2011)</li> <li>Create exclusions zones in accordance with Biodiversity Guidelines, Guide 2 (Roads and Maritime, 2016b)</li> <li>Re-establish native vegetation in accordance with Biodiversity Guidelines, Guide 3 (Roads and Maritime, 2016b)</li> <li>Reinstate habitat in accordance with Biodiversity Guidelines, Guide 5 and Guide 8 (Roads and Maritime, 2016b).</li> </ul>	Contractor	Construction	Additional safeguard B10
Koala habitat/glider connectivity	<p>Fauna fencing and arboreal rope bridges would be implemented in accordance with the details described within this REF to the <del>southern extent of the Mount Gilead residential subdivision</del> to the southern extent of Beulah to align with the northern limit of works for the Appin Road Safety Improvements Project. <b>The final location of arboreal rope bridges will be developed in consultation with Transport for NSW in the detailed design phase.</b></p>	Contractor	Pre-construction	Additional safeguard B11
<del>Koala</del>	<p>Koala proof fencing would be further investigated during the detailed design phase and the use of koala proof fencing and koala grids (at access points) along Appin Road in areas of likely occurrence would be undertaken.</p>	<del>Transport for NSW/ Contractor</del>	<del>Detailed design</del>	<del>Additional safeguard B12</del>
<del>Koala management</del>	<p>Transport for NSW will investigate, in consultation with, and meeting the requirements of OEH, management of koalas potentially using the remnant habitats within Noorumba Reserve to the large tracts of remnant vegetation along Appin Road in accordance with the recommendations of the expert report by Crowther (2018).</p>	<del>Transport for NSW/ Contractor</del>	<del>Detailed design/ Pre-construction</del>	<del>Additional safeguard B13</del>
Wildlife connectivity impacts	<p>Implement connectivity controls in accordance with the Wildlife Connectivity Guidelines for Road Projects (Roads and Maritime, 2016c). This would include providing connectivity structures for arboreal animals, such as glider crossings.</p>	Contractor	Construction	Additional safeguard B14
Consultation with RFS	<p>Future consultation with the RFS regarding the fauna fence and access requirements will be undertaken during detailed design.</p>	Transport for NSW/ Contractor	Detailed design/ Pre-construction	Additional safeguard B15



<p><b>Koala underpasses</b></p>	<p><b>The following design features will be included as part of any koala/fauna underpass:</b></p> <ul style="list-style-type: none"> <li>• <b>Fauna furniture will be included in/near each of the underpasses</b></li> <li>• <b>A natural substrate, such as blue metal, will line the floor of any underpass pipe and be overlaid with mulch (or similar)</b></li> <li>• <b>A natural light source will be provided to the middle of the Glen Lorne underpass</b></li> <li>• <b>Native revegetation at ingress/egress to pipes including Koala feed tree and shrub species</b></li> </ul> <p>Monitoring of underpasses via the use of devices such as infrared sensor cameras, will occur at each underpass entry/egress point to identify what animals are using the underpasses and when.</p>	<p><b>Contractor</b></p>	<p><b>Pre- construction / detailed design</b></p>	<p><b>Additional safeguard B16</b></p>
<p><b>Koala/fauna fence</b></p>	<p><b>The following design features will be included as part of any koala/fauna fence:</b></p> <ul style="list-style-type: none"> <li>• <b>Installation of koala/fauna grates at any access points to Appin Road in the relevant section. Tie in fencing at these grates will incorporate a fenced return (refer Figure 9 of this report)</b></li> </ul> <p>Fencing will occur sequentially to (and prior to) each section of works, to ensure full coverage during construction. Consultation with adjacent roadworks projects should occur to ensure continuity with the overall fencing strategy</p>	<p><b>Contractor</b></p>	<p><b>Pre- construction / detailed design</b></p>	<p><b>Additional safeguard B17</b></p>
<p><b>Scheduling of construction activities for underpasses</b></p>	<p>All clearing for construction will be scheduled to occur during optimal periods (excluding September to December) when koala activity is lowest.</p>	<p><b>Contractor</b></p>	<p><b>Pre- construction / detailed design</b></p>	<p><b>Additional safeguard B18</b></p>
<p><b>Maintenance of fencing</b></p>	<p>During construction, the overall fencing strategy should be regularly reviewed by the Project Control Group to ensure continuity between sections of fencing and monitoring of efficacy.</p>	<p><b>Contractor and TfNSW</b></p>	<p><b>During construction</b></p>	<p><b>Additional safeguard B19</b></p>
<p><b>Contaminated land</b></p>	<p>A Contaminated Land Management Plan will be prepared in accordance with the <i>Guideline for the Management of Contamination</i> (Roads and Maritime, 2013b) and implemented as part of the CEMP. The plan will include, but not be limited to:</p> <ul style="list-style-type: none"> <li>• Capture and management of any surface runoff contaminated by exposure to the contaminated land</li> <li>• Measures to ensure the safety of site personnel and local communities during construction.</li> </ul>	<p><b>Contractor</b></p>	<p><b>Pre-construction / detailed design</b></p>	<p><b>Core standard safeguard C1</b> Section 4.2 of QA G36 Environment Protection</p>

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Contaminated land	If contaminated areas are encountered during construction, appropriate control measures will be implemented to manage the immediate risks of contamination. All other works that may impact on the contaminated area will cease until the nature and extent of the contamination has been confirmed and any necessary site-specific controls or further actions identified in consultation with the Transport for NSW's Environment Manager and/or EPA.	Contractor	Construction	Core standard safeguard C2 Section 4.2 of QA G36 Environment Protection
Contaminated land	Areas identified to contain surface lying wastes, including the areas of ACM and SMF would be remediated prior to construction. All waste should be disposed of to a suitably licenced landfill facility.	Contractor	Pre-construction / detailed design	Core standard safeguard C3 Section 4.2 of QA G36 Environment Protection
Accidental spills	A site-specific emergency spill plan will be developed and include spill management measures in accordance with the Roads and Maritime <i>Code of Practice for Water Management</i> (RTA, 1999) and relevant EPA guidelines. The plan will address measures to be implemented in the event of a spill, including initial response and containment, notification of emergency services and relevant authorities (including Transport for NSW and EPA officers).	Contractor	Pre-construction / detailed design	Core standard safeguard C4 Section 4.3 of QA G36 Environment Protection
Hydrology and flooding	A contingency and evacuation plan will be prepared for a potential flood event while the proposal is being built. The plan will: <ul style="list-style-type: none"> <li>Evaluate what flood event would trigger the plan</li> <li>Include evacuation procedures</li> <li>Include a map indicating the area that is flood prone and the locations where to evacuate.</li> </ul>	Contractor	Pre-construction Construction	Additional safeguard: HF1
Hydrology and flooding	The layout and detail of the drainage system including water quality treatments, discharge points, swale design and scour protection will be refined during detailed design in consultation with the Transport for NSW Environment Branch.	Contractor	Detailed design	Additional safeguard: HF2
Hydrology and flooding	Drainage line crossing points will be designed in accordance with Guidelines for Watercourse Crossings (DPI Water, 2012).	Contractor	Detailed design	Additional safeguard: HF3
<b>Hydrology and flooding</b>	<b><i>Desktop groundwater assessment will be undertaken during detailed design to confirm risk of groundwater seepage into the underpasses. If required, provision should be made to ensure the underpasses are waterproofed.</i></b>	<b>Contractor</b>	<b>Detailed design</b>	Additional safeguard: HF4
Traffic and transport	A Traffic Management Plan (TMP) will be prepared and implemented as part of the CEMP. The TMP will be prepared in accordance with the Roads and Maritime Traffic Control at Work Sites Manual (Roads and Maritime, 2010) and QA Specification G10 Control of Traffic (Roads and Maritime, 2018). The TMP will include: <ul style="list-style-type: none"> <li>Confirmation of haulage routes</li> </ul>	Contractor	Pre-construction / detailed design	Core standard safeguard TT1 Section 4.8 of QA G36 Environment Protection

	<ul style="list-style-type: none"> <li>Measures to maintain access to local roads and properties</li> <li>Site specific traffic control measures (including signage) to manage and regulate traffic movement</li> <li>Measures to maintain pedestrian and cyclist access</li> <li>Requirements and methods to consult and inform the local community of impacts on the local road network</li> <li>Access to construction sites including entry and exit locations and measures to prevent construction vehicles queuing on public roads.</li> <li>A response plan for any construction traffic incident</li> <li>Consideration of other developments that may be under construction to minimise traffic conflict and congestion that may occur due to the cumulative increase in construction vehicle traffic</li> <li>Monitoring, review and amendment mechanisms.</li> </ul>			
Property access	<ul style="list-style-type: none"> <li>Property access will be maintained where feasible and reasonable and property owners will be consulted before starting any work that may temporarily restrict or control access</li> <li>(Side) road and lane closures will be minimised where feasible and reasonable.</li> </ul>	Contractor	Construction	Additional safeguard: TT2
Traffic management at ancillary sites	<p>The following traffic management provisions will be provided at each ancillary facility:</p> <ul style="list-style-type: none"> <li>Appropriate 'sight distances' to allow traffic to safely enter and exit</li> <li>Temporary painted road lines to provide delineation</li> <li>Suitable intersection arrangements where required</li> <li>Other controls to separate, slow down, or temporarily stop traffic to allow for safe entry and exit.</li> </ul>	Contractor	Construction	Additional safeguard: TT3
Staged crossing	A communications plan for the operation and use of the new staged pedestrian crossing will be prepared.	Transport for NSW	Post-construction / operation	Additional safeguard: TT4
Kellerman Drive interface	During detailed design, consultation on the design of the Kellerman Drive access to the 7-Eleven site will continue in conjunction with Roads and Maritime, Campbelltown City Council and landowners.	Transport for NSW/ Contractor	Detailed design	Additional safeguard TT5
Noise and vibration	A Noise and Vibration Management Plan (NVMP) will be prepared and implemented as part of the CEMP. The NVMP will generally follow the approach in the <i>Interim Construction Noise Guideline</i> (ICNG) (DECC, 2009) and identify:	Contractor	Pre-construction / detailed design	Core standard safeguard NV1 Section 4.6 of QA G36 Environment Protection

	<ul style="list-style-type: none"> <li>• All potential significant noise and vibration generating activities associated with the activity</li> <li>• Feasible and reasonable mitigation measures to be implemented, taking into account <i>Beyond the Pavement: urban design policy, process and principles</i> (Roads and Maritime, 2014b).</li> <li>• A monitoring program to assess performance against relevant noise and vibration criteria</li> <li>• Arrangements for consultation with affected neighbours and sensitive receivers, including notification and complaint handling procedures</li> <li>• Contingency measures to be implemented in the event of non-compliance with noise and vibration criteria.</li> </ul>			
Construction noise and vibration	<p>All sensitive receivers (eg. schools, local residents) likely to be affected will be notified at least five days prior to commencement of any works associated with the activity that may have an adverse noise or vibration impact. The notification will provide details of:</p> <ul style="list-style-type: none"> <li>• The proposal</li> <li>• The construction period and construction hours</li> <li>• Contact information for proposal management staff</li> <li>• Complaint and incident reporting</li> <li>• How to obtain further information.</li> </ul>	Contractor	Construction	Additional Safeguard NV2
Construction noise	<ul style="list-style-type: none"> <li>• Work will be undertaken in accordance with the Construction Noise and Vibration Guideline (Roads and Maritime, 2011)</li> <li>• Stationary and directional noise sources will be orientated away from sensitive receivers</li> <li>• Vehicles, obstacles and stockpiles will be utilised on site to provide shielding to receivers, especially for static noise sources</li> <li>• Equipment that has noise levels equal to or less than the sound power levels in Table 12.1 of Appendix F will be used</li> <li>• The simultaneous use of high noise generating equipment will be limited. The use will also be limited to standard hours where possible</li> <li>• Plant will be switched off when not in use</li> <li>• Plant, tools and equipment will be used such that noise is reduced to the minimum required.</li> </ul>	Contractor	Construction	Additional Safeguard NV3

Construction traffic noise	<p>The NVMP would include provisions to reduce the potential impact of construction traffic noise including:</p> <ul style="list-style-type: none"> <li>Restricting travel routes to and from the project site to using the main roads (e.g. arterial roads) and to avoid local roads and roads where residential receivers are potentially impacted</li> <li>Prohibiting the use of engine/compression brakes in or near residential areas</li> <li>Promoting driving behaviour that reduces potential noise impacts</li> <li>Prohibiting idling of plant and equipment engines near residential receivers when not in use</li> <li>Strategic positioning of site accesses to minimise the chance of trucks passing by residential receivers, especially at night.</li> </ul>	Contractor	Construction	Additional Safeguard NV4
Construction vibration	<ul style="list-style-type: none"> <li>Lower powered equipment should be used when working in close proximity to vibration sensitive receivers where possible</li> <li>Building condition /dilapidation surveys should be completed both before and after the works and attended vibration monitoring undertaken when works are proposed within the specified safe working distances</li> <li>Where work is required within the nominated safe working, additional vibration mitigation measures detailed in Table 12.2 of Appendix F should be considered.</li> </ul>	Contractor	Construction	Additional Safeguard NV5
Noise and vibration complaints	<p>Attended noise and/or vibration monitoring will be undertaken following a complaint. Report the monitoring results as soon as possible. In the case that exceedances of the management levels are recorded, review the situation and identify means to reduce the impacts to noise and vibration sensitive receivers. This is to include revision to the CNVMP where required.</p>	Contractor	Construction	Additional Safeguard NV6
Operational noise mitigation	<p>Mitigation measures to minimise operational noise will be investigated, including:</p> <ul style="list-style-type: none"> <li>Quieter pavement surfaces and suitability of such pavement types for through lanes and areas of acceleration, deceleration and turning movements</li> <li>Noise barriers</li> <li>Property treatments for residually affected receivers where feasible and reasonable.</li> </ul>	Contractor	Detailed design	Additional Safeguard NV7
Property treatments	<p>Where at property treatments are identified, consider implementing these at the commencement of construction. These treatments would alleviate any noise concerns/ complaints during the construction period.</p>	Contractor	Construction	Additional Safeguard NV8



Aboriginal heritage	The <i>Standard Management Procedure - Unexpected Heritage Items</i> (Roads and Maritime, 2015d) will be followed in the event that an unknown or potential Aboriginal object/s, including skeletal remains, is found during construction. This applies where Roads and Maritime does not have approval to disturb the object/s or where a specific safeguard for managing the disturbance (apart from the Procedure) is not in place. Work will only re-commence once the requirements of that Procedure have been satisfied.	Contractor	Pre-construction / detailed design	Core standard safeguard AH1 Section 4.9 of QA G36 Environment Protection
Aboriginal heritage	Further assessment of Aboriginal cultural heritage would be completed for the proposal for areas previously identified as of high archaeological potential (Virtus, 2017), in accordance with the Procedure for Aboriginal Cultural Heritage Consultation and Investigation (Roads and Maritime, 2011).	Transport for NSW	Pre-construction	Additional safeguard AH2
<b>Aboriginal heritage</b>	<b>Further assessment of the impact areas of the Glen Lorne and Browns Bush koala underpasses would be completed to confirm the statutory pathway for these works. A program for archaeological test excavation will be completed as guided by the Archaeological Research Design developed by GML (2022) for the koala underpass works.</b>	<b>Transport for NSW</b>	<b>Pre-construction</b>	<b>Additional safeguard AH3</b>
<del>Aboriginal heritage</del>	<del>An AHIP for would be obtained prior any works potentially impacting Aboriginal heritage.</del>	<del>Transport for NSW</del>	<del>Pre-construction</del>	<del>Additional safeguard AH3</del>
Non-Aboriginal heritage	A Non-Aboriginal Heritage Management Plan (NAHMP) will be prepared and implemented as part of the CEMP. It will provide specific guidance on measures and controls to be implemented to avoid and mitigate impacts to Non-Aboriginal heritage. The NAHMP will be prepared in consultation with the Office of Environment and Heritage	Contractor	Pre-construction / detailed design	Core standard safeguard H1 Section 4.10 of QA G36 Environment Protection
Non-Aboriginal heritage	<ul style="list-style-type: none"> <li>The <i>Standard Management Procedure - Unexpected Heritage Items</i> (Roads and Maritime, 2015d) will be followed in the event that any unexpected heritage items, archaeological remains or potential relics of Non-Aboriginal origin are encountered</li> <li>Work will only re-commence once the requirements of that Procedure have been satisfied.</li> </ul>	Contractor	Pre-construction / detailed design	Core standard safeguard H2 Section 4.10 of QA G36 Environment Protection
Non-Aboriginal heritage	A heritage induction would be provided for all workers prior to works commencing and include the values of the sites, avoidance procedure, and contacts (site manager, Roads and Maritime heritage officer) for reporting unexpected archaeological finds, or inadvertent impacts to heritage items.	Contractor	Pre-construction / detailed design	Additional safeguard H3
Loss of screening	Retention of natural vegetation screening will be retained wherever possible throughout the design and construction. Where impact to vegetation cannot be avoided, planting of new vegetation would be carried out.	Environmental Manager, Designers and All construction personnel	Pre-construction/ construction	Additional safeguard H4
Vibration impact on Silos	There is the potential risk for impacts to this heritage item from vibration during construction, depending on the nature of equipment utilised. Construction vibration damage to heritage items would be managed during	Environmental Manager, Designers and	Detailed design/ pre-construction/ post-construction	Additional safeguard H5

	the Project, and careful ongoing monitoring would be required. The construction methodology for works adjacent to the Silos is subject to approval by Roads and Maritime prior to the commencement of works in this area. Low vibration construction tools and alternatives will be considered wherever possible for works adjacent to the Silos and outlined in the CEMP.	All construction personnel		
Construction of noise walls on Denfield homestead	Construction of retaining walls close to Denfield homestead would not occur within two metres of the property boundary, nor would they impact upon the root systems of vegetation that runs along the property boundary. The construction of the noise wall at Denfield homestead would incorporate interpretive design elements that express elements of the place's history and integrate into the design as it develops. This expression can take many forms on the panels of the noise wall but will keep with the recognised State significant values of Denfield homestead.	Environmental Manager, Designers and All construction personnel	Detailed design/ pre-construction / post-construction	Additional safeguard H6
Landscape character and visual impact	<p>An Urban Design Plan will be prepared to support the final detailed project design and implemented as part of the CEMP.</p> <p>The Urban Design Plan will present an integrated urban design for the project, providing practical detail on the application of design principles and objectives identified in the environmental assessment. The Plan will include design treatments for:</p> <ul style="list-style-type: none"> <li>• Location and identification of existing vegetation and proposed landscaped areas, including species to be used</li> <li>• Built elements including retaining walls and noise walls</li> <li>• Fixtures such as seating, lighting, fencing and signs</li> <li>• Details of the staging of landscape work taking account of related environmental controls such as erosion and sedimentation controls and drainage</li> <li>• Procedures for monitoring and maintaining landscaped areas</li> <li>• Details on the proposed fauna fence.</li> <li>• The Urban Design Plan will be prepared in accordance with relevant guidelines, including: <ul style="list-style-type: none"> <li>• Beyond the Pavement urban design policy, process and principles (Roads and Maritime, 2014b)</li> <li>• Landscape Guideline (RMS, 2018)</li> <li>• Noise Wall Design Guidelines (RTA, 2006)</li> <li>• Shotcrete Design Guideline (RTA, 2005).</li> </ul> </li> </ul>	Contractor	Pre-construction / detailed design	Core standard safeguard UD1

Operational light spill impacts	The lighting design specification will be developed minimise light spill and light glare in accordance with the provisions of AS4282-1997 Control of the Obtrusive Effect of Outdoor Lighting (Standards Australia, 1997). This may require the use of directional lighting, cut-offs or filters.	Contractor	Detailed design	Additional safeguard: UD2
Operational visual and amenity impacts	Opportunity to improve planting, including within medians and verges, and adjoining private property should be investigated, and implemented where feasible.	Contractor	Detailed design	Additional safeguard: UD3
Operational visual and amenity impacts	Where feasible and reasonable, opportunities to reduce the visual impact of built structures such as retaining and noise walls, would be implemented through design, and selection of materials and colours.	Contractor	Detailed design	Additional safeguard: UD4
Construction light spill impacts	Measures to minimise the use and spill from temporary and construction lighting will be introduced onsite	Contractor	Construction	Additional safeguard: UD5
Socio-economic	A Communication Plan (CP) will be prepared and implemented as part of the CEMP to help provide timely and accurate information to the community during construction. The CP will include (as a minimum): <ul style="list-style-type: none"> <li>• Mechanisms to provide details and timing of proposed activities to affected residents, including changed traffic and access conditions</li> <li>• Contact name and number for complaints.</li> </ul> <p>The CP will be prepared in accordance with Road and Maritimes' <i>Community Involvement and Communications Resource Manual</i> (Roads and Maritime, 2008b).</p>	Contractor	Detailed design/ pre-construction	Core standard safeguard SE1
Property acquisition	All property acquisition will be carried out in accordance with the <i>Land Acquisition Information Guide</i> (Roads and Maritime, 2012a) and the <i>Land Acquisition (Just Terms Compensation) Act 1991</i> .	Transport for NSW/ Project Manager	Pre-construction and construction	Core standard safeguard SE2
Impacts on business and the community during construction	Road users, including freight companies will be informed of changed conditions, including likely disruptions to access during construction.	Contractor	Pre-construction and construction	Additional safeguard SE3
Community impacts during construction across the proposal footprint	Consultation will be undertaken with potentially affected residences prior to the commencement of and during works in accordance with the Roads and Maritime's Community Involvement and Communications Resource Manual. Consultation will include but not limited to door knocks, newsletters or letter box drops providing information on the proposed works, working hours and a contact name and number for more information or to register complaints.	Transport for NSW / Contractor	Pre-construction and construction	Additional safeguard SE4
Community impacts during construction across the proposal footprint	A complaint handling procedure and register will be included in the CEMP. The complaints register will be maintained throughout construction.	Contractor	Pre-construction and construction	Additional safeguard SE5
Emergency Access	Access for emergency vehicles will be maintained at all times during construction. Any site-specific requirements will be determined in consultation with the relevant emergency services agency.	Contractor	Construction	Additional safeguard SE6

Impacts to properties	Consultation will be undertaken with all affected property owners during detailed design and construction to develop and implement measures to mitigate impacts on land use viability, infrastructure and severance.	Transport for NSW	Detailed design	Additional safeguard SE7
Temporary utility service interruption	Residents and businesses will be notified before any utility interruption	Contractor	Pre-construction	Additional safeguard SE8
Utility relocation and adjustment	A utility management plan will be prepared to include: <ul style="list-style-type: none"> <li>• Utility company consultation</li> <li>• Maintenance and emergency access requirements</li> <li>• Construction staging and programming conflicts.</li> </ul>	Transport for NSW / Contractor	Detailed design, pre-construction and construction	Additional safeguard SE9
General Waste Management	A Waste Management Plan (WMP) will be prepared and implemented as part of the CEMP. The WMP will include but not be limited to: <ul style="list-style-type: none"> <li>• Measures to avoid and minimise waste associated with the project</li> <li>• Classification of wastes and management options (re-use, recycle, stockpile, disposal)</li> <li>• Statutory approvals required for managing both on and off-site waste, or application of any relevant resource recovery exemptions</li> <li>• Procedures for storage, transport and disposal</li> <li>• Monitoring, record keeping and reporting.</li> </ul> <p>The WMP will be prepared taking into account the <i>Environmental Procedure - Management of Wastes on Roads and Maritime Services Land</i> (Roads and Maritime, 2014d) and relevant Roads and Maritime Waste Fact Sheets.</p>	Contractor	Detailed design/ pre-construction	Core standard safeguard W1 Section 4.2 of QA G36 Environment Protection
General waste impacts	Waste accumulation, littering and general tidiness will be monitored during routine site inspections.	Contractor	Construction	Additional safeguard: W2
Resource minimisation	Recycled, durable, and low embodied energy products will be used to reduce primary resource demand in instances where the materials are cost and performance competitive and comparable in environmental performance (e.g. where quality control specifications allow).	Contractor	Construction Operation	Additional safeguard: W3
Hazard and Risk	A Hazard and Risk Management Plan (HRMP) will be prepared and implemented as part of the CEMP. The HRMP will include, but not be limited to: <ul style="list-style-type: none"> <li>• Details of hazards and risks associated with the activity</li> <li>• Measures to be implemented during construction to minimise these risks</li> <li>• Record keeping arrangements, including information on the materials present on the site, material safety data sheets, and personnel trained and authorised to use such materials</li> </ul>	Contractor	Detailed design/ pre-construction	Core Safeguard HAZ1

	<ul style="list-style-type: none"> <li>• A monitoring program to assess performance in managing the identified risks</li> <li>• Contingency measures to be implemented in the event of unexpected hazards or risks arising, including emergency situations.</li> </ul> <p>The HRMP will be prepared in accordance with relevant guidelines and standards, including relevant Safe Work Australia Codes of Practice, and EPA or Office of Environment and Heritage publications.</p>			
Hazard and Risk	<p>Where possible, hazardous materials and dangerous goods, avoided or substituted for less hazardous alternatives throughout the construction process. Where this is not possible, in the case for necessary fuels, oils and fluids required for activities in the proposal for example, the appropriate management and handling procedures will be implemented as part of the CEMP. This will include a Hazard and Risk Management Plan (HRMP) and Waste Management Plan (WMP) which will include, but not be limited to measures to avoid the generation of hazardous wastes, and the appropriate procedures for their storage, transport and disposal.</p> <p>The WMP will be prepared taking into account the <i>Environmental Procedure – Management of Wastes on Roads and Maritime Services Land</i> (Roads and Maritime, 2014d), and other relevant Transport for NSW hazardous materials and dangerous goods handling procedures to reduce environmental and worker risk such as <i>Managing the risks of working with bitumen and bituminous products</i> (Roads and Maritime, 2013e).</p> <p>The appropriate management and removal of existing hazardous materials and dangerous goods identified adjacent to the proposed works in the form of asbestos containing materials (ACM) and synthetic fibre materials (SFM) is addressed in section 6.2.4 of the Project REF.</p>	Contractor	Detailed design/ pre-construction	Core Safeguard HAZ2
Property protection	Additional safety measures required to provide protection for private properties along Appin Road will be investigated during detailed design.	Transport for NSW/ Contractor	Detailed design	Additional safeguard HAZ3
Air Quality	<p>An Air Quality Management Plan (AQMP) will be prepared and implemented as part of the CEMP. The AQMP will include, but not be limited to:</p> <ul style="list-style-type: none"> <li>• A procedure for monitoring dust onsite and weather conditions</li> <li>• An identification procedure for potential sources of air pollution and mitigation measures for likely scenarios such as imposing speed limits throughout the proposal footprint and site compounds</li> <li>• Maintaining air quality management objectives consistent with any relevant published EPA and/or OEH guidelines</li> <li>• Compliance with Stockpile Site Management Guidelines (Roads and Maritime, 2015a)</li> </ul>	Contractor	Detailed design/ pre-construction	Core standard safeguard AQ1 Section 4.4 of QA G36 Environment Protection



	<ul style="list-style-type: none"> <li>• Methods to manage work during strong winds or other adverse weather conditions such as reducing active earthworks on hot windy days</li> <li>• Implement a vehicle, plant and machinery maintenance program to comply with manufacturers specifications and ensure compliance with the <i>NSW Protection of Environment Operations Act 1997</i>.</li> </ul> <p>A progressive rehabilitation strategy for exposed surfaces.</p>			
Greenhouse gas and climate change	<p>Detailed design will consider opportunities to reduce building and construction material quantities and use appropriate materials wherever reasonable and feasible.</p> <p>Pavement design will ensure resilience against extreme temperature and intense and more frequent rainfall events.</p> <p>The use of climate tolerant vegetation will be considered and its ability to align with the existing landscape will be included in the landscape character and visual amenity design.</p>	Contractor	Detailed design	Additional safeguard GG1
Greenhouse gas and climate change	<p>Equipment performance and running and idling times will be monitored and managed to reduce emissions.</p>	Contractor	Construction	Additional safeguard GG2
Cumulative impacts	<p>Other developers will be consulted:</p> <ul style="list-style-type: none"> <li>• To obtain information about project timeframes and impacts. Identify and implement appropriate safeguards and management measures to minimise cumulative impacts. If required, this may include implementing traffic management controls in consultation with other project developers to minimise cumulative construction traffic impacts on Appin Road.</li> </ul> <p>To manage the interfaces of the proposal's staging and programming in combination with the other projects occurring in the area.</p>	Transport for NSW / Contractor	Pre-construction / Construction	Additional safeguard: CI1
Cumulative impacts	<p>All environmental management plans will be prepared to consider other developments in the area.</p>	Contractor	Pre-construction	Additional safeguard: CI2
Cumulative impacts	<p>Further consideration of the proposal and the Appin Road safety improvement work would be undertaken.</p>	Transport for NSW	Pre-construction	Additional safeguard: CI3

### 7.3 Licensing and approvals

All relevant licenses, permits, notifications and approvals needed for the Appin Road Upgrade and when they need to be obtained are listed in Table 7-2. Additional or changed licenses and approval requirements identified in this Addendum REF are indicated by underlined and/or struck out font.

Table 7-2: Summary of licensing and approval required

Instrument	Requirement	Timing
<b><i>Roads Act 1993 (s138)</i></b>	Road occupancy licence to dig up, erect a structure or carry out work in, on or over a road.	Prior to start
<b><i>Protection of the Environment Operations Act 1997</i></b>	EPL required to under Schedule 1, Clause 35, road construction	Prior to start

## 8. Conclusion

### 8.1 Justification

The Appin Road upgrade, including the proposed fauna crossings and fauna fencing, facilitates important road safety works while providing increased protection for the local koala population from traffic.

Overall, the proposed amendments will be minor in terms of construction impacts. Operationally, they would have a significant beneficial impact as they would help to provide safe fauna movement across Appin Road that would accommodate the Appin Road Upgrade but also residential development at Gilead and other nearby locations.

#### 8.1.1 Social factors

The proposed modifications would have a beneficial social impact by assisting in the protection of the local koala population.

#### 8.1.2 Biophysical factors

Any detrimental impacts on biodiversity and the local environment would be negligible and limited to small amounts of clearing to facilitate the construction of the underpasses. The beneficial impacts for the local koala population and other fauna that may use the underpasses are a major factor justifying for the proposed modification.

#### 8.1.3 Economic factors

The proposed modifications would increase the overall cost of the Appin Road upgrade works, however it is considered that the ecological benefits are commensurate with any increase in cost.

#### 8.1.4 Public interest

The proposed Addendum REF is in the public interest as the modification facilitates important road safety works while providing increased protection for the local koala population from traffic.

### 8.2 Objects of the EP&A Act

Table 8-1 Assessment against objectives of the EP&A Act

Object	Comment
<b>1.3(a) To promote the social and economic welfare of the community and a better environment by the proper management, development and conservation of the State's natural and other resources.</b>	<p>The proposed modification is located adjacent to the road corridor of Appin Road and has a small disturbance footprint. The proposed modification would not significantly impact on natural and artificial resources.</p> <p>There would be some impact to the environment, including clearing of vegetation, however these are safeguarded (refer to Chapter 7).</p>

<b>1.3(b) To facilitate ecologically sustainable development by integrating relevant economic, environmental and social considerations in decision-making about environmental planning and assessment.</b>	The proposed underpass is considered to be directly contributing the ecological sustainability of the Appin Road upgrade works.
<b>1.3(c) To promote the orderly and economic use and development of land.</b>	The proposed modification is predominantly contained within the existing road corridor and is consistent with the development of the land.
<b>1.3(d) To promote the delivery and maintenance of affordable housing.</b>	Not relevant to the proposed modification.
<b>1.3(e) To protect the environment, including the conservation of threatened and other species of native animals and plants, ecological communities and their habitats.</b>	The proposed modification would provide connectivity for the Campbelltown koala population habitat, increasing the populations' protection against external threats.
<b>1.3(f) To promote the sustainable management of built and cultural heritage (including Aboriginal cultural heritage).</b>	Safeguards proposed in Table 7-1 would minimise impacts upon Aboriginal and non-Aboriginal heritage items.
<b>1.3(g) To promote good design and amenity of the built environment.</b>	The proposed modification contributes to the good design and amenity of the approved future development.
<b>1.3(h) To promote the proper construction and maintenance of buildings, including the protection of the health and safety of their occupants.</b>	Not relevant to the proposed modification.
<b>1.3(i) To promote the sharing of the responsibility for environmental planning and assessment between the different levels of government in the State.</b>	Not relevant to the proposed modification.
<b>1.3(j) To provide increased opportunity for community participation in environmental planning and assessment.</b>	This Addendum REF would be exhibited to facilitate community participation.

## 8.3 Ecologically sustainable development

### 8.3.1 The precautionary principle

The precautionary principle has been incorporated into the assessment of the proposal to account for the subjectivity of professional judgement applied in environmental assessment and modelling uncertainty. Thus, the following precautionary measures have been adopted:

- The worst-case assumption of all noise generating construction equipment operating at the same time, at its maximum output, at a location closest to the nearest sensitive receivers;
- Assessing the potential maximum vegetation clearing requirements;
- Assessing the proposal's visual impact before any landscape planting and treatments have established and matured;
- Assessing impacts and including safeguards for impacts which are unlikely to happen such as major spills;
- Ensuring that the impact of elements of the proposal's design that are not fully detailed are assessed during the next stage and safeguarded before work starts; and
- The works proposed under the Addendum REF are intended to be better protective of koalas and other fauna, and as a consequence are wholly consistent with the precautionary principle when considering the Project as a whole.

### 8.3.2 Intergenerational equity

The Addendum REF would result in better protection of koalas and other fauna, so impacts of the Project are offset for future generations as described below. The ecological impacts are considered minor and would not affect the form, function, survival or wider condition of the biophysical values of the local area or region, while presenting a clear benefit to current and future koala populations.

As such the Addendum REF ensures intergenerational equity in that it protects fauna and ensures its survival into the future.

### 8.3.3 Conservation of biological diversity and ecological integrity

The combined footprints would impact an additional 0.25 ha of land, comprising 0.22 ha of native vegetation (0.12 ha of low condition Cumberland Plain Woodland (CPW) and 0.09 ha of modified Shale Sandstone Transition Forest (SSTF) that was not assessed in the Project REF and that is not within the Biodiversity Certified land within the Figtree Hill development area. Once the underpasses have been constructed, the disturbed area would be revegetated back to CPW and SSTF and managed as part of the proposed 28 ha Browns Bush Biodiversity Stewardship site that is adjacent to the proposed Georges River Koala National Park.

The State and Commonwealth has published guidelines to determine if certain actions and activities would have a significant impact on the values and defining features of legally protected ecological values. Central to the guidelines is the consideration of whether the impacts would have a material impact on biological diversity and ecological integrity to the point of affecting their overall conservation.

In the case of the proposal these assessments, which are reported in Appendix E, conclude that while the impacts are material, meaning they would have a minor adverse impact on.

### 8.3.4 Improved valuation, pricing and incentive mechanisms

In the case of the proposal there is a commitment to:

- Use recycled and low-embodied energy materials where feasible and reasonable in their application to consider the lifecycle demand on natural resources and their conservation
- Source materials and dispose of waste locally to minimise transportation impacts. This is termed the 'proximity principle'.

Transport for NSW has developed environmental assessment guidance to allow external parties to prepare its environmental assessment documentation. These external parties comprise specialists who are competent in environmental impact assessment and are experienced in identifying cost-effective safeguards and management measures based on a hierarchy of avoidance over mitigation. In addition, Transport for NSW has its own in-house team of environmental specialists who

review all environmental assessments to ensure the safeguards and management measures are cost-effective and achieve the proposal's environmental goals and Transport for NSW's organisational goals.

## 8.4 Conclusion

This addendum REF has examined and taken into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of the proposed activity.

This has included consideration where relevant, of conservation agreements and plans of management under the NPW Act, biodiversity stewardship sites under the BC Act, wilderness areas, areas of outstanding value, impacts on threatened species, populations and ecological communities and their habitats and other protected fauna and native plants. It has also considered potential impacts to matters of national environmental significance listed under the Federal EPBC Act.

A number of potential environmental impacts from the proposed modification have been avoided or reduced during the design development and options assessment. The proposed modification as described in the addendum REF best meets the project objectives but would still result in some impacts on the local environment. Safeguards and management measures as detailed in this addendum REF would ameliorate or minimise these expected impacts. The proposed modification would also facilitate the Appin Road upgrade works under the Project REF, while enabling koalas and other fauna safe passage across Appin Road. On balance the proposed modification is considered justified, and the following conclusions are made.

### 8.4.1 Significance of impact under NSW legislation

The proposed modification would not result in a change to the findings of the Project REF and associated submissions report and would be unlikely to cause a significant impact.

### 8.4.2 Significance of impact under Australian legislation

The proposed modification would not likely cause a significant impact on matters of national environmental significance or the environment of Commonwealth land within the meaning of the EPBC Act. A referral to the Australian Government Department of Climate Change, Energy, the Environment and Water is not required.



## 9. Certification

This addendum review of environmental factors provides a true and fair review of the proposed modification in relation to its potential effects on the environment. It addresses to the fullest extent possible all matters affecting or likely to affect the environment as a result of the proposed modification.



Verity Blair  
Associate Director  
EMM Consulting Pty Limited

Date: 18 November 2022

I have examined this addendum review of environmental factors and accept it on behalf of Transport for NSW.

Insert name

Position title, e.g., Environment Officer

Company name

Date:

[Redacted]

## 10. EP&A Regulation publication requirement

Respondent	Yes/No
Does this REF need to be published under section 171(4) of the EP&A Regulation?	Yes

# 11. Terms and acronyms used in this addendum

## REF

Term /acronym	Description
AusLink	Mechanism to facilitate cooperative transport planning and funding by Commonwealth and state and territory jurisdictions
BC Act	<i>Biodiversity Conservation Act 2016 (NSW).</i>
CEMP	Construction / Contractor’s environmental management plan
EIA	Environmental impact assessment
EP&A Act	<i>Environmental Planning and Assessment Act 1979 (NSW).</i> Provides the legislative framework for land use planning and development assessment in NSW
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth).</i> Provides for the protection of the environment, especially matters of national environmental significance, and provides a national assessment and approvals process.
ESD	Ecologically sustainable development. Development which uses, conserves and enhances the resources of the community so that ecological processes on which life depends, are maintained and the total quality of life, now and in the future, can be increased
FM Act	<i>Fisheries Management Act 1994 (NSW)</i>
Heritage Act	<i>Heritage Act 1977 (NSW)</i>
LALC	Local Aboriginal Land Council
LEP	Local Environmental Plan. A type of planning instrument made under Part 3 of the EP&A Act.
LoS	Level of Service. A qualitative measure describing operational conditions within a traffic stream and their perception by motorists and/or passengers.
NES	Matters of national environmental significance under the Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999.</i>
NPW Act	National Parks and Wildlife Act 1974 (NSW)
Roads and Maritime	NSW Roads and Maritime was dissolved by the Transport Administration Amendment Bill in August 2019, all function are now managed by Transport for NSW
SEPP	State Environmental Planning Policy. A type of planning instrument made under Part 3 of the EP&A Act.
SEPP (Biodiversity and Conservation)	State Environmental Planning Policy (Biodiversity and Conservation) 2021
SEPP (Planning Systems)	State Environmental Planning Policy (Planning Systems) 2021
SEPP (Precincts – Central River City)	State Environmental Planning Policy (Precincts – Central River City) 2021

SEPP (Precincts – Eastern Harbour City)	State Environmental Planning Policy (Precincts – Eastern Harbour City) 2021
SEPP (Precincts – Regional)	State Environmental Planning Policy (Precincts – Regional) 2021
SEPP (Precincts – Western Parkland City)	State Environmental Planning Policy (Precincts – Western Parkland City) 2021
Vehicle strike	Vehicle strike (or road strike) refers to a vehicle colliding with an animal as it attempts to cross a road. It usually results in the koala being injured or killed.
SEPP (Resilience and Hazards)	State Environmental Planning Policy (Resilience and Hazards) 2021
SEPP (Transport and Infrastructure)	State Environmental Planning Policy (Transport and Infrastructure) 2021
TSC Act	<i>Threatened Species Conservation Act 1995</i> (NSW)
QA Specifications	Specifications developed by Roads and Maritime Services for use with road work and bridge work contracts let by Transport for NSW.

## 12. References

- Department of Planning and Environment, *Cumberland Plain Conservation Plan*, August 2022
- Department of Planning and Environment, *Cumberland Plain Conservation Plan – Subplan B – Koalas*, August 2022
- Department of Planning and Environment, *Cumberland Plain Conservation Plan Biodiversity Certification Orders*, August 2022
- Department of Planning and Environment, *Greater Macarthur 2040 – update*, 2021
- Department of Planning and Environment, *Guidelines for Division 5.1 assessments*, June 2022
- Department of Planning and Environment ‘*How to keep koalas off roads*’ June 2020
- Environmental Planning and Assessment Act 1979* (NSW)
- Environment Protection and Biodiversity Conservation Act 1999* (Federal)
- Landscape design guideline 2018 (nsw.gov.au)
- NSW Chief Scientist, *Advice on the protection of the Campbelltown Koala population*, 2020
- NSW Chief Scientist, *Advice on the protection of the Campbelltown Koala population – update*, May 2021
- Referral guidance for the endangered koala - DCCEEW
- RTA, *Biodiversity Guidelines*, September 2011
- Strategic assessment of some NSW road and traffic management works - DCCEEW
- Transport for NSW, *Appin Road Upgrade, Mount Gilead to Ambarvale - Review of Environmental Factors, November 2018* (nsw.gov.au)
- Transport for NSW, *Appin Road Upgrade, Mount Gilead to Ambarvale - Review of Environmental Factors - Appendix C Biodiversity Assessment - November 2018* (nsw.gov.au)
- Transport for NSW, *Appin Road improvements – Review of Environmental Factors*, 2018
- Water Group, DPE website: Current recommended practices and performance Standards - Sydney Catchment Authority

# Appendix A

NSW Chief Scientist 'Advice on the protection of the Campbelltown Koala population'





**Chief Scientist  
& Engineer**

**Advice on the protection of the Campbelltown Koala  
population**

**Koala Independent Expert Panel**

30 April 2020



## Chief Scientist & Engineer

The Hon Matt Kean MP  
Minister for Energy and Environment

The Hon Rob Stokes MP  
Minister for Planning and Public Spaces

Dear Ministers

### **Advice regarding the protection of the Campbelltown Koala population**

In December 2019 you requested expert advice on proposed measures to protect the Campbelltown Koala population, specifically on those measures for the proposed Mount Gilead Stage 2 Development and in the draft Cumberland Plain Conservation Plan, including advice on possible east-west corridors linking the Nepean and Georges Rivers.

This report is submitted in fulfilment of the Terms of Reference. An independent expert panel was established to provide the advice chaired by myself and that included Professor Kathy Belov AO (The University of Sydney), Dr Carolyn Hogg (The University of Sydney) and Professor Jonathan Rhodes (The University of Queensland).

In providing its advice the Panel considered the measures proposed in both the Mount Gilead Stage 2 documents and draft Cumberland Plain Conservation Plan, to provide a holistic and consistent approach in the region.

The Panel advises that access to increased (or retained) koala habitat has prima facie benefits for koalas, however, key is whether the retained habitat in east-west corridors between the Nepean and Georges Rivers can be managed such that koalas are not exposed to increased threats such as traffic and dogs, and whether mitigation measures will separate koalas from these threats. Key to the success of this will be ensuring that koalas are separated from the risks that threaten them.

This report provides recommendations to improve the proposed measures and considers a range of possible scenarios for the mitigation approaches proposed, given constraints including those that are geographic in nature. An adaptive management approach is identified as crucial, with consideration of data collection and monitoring requirements, to ensure and demonstrate the effectiveness of mitigation strategies.

Yours sincerely

**Dr Chris Armstrong PSM**  
**Deputy NSW Chief Scientist & Engineer**  
**30 April 2020**

## EXECUTIVE SUMMARY

Urbanisation is one of the main causes of declines in koala populations in NSW. These declines are associated with habitat loss and fragmentation, reduced connectivity or isolation of populations reducing genetic diversity, increasing susceptibility to disease and increasing threats from vehicle strikes and dog attacks.

There is strong evidence that urban development has major impacts for wildlife globally and drives the decline in many species. It then becomes a question of whether the impacts can be mitigated to such a degree so as to reduce them to an acceptable level.

The Macarthur region is host to a historically continuous population of koalas, known as the Campbelltown population. The population of between 250 and 500 individuals is surviving in a landscape that is predominantly native bushland that is connected to rural farmland or peri-urban environment in the vicinity of the Greater Macarthur area. The Campbelltown population is one of the few remaining populations in the Sydney region. The population is considered to be healthy and uniquely Chlamydia free. The main causes of mortality are vehicle strikes and dog attacks. The impact of the widespread 2019/20 bushfires across NSW has increased the comparative importance of this koala population.

The Greater Macarthur region has been declared a growth area to provide homes for Sydney's growing human population. Land use and infrastructure plans for the region are set out in *Greater Macarthur 2040 – An interim plan for the Greater Macarthur Growth Area* (GMGA). There are currently ~3,000 people living between Menangle Park and Appin and with an estimate of another 39,000 new homes the local human population could increase to ~109,000 people over the next 36 years. The development will include new town centres, retail and commercial services, improved transport corridors and schools. A planning principle for the GMGA is the conservation of biodiversity and koala populations.

Biodiversity certification for the GMGA is being sought by two parties: the Campbelltown City Council on behalf Lendlease for a proposed development in Mount Gilead and by the NSW Government for the remainder of the area through the Cumberland Plain Conservation Plan (CPCP). Biodiversity certification identifies, at a regional scale, areas of high conservation values that development should avoid and be protected, areas that can be developed and measures to offset any potential impacts from development.

In December 2019, the Minister for Energy and Environment and the Minister for Planning and Public Spaces requested advice on the protection of the Campbelltown koala population. Specifically, if the (1) the adequacy of the proposed measures for koalas and their consistency with the NSW Koala Strategy and if additional conservation measures are required for the proposed Mount Gilead Stage 2 development and (2) site specific measures required for the CPCP in the GMGA to support the long-term viability of the koala population including an assessment of east-west corridors.

An independent expert panel, chaired by the Deputy NSW Chief Scientist & Engineer, was established to assess the protection measures and provide this advice.

The Panel assessed the adequacy of protection measures proposed in relation to the NSW Koala Strategy, which has the objective of stabilising and increasing koala numbers over the longer-term to ensure genetically diverse and viable populations across NSW. The guiding principles for the Panel were to maximise koala population persistence and abundance, koala habitat amount and connectivity, and minimise contact between koalas and the urban environment to reduce hazards and threats.

Few dense urban new developments in Australia have successfully, over the long term, avoided declining koala populations in the context of rapid growth in urban infrastructure,

dwellings, and the threats that arise from thousands of human residents. Due to the large time lag between new developments and impacts on koala numbers, it may be difficult in the near term to fully understand population impacts caused by urbanisation. Monitoring for population growth may provide a clearer picture of impacts. However, the opportunity presents itself, through forward planning and commitments by parties to protect habitat, mitigate threats and reduce stressors. If this approach is successful, and if it can be monitored, managed and measured, it could show the way for future developments on the rural fringe to minimise the impacts that will arise.

Key to the success of this will be ensuring that koalas are separated from the risks that threaten them, in particular road traffic, and predation by dogs. The proposed high densities for residential and urban development that are proposed makes it unlikely that koalas could persist in the long-term in the urban matrix. Exclusion fencing will be key to keeping them separated from this, as will ongoing observation of the koala population to monitor for disease, indirect stressors such as light and noise, and also to monitor genetic health, population size and distribution.

Habitat and corridor protection in landscapes is not only beneficial to koalas but also other flora and fauna.

The Panel reviewed draft planning proposal information for the MGS2 site and the CPCP area associated with the GMGA. The Panel observes that access to increased (or retained) koala habitat has prima facie benefits for koalas, however, key is whether the retained habitat in east-west corridors between the Nepean and Georges Rivers can be managed such that koalas are not exposed to increased threats such as traffic and dogs, and whether mitigation measures will separate koalas from these threats.

If the removal of key risks cannot be accomplished, then the better management approach would be to monitor the impacts on the koala population and if it declines then consider active management which could include moving koalas between sites for breeding or relocation to safe areas, preferably in the local region. However, if separation from threats can be achieved in the landscape and maintained over the long term, then the better outcome for the koalas, and other flora and fauna, would be to retain the east-west corridors.

Exclusion fencing to prevent koalas accessing Appin Road from the eastern or western side is critical, as is the use of exclusion fencing more broadly to keep koalas separated from dogs and road traffic in the developments. Efforts to sympathetically landscape buffer zones further assists in separating koalas from urban impacts and related stressors, while the approach proposed by the proponents to landscape street scapes and backyards of dwellings so to exclude koala feed trees is welcome, as it removes an attractant for koalas into the urban matrix.

Cooperation, vigilance and participation of the community will be critical, when driving, in checking the integrity of fence lines, in reporting injured or dead animals, keeping dogs enclosed in yards or not taking them into koala areas, maintaining bush regeneration, or even assisting with wildlife counting and monitoring efforts. This is very much in line with the spirit of the NSW Koala Strategy.

This Executive Summary should be read in conjunction with the Findings and Recommendations chapter that follows.

## FINDINGS AND RECOMMENDATIONS

### Findings

In developing this advice in response to the Review's Terms of Reference, for the proposed developments at the Mount Gilead Stage 2 (MGS2) site and for the draft Cumberland Plains Conservation Plan (CPCP) within the Greater Macarthur Growth Area (GMGA), the Panel has taken a risk-based approach. This advice is based on an assessment of adequacy in terms of the objectives of the NSW Koala Strategy to stabilise and then increase koala numbers over the longer-term, ensuring genetically diverse and viable populations across NSW. In doing so the Panel has considered: hazards and threats to koalas; the benefits of the set of proposed risk mitigation and protection measures; and the costs and disbenefits of measures; residual risks of these measures. The Panel has also considered a range of scenarios to guide its advice on preferred approaches should anticipated outcomes not eventuate.

While the Panel is conscious that it has been asked to provide advice on two distinct development footprints, proceeding under different legislation, at different stages of progress, the Panel is nevertheless keen to highlight the importance of a holistic planning approach. By their very nature, the habitat corridors within the two study areas cross multiple tenures and landscapes, connect internally and with each other. Koalas, in using these corridors, do not recognise lines on maps. Therefore, the Panel report moves between the MGS2 proposal and the CPCP draft planning material fairly freely. While a reader may be interested in one development or another, there is benefit reading them together as a single document. (For the purposes of clarity, the Panel report has adopted a naming convention used in the Figure 5 with six corridors labelled from A to F as you move from north to south, with three corridors A, B, C particularly relevant for MGS2 and four corridors C, D, E and F pertinent for the CPCP planning.)

The Review Terms of Reference seek the Panel's view on the benefit of maintaining an east-west connectivity between the Georges River and Nepean River. The habitat in this region contains high quality feed trees due to the sandstone shale transition forest. The Campbelltown koala population is expanding and therefore, it is essential that this habitat supports the movement of koalas such that dispersing koalas can move through the landscape, can breed to ensure genetic diversity, and can access refugia in times of stress, drought or other threats. Overall, the Panel finds that efforts to increase the availability of habitat while reducing the interface with threats, and maintain genetic and physical health status, are important pillars upon which to plan mitigation measures.

The following findings are laid out corridor-by-corridor, for mitigations and measures in both the sets of north-south and east-west corridors. These are followed by a number of thematic findings of relevance across the landscape.

#### **Georges River Corridor (north south), Mount Gilead vicinity and CPCP planning**

The protection of the Georges River corridor, including the creation of the Georges River Koala Reserve, and the replanting of habitat will provide crucial linkage for the koala population of Southern Sydney to the Southern Highlands. While being adjacent to habitat further east in National Parks and Sydney Catchment Special Areas, the habitat in the corridor has a high nutrition value and supports one of the only koala populations in NSW that is thought to be growing and chlamydia free.

The Panel finds the current and proposed efforts to protect and improve the habitat in this corridor to be essential and agrees broadly with the Department's approach. Efforts to protect the habitat and reduce risk to koalas from threats associated with urbanisation using exclusion fencing will be important as the local human population increases with

urbanisation of the region. Regular monitoring and control of predators (such as dogs) within the corridor will be an important ongoing management tool, as will measurements of koala population dynamics.

Arguably, after the establishment of the Georges River Koala Reserve, the most important measure to be delivered for koalas in either the MGS2 plans or the CPCP will be exclusion fencing along Appin Road. Appin Road is currently a hot spot for koala mortality, so the Panel finds the use of fencing to stop koalas entering the road surface from either the east-side or west-side to be a fundamental requirement for the success of protecting koalas in the region.

Crossing structures to traverse Appin Road will also be key if the connectivity to east-west corridors is to be provided, unless intensive active management is to be employed, including translocations for breeding. The crossing infrastructure at locations along the road to facilitate east-west movement could include culverts, underpasses or bridges, while the inclusion of grids and gates will also be necessary to enable the movement of humans and vehicles onto the road while preventing koala access. These crossings are discussed below.

The Panel finds that an additional measure is required in the Georges River Corridor to prevent the development of a koala vehicle collision hotspot. Appin Road crosses the Georges River at Kings Falls Bridge within the corridor east of the Appin township. This location has the potential to create heightened risks for koalas as the number of vehicles increases with urbanisation unless suitable mitigation and crossing structures are developed. An approach using exclusion fencing along this stretch of Appin Road, with the terrain under the bridge modified with appropriate structures to ensure a safe thoroughfare for koalas, would be a valuable pre-emptive measure to prevent road deaths.

### **Nepean River Corridor (north-south), Mount Gilead and CPCP planning**

Koala habitat in river and creek valleys provides important refugia and resilience to warming and drying climates, a characteristic that is likely to become increasingly important with climate change. The majority of the corridors discussed in this Review are riverine, which includes that along the Nepean. This north-south corridor has been identified as a primary corridor by the Department. It contains high quality habitat and connects populations to the south east in the Sydney Catchment and then further to the Southern Highlands.

The habitat associated with the Nepean River has been identified in the draft CPCP material as a strategic conservation area, and possible protections will include Biodiversity Stewardship Agreements (BSA). The Panel agrees with this approach. Additional pockets of habitat that could be replanted or improved have been identified by the Department and the Panel encourages these efforts as well.

The Panel recommends the establishment of exclusion fencing to separate koalas from threats associated with urban development, particularly from dogs and cars. While it is expensive to install and maintain fencing, these costs are small relative to the scale of the development and investment that will occur in the region over the next 36 years.

The Panel notes a particular concern regarding the Nepean Corridor, which is to prevent a functional 'dead-end' at its north end. Observing maps and images of the northern reach of the corridor, it appears to end in the vicinity of the MGS2 site where the Hume Highway crosses the Nepean River. Wildlife corridors that end with no connection to other habitat can be a considerable risk, in particular where the habitat exposes wildlife to threats, and in doing so can create population sinks, where wildlife kills occur, causing vacancies in the location which subsequently attract more animals.

### **Corridor A – Menangle Creek to Noorumba (east west), Mount Gilead development**

It is the functional role that habitat in Mount Gilead site plays in connecting the north end of the Nepean Corridor in an easterly direction that means protecting corridor structures at



MGS2 is critical, preventing an isolated population at Nepean. Two corridors are the focus of protection in the MGS2 proponents: Corridor A in the north and Corridor B further south.

The proponents have approval for the protection of habitat in the Noorumba Biobank site to offset the Mount Gilead Stage 1 (MGS1 development). The site is bordered to the north by Campbelltown suburbs, to the south by MGS1 future dwellings, to the east by Appin Road and to the west by dwellings, farmland and a narrow (<85 m) wildlife corridor.

The proponents of MGS2 view the Noorumba site as part of the corridor for koala east-west movement. However, to achieve this an effective koala crossing (one that has been shown to be used by koalas elsewhere) is needed between the two sides of Appin Road. The Panel holds reservations that the proponent's preferred approach for a koala crossing (a tree-top bridge structure) will be used by koalas. Koalas primarily move on the ground between trees, and so crossings that enable this are found by the Panel to be preferred. These could include culverts or underpasses under the road, or wide overpasses or land bridges. The Panel has been informed by the proponent and others that the local topography at Noorumba does not lend itself to having a culvert built under the road.

The Panel has set out scenarios for this corridor given the tree-top bridge may not be functional, including exploring other crossing structures. The Panel finds that if the Noorumba crossing of Appin Road is not feasible, then the site would become functionally fragmented and not perform as an east-west corridor. If this were to occur, the Panel finds that monitoring of the Noorumba site would be required, combined with active management of koalas in that location to avoid genetic bottlenecks and to facilitate movement of young koalas to other areas. Monitoring for predators would also be required with the development of exclusion fencing increasingly needed as the human population increases in the adjacent suburb.

If the Noorumba site can be secured with an Appin Road crossing effective for koalas, then exclusion fencing between habitat and threats would still be required. Efforts to widen the corridors should also be made, while it is acknowledged that there are constraints with corridor widening west of Noorumba due to land use and tenure issues. Narrow corridors with open vegetation, without exclusion fencing place koalas at risk of exposure to threats such as roaming dogs and foxes, so fencing should be pursued. If fencing is not feasible, then buffer zones (~60 m wide) containing non-feed trees, and with monitoring to track predators, and population dynamics to understand these outcomes will be needed. Management decisions regarding the koala population in this area will be informed by those data, and responses could include further active management or even relocation to more suitable habitat.

### **Corridor B – Woodhouse Creek to Beulah (east west), Mount Gilead development**

The proponents of MGS2 have identified the Corridor B route to be important for koalas and other wildlife through the proposed development. A conceptual drawing of a possible Appin Road underpass crossing has been provided to the Panel, with the crossing emerging adjacent to (not within) the Beulah site. The Panel finds that this is a well-conceived structure and is likely to be used by koalas. Should planning activities continue to progress, the Panel believes that discussions with Transport for NSW (TfNSW) should occur to gain more detail of the specific requirements for the site on Appin Road including road uses and utilities associated with the roadway.

The Panel agrees that the protection of habitat along Woodhouse Creek to secure corridors is fundamental to the viability of the corridor. However, the Panel disagrees that post-and-rail fences should be used between the koala habitat and the suburban landscape which includes a range of threats and stressors for koalas. This will not reduce threats at the koala habitat-urban interface. The Panel finds that here, as with other locations in the landscape, exclusion fencing should be used to separate koalas from threats and hazards. Koala exclusion fencing can successfully prevent koalas leaving the corridor and walking onto

roads and meeting neighbourhood dogs. Exclusion fencing will also prevent dogs from entering the habitat.

The Panel finds that the functional roles of Asset Protection Zones (APZ) and of buffer zones to protect koalas are different, and as such need to be differentiated in the design of the interface. APZs serve a role of protecting people and property from bushfire hazard, while buffers associated with koala protection reduce the impact of threats, light and noise on koalas. The goal being to reduce stress on koalas which has general health benefits and impacts on mortality and breeding rates. For this reason, the Panel finds that buffers should be more clearly defined in MGS2 material in terms of their purpose, with buffers being in place on both sides of the corridor and be in addition to APZs (see Figure 10).

As a general rule for this Review, in this region with growing urbanisation and an additional 110,000 human inhabitants, buffers should be at least 30 m wide from the edge of existing corridor habitat, occur on both sides of the corridor, and have exclusion fencing at their edge, with koala feed trees allowed to grow to the fence, with a suitable distance between trees and fencing to prevent fallen boughs creating damage to the fence.

The APZ should be in the development footprint, not the koala corridor/buffer, and the APZ should be on the development side of the exclusion fence. The APZ, unlike the buffer, could accommodate roadways and parks. People would be permitted into the koala buffer, but dogs would be prohibited from entering through the exclusion fence area.

Not all locations will accommodate exclusion fencing, with steep terrain being incompatible. In these cases where exclusion fencing is not achievable, then a wider koala buffer (~60 m) should be established that does not include koala food trees. While the buffer in this case is designed to both discourage koalas from passing through it to reach the development footprint, it is also designed to keep stressors such as light and noise from disturbing and possibly stressing koalas and other threats at a greater distance. Therefore, these buffers should not have roads, playgrounds or picnic areas included in their boundaries, and dogs should not be permitted. The buffer will need monitoring in place to identify incursion by dogs. The APZ (bushfire protection) here, as with other locations, should be considered additional to the buffer, but could include structures such as roads and playgrounds etc. Where a road is passing in the vicinity of a koala corridor where there is no exclusion fencing, then the vehicle speed limit should be reduced to a maximum of 40 km/h, and with the installation of traffic calming devices and signage.

A number of different reports have been produced over time that aim to provide measurements for the scale or width of corridors – these are summarised and discussed in Chapter 2. These analyses tend to calculate the average width of a corridor over an area, and range from 300 m to 425 m. Every opportunity to maintain or increase the width of corridors should be taken and work to understand whether there is a minimum width to make a viable corridor, as well as how this minimum is affected by vegetation density of the corridor and urban density of the surrounding developments. The Panel notes that some stakeholders have recommended a minimum width of 200m. It is noted that within MGS2, in both Corridor A and B, there are locations with narrow widths – including 85 m in Corridor A and 115 m in Corridor B. Efforts to widen the habitat in these areas is important and this could contribute to addressing any koala habitat offset deficits (koala credits) if possible.

It is noted that koalas move through a range of different densities of habitat including between trees in open ground. The Panel notes that due to the range of linear infrastructure running perpendicular to the corridors through the GMGA, for gas and electricity transmission, where vegetation is generally absent, koalas will have to travers these areas. The Panel finds that this could create a location of increased risk from predators, if these easements are not as well fenced as the corridor areas. The Panel would see great merit in proponents looking to options, in discussion with TransGrid (transmission) and Jemena (natural gas) as appropriate, for installing gates in these areas to enable access to pipes and

wires in the corridor while preventing dog incursion. Monitoring in these areas for threats and population response may be required for adaptive management.

As addressed above, the importance of the Mount Gilead site to the east-west movement of koalas is amplified by its location at the north end of the Nepean corridor. Koalas currently can move through the landscape in an easterly direction towards the Georges River. However, once housing development occurs along the western flank of the MGS2 site, the route for koalas to move east or west will be through a narrow strip of habitat at the confluence of the Nepean River and Menangle Creek. However, the Panel notes that planning for future transport corridors (Figure 1) includes an indicative transport corridor to potentially run through this strip of habitat, while the MGS2 biodiversity certification application and conceptual plans illustrate (Figure 2 and Figure 8) this habitat being potentially surrounded by three roads. The biodiversity certification application notes two elevated bridge crossings and possibly a third, designed to maintain vegetation and koala movement. Some clarity needs to be provided as to the vision for this linking habitat, including whether all three bridges would be built at the same time, and some insights into whether koalas would use this area of the landscape with this density of infrastructure. The Panel notes that other wildlife also benefit from corridors. If koalas don't use this connection, options may potentially be needed to confirm the ongoing viability of the link between Corridor B and the northern end of the Nepean Corridor at Menangle Creek.

### **Corridor C – Nepean Creek to Beulah (east west), Mount Gilead development and draft CPCP plans**

Should Corridor B become secured, the relative importance of Corridor C is reduced in terms of its function in connecting the Beulah Biobank site to the northern end of the Nepean Corridor. Notwithstanding this, the biodiversity certification application does identify the koala movement corridor along Corridor C, as well as the Mallaty Creek Corridor D with widths ranging from 100-200 m. However, if koala connectivity at the Nepean River and Menangle Creek confluence is temporarily or permanently broken (during the construction of the bridges, or if koalas do not use them), the role of Corridor C will need to be revisited, as it would provide other possible linkages between Beulah and the Nepean River. It is acknowledged that linear infrastructure currently does, and is further planned to, transect Corridor C, so an assessment would need to be made as to which corridor and infrastructure would be more accommodating to koala habitat. The level of protection offered to Corridor C will depend on its eventual role vis-à-vis a temporary or permanent linkage to the Nepean. However, until that connectivity issue is resolved, the Panel finds it sensible to preserve the habitat in Corridor C, monitor koala population dynamics and threats, and have management actions informed by this monitoring.

This corridor provides an example of where planning considerations across both MGS2 and CPCP need to be considered jointly, as decisions in one footprint impact the relative priority of approaches in the other planning area.

### **Corridor D – Mallaty Creek to Georges River (east west), CPCP plans**

Corridor D is similar to Corridor C in that its potential importance is dependent on connectivity scenarios that will play out in another corridor. Corridor E contains a large area of koala habitat that reaches east toward Appin Road, but where there is nevertheless a potential barrier to linking across Appin Road. Corridor D has fewer barriers to crossing Appin Road and therefore may provide a more achievable crossing. In discussions with Department officials, their preferred approach would be to secure a Corridor E crossing and have that be designated as the koala corridor.

Therefore, the Panel finds that there are benefits to preserving Corridor D as koala corridor until and unless a Corridor E crossing can be guaranteed. This would require an under-road solution at Corridor E under Appin Road such as a culvert, a structure type that koalas are known to use. Once clarity about crossing feasibility and functionality at Corridor E is

decided, then further decisions can be taken on the long-term role of Corridor D for koala movement.

In the event that Corridor D is designated as the koala corridor for east-west movement, then the approach described above should be deployed, with exclusion fencing between the corridor buffer and APZ, where the APZ is outside the exclusion fencing in the development footprint, and koala feed trees can extend to the exclusion fence (with a setback to avoid damage). Where exclusion fencing is not feasible a wider 60 m buffer should be installed, separate to the APZ, where non-feed trees are used in the buffer, and where nearby traffic has a maximum 40km/h speed limit. Monitoring for population dynamics, threats and other attributes to inform management decisions, such as mitigations or active management of populations. Corridor D is narrower than E, and some replanting in D would be needed to increase the width of the corridor, as it only approximately 200 m – 300 m wide, rather than the average 390 m to 425 m proposed by stakeholders. The use of this new habitat as BSA offsets could be explored if this scenario were to play out.

### **Corridor E – Ousedale Creek (east-west), CPCP plans**

Corridor E is the preferred east-west link for the areas in the draft CPCP plans, because it has the most habitat. As discussed above, there are questions about habitat being extended to Appin Road, due to the numerous suburban and rural properties between the habitat edge and road surface, on both the east and west sides. The Panel agrees that discussions with TfNSW on these potential crossings at D and E should occur early in the planning phase before any final decisions regarding primary Corridor designation are made between Corridors D and E.

The Panel agrees that the same approaches to separating koalas from threats should be deployed across the landscape. The team developing the CPCP has mapped the terrain and feasibility of deploying fences, which shows minimal locations where fences are not feasible for Corridor E. The Panel recognises that fencing construction and upkeep is not a trivial cost, so where possible fencing should be laid in a relatively straight line to minimise its length between two points and minimise costs and improve the feasibility of maintenance. As with other locations, the design of buffers should take into account the presence /absence of koala exclusion fencing, and the distance to local roads, and with the APZ outside of the exclusion fence. Monitoring of population dynamics, animal health, threats should be undertaken and inform decision making. Active management of koalas, including to improve genetic health through breeding and relocation/translocation and pest control will also, in combination with habitat protection, connectivity across the landscape and separation from threats provide the koalas with the best chance of their population growing in this corridor.

### **Corridor F – Elladale Creek and Simpsons Creek to the colliery (east-west), CPCP plans**

While Corridor F contains a considerable area of koala habitat that enhances the functionality of the Nepean River Corridor to support koala populations, it does not provide a link towards the east. Therefore, the Panel agrees with the draft CPCP preferred approach for the koalas in this area to be protected from threats using exclusion fencing and buffers, as described above, and could include some replanting efforts to infill habitat in order to reduce the edge:area ratio. Active management would be required here, given the lack of multiple exits to the corridor, so as to prevent it becoming a population sink should predators or fire become an issue within the corridor.

### **Construction**

Early implementation of koala habitat planting can lead to trees being at a more mature stage by the time they are needed for mitigation purposes. The region-wide planning approach occurring at the beginning of the process for the GMGA aids this preparedness.

A Construction Environmental Management Plan (CEMP) and a Koala Management Plan (KMP) should be developed by the proponent and approved through a Commonwealth process. This would include processes to protect koalas during construction and operational phases of the development. Material provided by the proponent indicates that an onsite ecologist would be present through the duration of pre-clearance surveys and clearing works, tree-felling protocols would be used, and education programs for construction workers would be provided etc.

Some complex areas with multiple civil construction developments have been identified in this Review, which interface with the dwelling development footprints and the environmental lands. These areas, such as that described at the Menangle Creek and Nepean River confluence, need to be carefully planned to enable ongoing connectivity to be provided between the Georges River and the Nepean River, some scenario fallback positions have been identified by the Panel. Similarly, the selection of preferred east-west corridors is dependent on securing a suitable connection across Appin Road, as is the role of the Noorumba Biobank site – will it be a part of a functional Corridor A (with an Appin Road crossing) or an enclosed actively managed site (without an Appin Road crossing)? All these issues and their implications need to be considered at a regional scale across the GMGA and over the timeframe for development.

### **Suburban design**

The Panel has also reviewed the approach to urban design to better provide for safe koala habitation. The Panel agrees with the proposed approaches of not including koala food tree species in backyards and streetscapes, as they can be an attractant to koalas to leave their domain and enter higher risk areas (especially for urban development at the densities proposed). The Panel heard of experiences further north in Campbelltown where a small group of three female koalas is understood to inhabit bushland, that is separated from other bush by human residences. However, this site, the Panel understands, is also a location for a high number of koala deaths as young koalas are likely to disperse from this habitat to reach the distant feed trees.

Proposed rules for fences in suburban backyards to prevent escape of dogs and entry of koalas is important, as are other mitigations proposed such as ropes to assist koalas to escape from backyard swimming pools.

MGS2 has proposed speed limits of 50km/h on local roads. The Panel agrees that this would be suitable provided koala exclusion fencing is deployed. For those locations where exclusion fencing is not in place and only buffers are used, then a speed limit of 40km/h should be set and traffic calming (speedhumps, chicanes, signs) be used.

### **Adaptive and active management**

While planning over a large regional area provides a more holistic perspective of how communities, environment and infrastructure will function and interact, the long timeframes and complex interdependencies mean that there is still uncertainty. To manage this uncertainty, as it relates to decisions about protecting koalas and their habitat in the context of the urbanisation of the GMGA, the Panel supports the principle of utilising adaptive management strategies to guide risk management and to improve practice. This is also one of the seven principles for the draft Koala Plan of Management Guidelines as part of the new Biodiversity and Conservation SEPP 2021. Adaptive management relies on the ongoing collection of information and data that informs future decisions about management, responding to threats as they emerge for acute issues, or changing the direction of management approaches to address longer term threats. This relies on appropriately targeted monitoring activities and the development of thresholds and targets and triggers to guide decisions.

In line with the approach recommended in the NSW Koala Strategy and elaborated in the draft NSW Koala Monitoring Framework, the Panel finds that monitoring efforts ranging from the deployment of monitoring devices to community surveys can all play a role in growing

the information available for decisions. Monitoring should be undertaken at the koala population level, and on a site by site basis. Developers should fund the cost of this activity. The Panel has noted the concept of a 'monitoring trust' for the GMGA to support efforts into the future.

Monitoring informs decision making in the short and long-term, to address acute threats and to improve design and management practices for subsequent rolling construction and development phases for future suburb development stages. Efforts can include: population monitoring (dynamics); genetics sampling; disease monitoring; tests for chlamydia; predator threat monitoring (including at the entrances of bridges and underpasses); infrastructure integrity (holes in fences); movement trackers (predators); location sensors – movement of koalas through landscape; koala counting and surveys; the monitoring of mitigation effectiveness.

These can inform management decisions, including active management programs which are important where a population is isolated in a fragmented patch of habitat. Management decisions can include: vaccinations; fence repair; predator capture; relocation, translocation for breeding and gene dispersal; and education and social engagement programs.

Catch and release efforts with koalas can enable health checks, genetic sampling, vaccination for chlamydia and possibly koala retrovirus (KoRV), and the attachment of sensors to monitor the movement of koalas through the landscape.

Monitoring can also provide insights into how the response of koalas to landscapes change over time and generations, including changes in use of landscape, or whether different character traits of koalas emerge such as being more resilient and less stressed to urban growth. Such information can be used to inform other planning and development proposals into the future.

Reporting data and information once data is collected, and analysed against triggers for adaptive management, should then be reported in the public literature as soon as possible but within three years. Tissue sample collection should be provided to the NSW Koala Biobank.

The recent 2019/2020 bushfires, including in nearby regions to the Campbelltown koala population such as Balmoral, highlight the importance of management of the bushland to reduce the chance and intensity of fires, although it is noted that the close proximity of these corridors to human inhabitants will mean that particular focus on fire prevention will already be in place.

## **Recommendations**

### **Recommendation 1 – Georges River Koala Reserve**

The Georges River Koala Reserve should be protected and revegetated as set out in the draft CPCP, ensuring that revegetation is undertaken in such a manner as to ensure long term sustainability (i.e. species are planted to maintain genetic diversity and minimise kinship to ensure reproduction). Connectivity and threats should be considered within this corridor. Fencing should be placed on Appin Road and a connectivity structure be developed with the bridge over the Georges River.

### **Recommendation 2 – Connectivity and habitat**

East-west corridors within the Greater Macarthur Growth Area can provide connectivity and biodiversity values for flora and fauna species. Not all the identified corridors are suitable to provide connectivity for koalas, but the habitat should be protected for koala habitat, biodiversity values and amenity in the region.

- a) Within the proposed Mount Gilead development:
  - The Menangle Creek to Noorumba Reserve corridor (A) should be used for koala movement if:



- a connectivity structure can feasibly be constructed on Appin Road. The proposed tree-top bridge is not likely to be adequate and would not be used by koalas. A land bridge should be considered to allow koalas and other fauna to cross Appin Road, an example of this is being developed for wallabies at Mona Vale.
  - If the crossing is not feasible, the koala habitat at Noorumba will be isolated and not function as connected koala habitat, therefore should be fenced off at Appin Road. In this case, the koalas within this fragmented area will need to be actively managed.
  - The Woodhouse Creek to Beulah corridor (B) is an important northern connection for the koala population between the Georges River Reserve and the Nepean Corridor and should be retained. The proposed measures to protect the habitat in the corridor are currently not adequate and should be improved with the measures outlined in c). The underpass near Beulah as proposed by Lendlease should be constructed.
  - Close attention should be paid to test the feasibility of the design of the koala connectivity at the confluence of Menangle Creek and Nepean River, near the Hume Highway and possibly under three bridges.
- b) Within the Greater Macarthur Growth Area covered in the draft Cumberland Plain Conservation Plan:
- The Ouesdale Creek to Appin North Corridor (E) should be secured as the east – west corridor to connect the Georges River Reserve and Nepean Corridors. A suitable crossing structure (e.g. culvert) should be constructed at Appin Road.
  - The Mallaty Creek to Georges River Corridor (D) should be fenced if feasible and protected in the event that suitable land cannot be purchased to finalise corridor E. If a crossing at E cannot be progressed, then an underpass across Appin Road should be developed at Corridor D. The measures to protect the corridors as in c) should be applied.
  - If a crossing at Corridor E is secured and crossing at Appin Road for Corridor D not pursued, then a decision would need to be made based on the risk/benefits of maintaining the koalas and mitigation measures in Corridor D without a crossing at Appin Road.
  - The habitat in Corridor F should be protected including with exclusion fencing to minimise risks from threats, and with monitoring of risks to avoid a population sink.
- c) Habitat within identified corridors should be:
- protected (especially from development creep)
  - widened through revegetation (average size 390 to 425 m)
  - include a buffer on either side of the corridor habitat that is at least 30 m wide from the corridor to the exclusion fence with feed trees permitted in this buffer area
  - include, between the buffer area and the urban areas, koala proof fencing to prevent the movement of koalas out of the corridor into urban areas (with trees more than 3 m from the fencing to avoid damage) and the movement of domestic dogs (amongst other potential threats) into the corridor
  - for sites where exclusion fencing is infeasible due to steep terrain, then additional buffer width should be utilised (buffer ~60 m), with a traffic speed limit of 40 km/h and predator / dog monitoring
  - asset protection zone is outside the exclusion fencing, within the development footprint

Further, connectivity structures within corridors should also be assessed including local roads and other infrastructure (e.g. the Upper Canal).

### **Recommendation 3 – Monitoring and adaptive management**

Monitoring should be undertaken to enable adaptive management of the koala population in the proposed Mount Gilead Stage 2 development and in the draft Cumberland Plain Conservation Plan.

This monitoring should:

- be consistent across the region to ensure data and adaptive management strategy outcomes are comparable
- include trigger levels that enable actions for adaptive management e.g. increased vehicle strikes, increased dog attacks or disease prevalence. (As part of the planning process, targets should be set to gauge success.)
- align with best practice and the NSW Koala Monitoring Framework (as part of the NSW Koala Strategy) and data made available through the SEED portal and any tissue samples provided to the NSW Koala Biobank
- be funded by developers through the establishment of a monitoring trust
- monitor the movement of koalas in the region and understand use of the corridors and connectivity structures, the NSW Government should investigate the development of implantable sensor technologies, such as through the NSW Smart Sensing Network.

### **Recommendation 4 – disease prevention**

Koalas that are captured and/or handled as part of a monitoring program or those that are rehabilitated and released back into the Campbelltown population should be vaccinated against chlamydia. If a joint vaccine for chlamydia and KoRV is available this should be used. Koalas with no microchip or other identifying features that are captured should have a tissue sample taken for genetic analysis, with the tissue samples lodged with the NSW Koala Biobank.

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# 1 INTRODUCTION

On 9 December 2019, the Minister for Energy and Environment and the Minister for Planning and Public Spaces requested that the Deputy Chief Scientist & Engineer chair an independent expert panel (the Panel) to provide advice regarding the protection of the Campbelltown koala population.

This advice was to include:

- The adequacy of the proposed measures, by the property group Lendlease, for koala conservation on the land referred to as Mount Gilead Stage 2 (MGS2) and the consistency of these measures with the NSW Koala Strategy (the Strategy)
- What, if any, additional conservation measures are considered necessary
- What, if any, site specific measures for koala species should be incorporated into the Cumberland Plain Conservation Plan (CPCP) for the Greater Macarthur Growth Area (GMGA) to support the long-term viability of the koala population.
- Whether east-west corridors linking the Nepean and Georges Rivers can contribute to the conservation of the Campbelltown Koala population; and if so, which east-west corridors and what measures should be taken to ensure their effectiveness.

The full Terms of Reference are at Appendix 1.

This report constitutes the Panel's advice on the Terms of Reference and provides a review of the adequacy of the proposed protection measures for koalas as part of the MGS2 development and the draft CPCP plans viewed by the Panel to date. 'Adequacy' in the Panel's report has been defined in terms of the objective of the NSW Koala Strategy to "*stabilise and then increase koala numbers over the longer-term, ensuring genetically diverse and viable populations across New South Wales*"(NSW Government, 2018).

The Panel has assessed the measures to protect koalas in the GMGA considering those proposed in the biodiversity certification application for MGS2 and in the draft CPCP documentation to ensure a consistent approach in the region.

This report provides recommendations to improve the proposed measures and considers a range of possible scenarios for the mitigation approaches proposed, given constraints including those that are financial and geographic in nature. An adaptive management approach is identified as crucial, with consideration of data collection and monitoring requirements, to ensure and demonstrate the effectiveness of mitigation strategies.

This chapter provides an overview of proposed urban development in the GMGA, as well as relevant legislation and guidelines, an overview of the Campbelltown Koala population and a description of threats and impacts to koala populations from urbanisation.

## 1.1 DEVELOPMENT IN GREATER MACARTHUR

The population of Greater Sydney is growing and is expected to reach 8 million people by 2038, with the population of Campbelltown growing from 740,000 in 2016 to 1.1 million by 2036 to over 1.5 million by 2056 (DPIE, 2020a; GSC, 2020). The *Greater Sydney Region Plan: A Metropolis of Three Cities* (GSC, 2018), developed by the Greater Sydney Commission, provides a vision to support the growing population of Sydney dividing the region into three cities – the Western Parkland City, Central River City and the Eastern Harbour City.

The Western Sydney City Deal, signed in March 2018, is a partnership between the Commonwealth Government, NSW Government and eight local governments (Blue

Mountains, Camden, Campbelltown, Fairfield, Hawkesbury, Liverpool, Penrith and Wollondilly) to deliver the Western Sydney Parkland City (WSCD, 2020). The Deal includes measures to improve transport and connectivity, education, the environment, jobs and housing.

In November 2018, the NSW Department of Planning and Environment (now the Department of Planning, Industry and Environment, 'the Department') released *Greater Macarthur 2040 – An interim plan for the Greater Macarthur Growth Area*, a land use and infrastructure implementation plan for future development in the region (DPIE, 2018). Greater Macarthur 2040 includes a draft Structure Plan and responds to the NSW Government's commitment that land east of Appin Road will be retained as Environmental Conservation and for a koala reserve. The proposed structure plan for the GMGA is at Figure 1.

In 2019, the NSW Government declared Greater Macarthur as a Growth Area and amended the *State Environment Planning Policy (Sydney Region Growth Centres) 2006* to reflect this declaration (DPIE, 2020b). A planning principle of the *Greater Macarthur 2040* is that "conservation of biodiversity and koala colonies will be at the heart of the Growth Area". The Department is finalising *Greater Macarthur 2040* in response to feedback from the community and proposes to update the Structure Plan to align with the final CSCP and its conservation boundaries.

An estimated 39,000 new homes are proposed in the land release area of Greater Macarthur, (15,000 in North Gilead Precinct (of which, 1,700 is already re zoned), 4,000 in Menangle Park, 5,000 in North Appin and 15,000 in Appin) , and will also include new town centres, retail and commercial services, improved transport corridor and schools (DPIE, 2018). This will change this area from a peri-urban and rural area to urban, with the population increasing from ~3,000 to ~109,000 people when the region is developed (DPIE, 2018).<sup>1</sup>

Under the Western Sydney City Deal, there is a commitment for strategic assessment under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) to protect the environment and streamline environmental approvals for development (NSW Government, 2020a). This includes the GMGA as well as the Greater Penrith to Easter Creek Investigation Area, Western Sydney Aerotropolis and the Wilton Growth Area. The CSCP is being developed by the Department to conduct strategic assessment under the EPBC Act as well as identifying the areas within the growth areas that will be certified for development under the NSW *Biodiversity Conservation Act 2016* (BC Act).

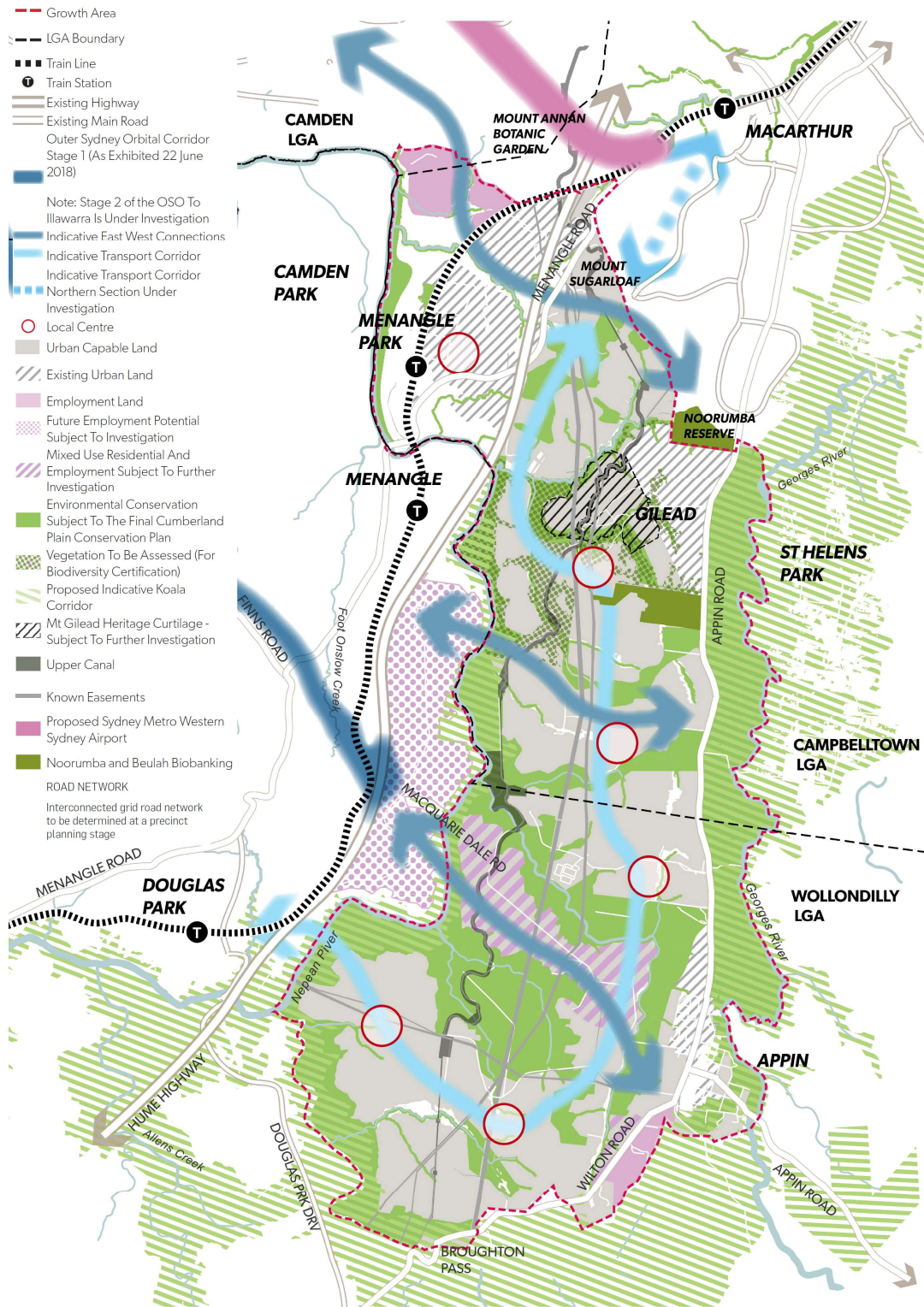
The Mount Gilead development has been proposed as two stages – Stage 1 (MGS1) and Stage 2 (MGS2). Lendlease Communities Pty Ltd (Lendlease) has proposed a second stage residential development in Gilead (Stage 2) within the GMGA, and which is the subject of this review. Lendlease's Stage 1 development also known as Mount Gilead, and is already rezoned for urban development, is being marketed by Lendlease as Figtree Hill (Lendlease, 2020a). Within the GMGA, biodiversity certification for Stage 1 Gilead was initiated prior to the start of the strategic assessment. Both MGS1 and MGS2 sites are not within the area subject to the draft CSCP, and due to legislative transitional arrangements will be assessed under the NSW *Threatened Species Conservation Act 1995* (TSC Act). Note, both stages of the development are subject to assessment and approval under the EPBC Act.

In July 2018, Campbelltown City Council as the planning authority, applied for Biodiversity Certification of the MGS1 land on behalf of Lendlease and certification was conferred in June 2019. In August 2019, Campbelltown City Council, on behalf of Lendlease, Campbelltown Council applied for Biodiversity Certification of land in MGS2.

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<sup>1</sup> This is based on 39,000 homes and an estimated average household of 2.8 people (DPIE, 2020e)





**Figure 1: Proposed structure plan for the Greater Macarthur Growth Area**

Source: DPIE (2018)

### 1.1.1 Draft Cumberland Plain Conservation Plan

The Department has undertaken strategic conservation planning to develop the CPCP in response to the rapid growth of Western Sydney. The Plan is being developed to address strategic biodiversity certification provisions under the BC Act and strategic assessment under the EPBC Act, identifying strategically important biodiversity areas within the Cumberland subregion to offset the biodiversity impacts of future urban development. It aims to facilitate the biodiversity approvals required to deliver four Western Sydney growth areas and supporting major transport infrastructure.

Three sub-plans are included to provide details on the implementation of the CPCP, and actions to deliver its commitments. These are:

- Sub-Plan A: Conservation Program and Implementation – the proposed conservation program and its implementation as well as how the Plan will meet its vision and objectives
- Sub-Plan B: Evaluation – the monitoring, evaluation and reporting framework, and how adaptive management will ensure the ongoing effectiveness of the conservation program
- Sub-Plan C: Koalas – protection of the koala population in Western Sydney and how the Plan supports other government initiatives to protect koalas.

A *Cumberland Plain Assessment Report* has been prepared for the Department (Biosis & Open Lines Environmental Consulting, 2020). The report provides the Biodiversity Conservation Assessment Report (BCAR) (in accordance with the BC Act) and a Strategic Assessment Impact Report (under the EPBC Act). It is noted in this report that *“As the proposed development has been determined by the NSW Environment Minister to be considered for approval under a ‘strategic biodiversity certification’, the offset rules under the BC Regulation do not apply and the Minister can determine any measure to be a conservation measure”*.

The Koala Sub-Plan provides a number of specific commitments and actions for protecting the koala population from development in the Wilton and GMGA (NSW Government, 2020c). The conservation program for koalas will:

- establish the Georges River Koala Reserve east of Appin Road from Kentlyn through to Appin protecting up 1,800 ha of koala habitat and movement corridors (including ecological restoration)
- protect vegetation through environmental zoning in potential east-west koala movement corridors between the Georges and Nepean Rivers
- ecological restoration of koala habitat within the CPCP’s strategic conservation area
- mitigate indirect and prescribed impacts from urban and transport development on koalas including exclusion fencing
- manage landscape threats e.g. fire, weed and pest management
- building capacity and supporting stakeholders, including leveraging existing programs including the NSW Koala Strategy and SoS to raise community awareness, undertake research and support koala health and welfare

The CPCP also includes a monitoring and adaptive management plan. Specific measures in the draft CPCP are discussed in their relevant sections in Chapter 2.

### 1.1.2 Mount Gilead Stage 2 development

The proposed MGS2 development is a 332.17 ha urban development project (total area of MGS2, including native vegetation, is 672.57 ha), west of Appin Road and the approved

MGS1 development (Figure 2). Figure 3 shows a master plan for both stages of the development. The site is in the area identified for future growth as part of the GMGA. The proposed development includes low and medium residential development<sup>2</sup> with associated infrastructure, retail, educational facilities, public spaces, active and passive open spaces and conservation lands. MGS2 is expected to deliver 4,500 lots and is proposed to commence from 2024 and take up to 10 years to complete over 7 stages.

The proposed development site is bound by the Nepean River and Hume Highway/ Motorway to the west, rural land to the north and south and the approved MGS1 to the east. The Upper Canal<sup>3</sup> runs through the site as well as easements for electricity and the eastern gas pipeline. The Woodhouse, Nepean and Menangle Creeks flow north and west through the site to the Nepean River. The south east site boundary abuts the Beulah Biobank site and there are several registered Biobank sites to the west as a part of MGS1 and the Noorumba Reserve in the north east.

The site contains remnant patches of native vegetation, heavily vegetated riparian corridors and gullies, and agricultural land that has a long history of disturbance associated with cattle grazing and horse agistments since the 1850's. The site is currently zoned rural and is used for pivot irrigation, cropping, cattle grazing and horse agistment. Despite the history of anthropogenic land use, koalas still persist in this area and use it as a corridor.

The native vegetation communities are comprised of five biometric vegetation types, which include two listed as endangered ecological communities under the TSC Act and the EPBC Act (Cumberland Plain woodland, and Shale Sandstone Transition forest) and one listed as endangered under the TSC Act and is being considered for a listing under the EPBC Act. There are also five flora and fauna species that have been assessed under the BCAM due to impacts on habitat: the koala, squirrel glider, Cumberland Plain land snail, southern Myotis and the hairy-stemmed shrub brown pomaderris (*Pomaderris brunnea*).

A MGS2 Biocertification Assessment Report (BCAR) and Biodiversity Certification Strategy have been prepared for Lendlease by Eco Logical Australia, and is being used to seek biodiversity certification for the proposed development. This was submitted by Campbelltown City Council to the Department in August 2019 and will be assessed using the BC Act transitional arrangements, meaning that it will still be assessed by a BCAM under the TSC Act. The BCAM determines whether biodiversity certification will improve or maintain biodiversity values. i.e. the method to assess loss of biodiversity values on the land proposed for certification and the impact of the proposed conservation measures.

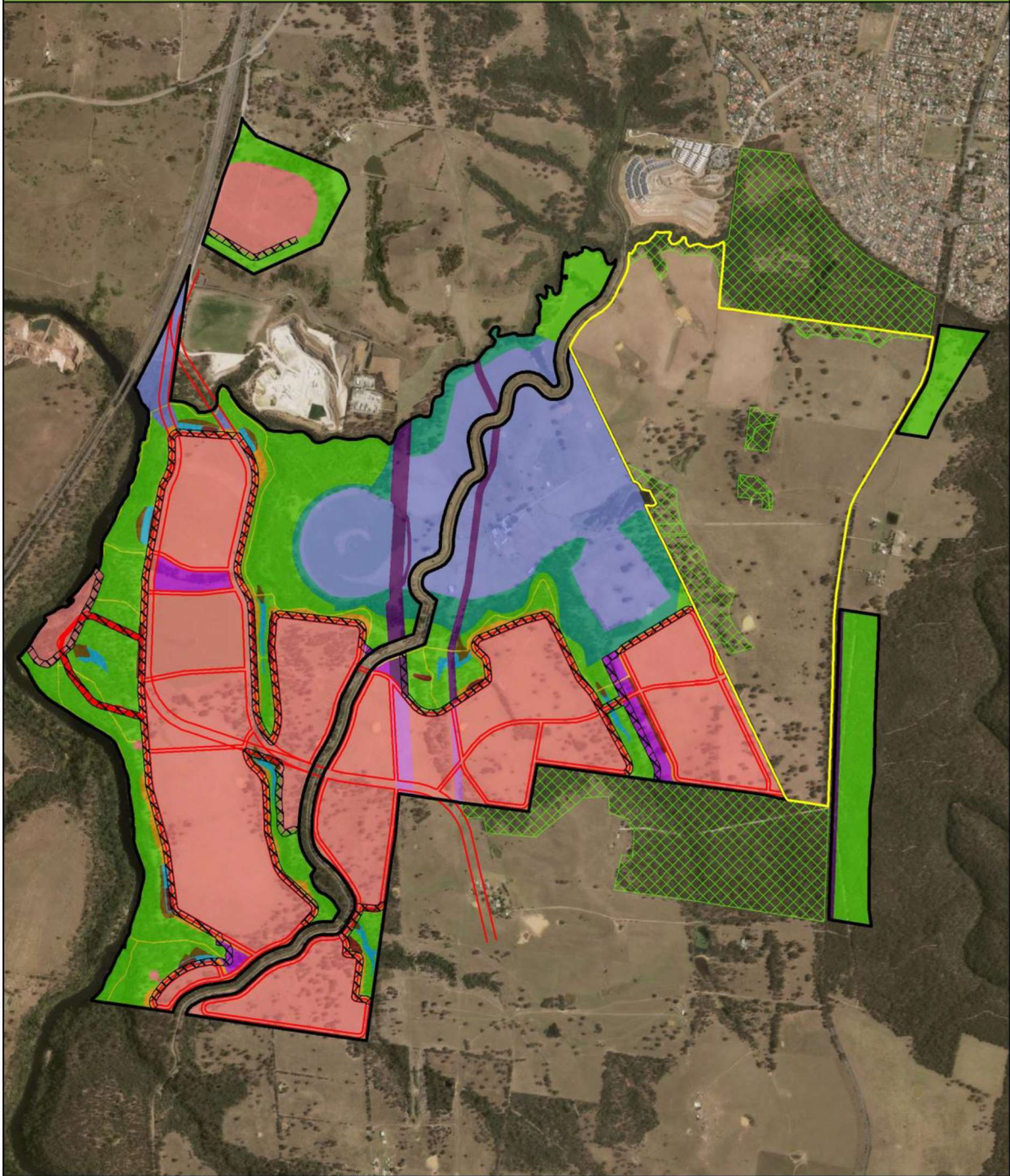
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<sup>2</sup> Low density is 15 - 25 dwellings/ha and medium density is 25 - 35 dwellings/ha

<sup>3</sup> The Upper Canal was built in the 1880s and is still the only way of transferring water to Sydney from the four Upper Nepean dams (Cataract, Cordeaux, Avon and Nepean) (WaterNSW, 2020). The system is managed by the Sydney Catchment Authority on behalf of WaterNSW and is listed on the NSW State Heritage Register, which means The Upper Canal is protected by the Heritage Act 1977 and its 2010 amendments (DPIE, 2020g).



**Biodiversity Certification Assessment Area**



<b>Legend</b>				0 150 300 600 Metres
Biodiversity Certification Assessment Area Stage 2	Development	Conservation	Retained	Datum/Projection: GDA 1994 MGA Zone 56
Mt Gilead Stage 1	Asset Protection Zone	Conservation (Homestead)	Local Open Space	
Red Flag EEC Buffer	Bio-Retention Basin	Online Detention Basin	Existing Easement	<b>eco logical</b> AUSTRALIA A TETRA TECH COMPANY Prepared by: MF Date: 2/07/2019
Existing Conservation Areas	Easement - Development	Online Detention Basin Embankment		
Roads	Walking Track			

**Figure 2: Mount Gilead Stage 2 Concept Plan**

Source: Eco Logical Australia (2017)





**Figure 3: Mount Gilead Stage 1 and 2 Master Plan**

Source: Lendlease (2020b)

The BCAR states that there 332.17 ha (~50%) of the assessment area that will be directly impacted, of which 76.89 ha is mapped as native vegetation and threatened species habitat (Table 1). The BCAR has estimated that 72.22 ha of koala habitat will be impacted: 6.29 ha of high, 12.78 ha of moderate and 36.19 ha of low-quality habitat.

**Table 1: Mount Gilead Stage 2 BCAR assessment area**

Source: Eco Logical Australia (2017) and Lendlease (2020b)

Area	Size
Total land assessed	627.57 ha
Native vegetation	265.81 ha
Exotic vegetation & cleared land	406.76 ha
Total assessed land impacted	332.17 ha (~50% of total area)
Impacted native vegetation & threatened species habitat	76.89 ha
Koala habitat impacted	72.22 ha
Total assessed permanently protected	201.81 ha (~30% of total area)
Generate ecosystem credit (Biobank)	197.46 ha
Red flag vegetation conservation area buffer	4.35 ha

Permanently protected and managed habitat for conservation totals 201.81 ha (197.46 ha of which will generate ecosystem credits (i.e. Biobanks), the remaining 4.35 ha being a red flag vegetation conservation area buffers), with five Biobanks sites to be registered in the area:

Browns Bush, Mount Gilead Homestead, Woodhouse Creek, Nepean and Medhurst biobank sites.

This includes the restoration of native vegetation (200.42 ha), with 38.9 ha fully restored, 37.21 ha enhanced and 124.31 ha of minor restorations (Lendlease, 2020b).<sup>4</sup> Additionally, 138.59 ha of land will be retained as public open space and existing easements. There is a further 16.96 ha that will be used for establishment of detention basins (1.9 ha), wide bush walking track through the koala habitat (1.05 ha), modification of existing habitat to establish bushfire Asset Protection Zones (APZs) (14.01 ha).

Other specific measures to protect koalas as described in the BCAR and supplementary material provided to the Panel are discussed in relevant sections in Chapter 2.

## **1.2 LEGISLATION, GUIDELINES AND INITIATIVES**

There are a number of Federal and State legislative instruments that apply to the conservation of koalas and their habitat in NSW. This section outlines the specific legislation, guidelines and instruments of relevance to the Panel when considering aspects of MGS2 and the CPCP and is not an exhaustive examination of all legislation related to the protection of koalas.

### **1.2.1 Environment Protection and Biodiversity Conservation Act (1999) [Cth]**

The combined koala populations of Queensland, New South Wales and the Australian Capital Territory are listed as 'vulnerable' under the EPBC Act, requiring project proponents to consider whether their project will have a significant impact on important koala populations in these jurisdictions. If a project has or will have a significant impact, the EPBC Act requires the project to be referred for a decision by the Federal Environment Minister on whether the project is a 'controlled action'. If unsure, project proponents may refer the project to the Minister.

### **1.2.2 Biodiversity Conservation Act 2016 [NSW] and repealed Threatened Species Conservation Act 1995 [NSW]**

The BC Act replaced the repealed TSC Act on 25 August 2017. The BC Act lists koalas as 'vulnerable', due to their decline in numbers from multiple threats (i.e. habitat loss, fragmentation and loss; disease; vehicle strike; predation; etc.), resulting in development proposals that impact koalas being more rigorously assessed. The primary purpose of the BC Act is to "*maintain a healthy, productive and resilient environment for the greatest well-being of the community, now and into the future, consistent with the principles of ecologically sustainable development*" (DPIE, 2019a).

Strategic biodiversity certification (under both the BC Act and repealed TSC Act) identifies, at a regional scale, areas of high conservation value that should be avoided or protected, areas that can be developed (once certified) and measures to offset any potential impact of development. In effect, the strategic biodiversity certification removes the need for site-by-site assessment of the threatened species, populations or ecological communities if any proposed development falls within the biodiversity certified land, as the strategic biodiversity certification examines any biodiversity measures at a landscape scale.<sup>5</sup>

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<sup>4</sup> Full restoration – Cleared land/pasture (low quality habitat) fully restored to high quality habitat. Enhanced restoration – Low quality habitat that will be enhanced to create high quality habitat. Minor restoration – High quality habitat that will be subject to weed and feral animal control to improve and maintain habitat quality.

<sup>5</sup> Under Part 7AA of the TSC Act, this relates to; projects under Part 3A, infrastructure under Part 5.1, development under Part 4 and activities under Part 5 of the *Environmental Planning and Assessment Act 1979* (EP&A Act); and, the *Native Vegetation Act 2003* does not apply

The biodiversity certification scheme under the repealed TSC Act allowed only planning authorities<sup>6</sup> to apply to the Minister of the Environment to have biodiversity certification conferred to an area where the biodiversity outcomes were improved or maintained, with the Biodiversity Certification Assessment Methodology (BCAM) providing the method of assessment.

In establishing the new biodiversity certification scheme, the BC Act allows both planning authorities and individuals to seek certification using the Biodiversity Assessment Method (BAM) for specific types of development proposals, with the aim to prove adequacy of conservation measures to the Minister.<sup>7</sup>

There are transitional arrangements for previous biodiversity certified land under the TSC Act. As set out in the *Biodiversity Conservation (Savings and Transitional) Regulation 2017*, development applications set out prior to the commencement of the BC Act will be considered under the previous legislation (i.e. the TSC Act).

### **Biodiversity Offsets Scheme**

Under the previous TSC Act biobanking allowed for 'biodiversity credits' to be generated on a voluntary basis and sold to the market in order for developers and landowners to offset their impacts on biodiversity. The BC Act, with the associated *Biodiversity Conservation Regulation 2017*, takes a similar approach in establishing the Biodiversity Offset Scheme<sup>8</sup>, a statutory framework to assess the impacts or likely impacts of development and associated native vegetation and habitat clearing activities on biodiversity, moving through a hierarchy of avoiding, minimizing and/or offsetting these impacts (DPIE, 2019b). This Scheme allows for potential adverse impacts on biodiversity at the site of development to be offset by the protection or improvement of the environment at other sites in-perpetuity. Offsets are predicated at both the State and Federal level to be used only when efforts have been made to either avoid or mitigate environmental impacts.

The Scheme establishes biodiversity stewardship sites (via agreements between the landholder and the Minister), the creation of biodiversity credits and a system for these to be traded, prescriptions for biodiversity impact assessments and reports by accredited persons, and the establishment of the BAM.<sup>9</sup>

The BAM provides a consistent method for biodiversity assessment on sites to be developed and/or cleared, guidance on avoiding or minimizing potential impacts on biodiversity, and the residual number and class of credits (either ecosystem or species credits) that are required to be offset to achieve an outcome of 'no net loss' of biodiversity. The BAM is applied by an accredited assessor and is informed by the Biodiversity Assessment Method Operational Manual and the metrics within. This leads to the development of Biodiversity Development Assessment Reports (BDARs), Biodiversity Certification Assessment Reports (BCARs) and Biodiversity Stewardship Site Assessment Reports, depending on the intent of the proponent.

It is the BDAR/BCAR that is submitted as a component of the application for development, with the BCAR usually reserved for larger, multi-staged development proposals.

The BAM is also used to assess the establishment of an area as a biodiversity stewardship site that generates offset credits for the landholder to sell to those who need to purchase credits to offset their impacts. Similar to the BDAR/BCAR, a Biodiversity Stewardship Site Assessment Report is developed that outlines the class (species or ecosystem credits) and

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<sup>6</sup> A planning authority under the TSC Act means the Minister for Planning, local councils, a determining authority, the Secretary of the Department of Planning and Environment, or any other person or body declared by the regulations to be a planning authority

<sup>7</sup> Development proposals include those identified in the EP&A Act (Part 4, Part 5), BC Act (Part 5 Activity, Div. 2, Section 7.14(1), 8.2 and 8.7(1)), *Local Land Services Act 2013* (Part 5A, Div. 6), *SEPP (Vegetation in Non-Rural Areas) 2017*

<sup>8</sup> BC Act, Part 6

<sup>9</sup> BC Act, Part 6, Cl. 6.2



number of credits generated if the site is approved under a Biodiversity Stewardship Agreement (BSA).

BSAs have also replaced BioBanking Agreements that were established under the repealed TSC Act. Existing BioBanking agreements, such as those identified in MGS1 and MGS2, remain in place and will be managed as BSAs by the Biodiversity Conservation Trust (BCT\_.

### **1.2.3 State Environmental Planning Policy (Koala Habitat Protection)**

The listing of koalas as vulnerable means they must be considered under the NSW *Environmental Planning and Assessment Act (1979)* (EP&A Act) when preparing environmental planning instruments and when undertaking development assessments. The EP&A Act is the legislative tool that sets out how planning occurs in NSW, including environmental planning instruments<sup>10</sup> such as State Environmental Planning Policies (SEPPs).<sup>11</sup>

*SEPP (Koala Habitat Planning) 2019* ('Koala SEPP') repealed and replaced the former *SEPP 44 – Koala Habitat Protection* on 1 March 2020, and has two primary aims: to assist in the preparation of Comprehensive Koala Plans of Management (CKPoMs) and to standardize the process for preparing, assessing and implementing development applications for applicants and consenting authorities. The Koala SEPP includes a draft Koala Habitat Protection Guideline, applicable to proponents where land is over 1 hectare and identified on the Koala Development Application Map (if there is no approved council KPOM applying to the land).

### **1.2.4 Campbelltown Comprehensive Koala Plan of Management**

The draft and revised 2018 Campbelltown CKPoM has been prepared in accordance with the NSW Koala Recovery Plan (2008) and SEPP 44 to *“provide for the long-term maintenance of a viable, free-ranging koala population in the Campbelltown LGA”*. The Campbelltown CKPoM aims to enable persistence of a koala population of at least 300 koalas in the area with the increased human population and safeguard the future of the Campbelltown koala population through regulatory and non-regulatory mechanisms (Phillips, 2018). The Panel understands that the Council has submitted the Campbelltown CKPoM to the Department for approval by the Secretary and is currently under consideration, noting that the NSW Government released a new Koala Habitat Protection SEPP March 2020.

### **1.2.5 NSW Koala Strategy and Saving our Species**

The NSW Koala Strategy (the 'Strategy') was released in May 2018. The Strategy responded to the recommendations of the NSW Chief Scientist and Engineer's 2016 *Independent Review into the Decline of Koala Populations in Key Areas of NSW* (CSE, 2016).

The objective of the Strategy is to stabilise and then increase koala numbers over the longer-term, ensuring genetically diverse and viable populations across NSW. The Strategy includes several actions to be undertaken over three years under four pillars: koala habitat conservation, conservation through community action, safety and health of koala populations and building our knowledge.

The Saving our Species (SoS) program in the Department is a statewide program that aims to secure threatened plants and animals in the wild of NSW for 100 years. This program includes the SoS Iconic Koala Project and includes the Southern Highlands Koala Conservation Project to improve habitat and reduce impacts in the region (DPIE, 2020f).

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<sup>10</sup> EP&A Act, Division 3.2

<sup>11</sup> EP&A Act, Division 3.3

## **1.2.6 Inquiry into Koala Populations and Habitat in New South Wales**

On 20 June 2019, an inquiry into Koala Populations and Habitat in New South Wales (the Koala Inquiry) was established in the Legislative Council of the NSW Parliament. The Committee aims to report on actions, policies and funding by the NSW Government to ensure the sustainability of koala populations and habitats in NSW. This includes the examination of key habitat, population trends, and threats; resourcing and adequacy of protections; the effectiveness of current legislative conservation measures and the impact of regulatory reforms and programs (particularly around forestry in NSW); and, understanding the impact of climate change on koalas and their distribution. The inquiry will conduct 10 hearings between 16 August 2019 and 8 April 2020 and is accepting public submissions (Parliament of New South Wales, 2020). The Committee is expected to submit its report by 15 June 2020.

## **1.3 KOALAS IN NEW SOUTH WALES**

Koalas are one of Australia's most iconic species, recognisable around the world and a major tourist attraction (DPIE, 2020c). Historically koalas were distributed throughout the woodlands and forests of NSW, however, they are now threatened across their range from impacts such as habitat loss and fragmentation (such as from urban development and agriculture), vehicle strikes, dog attacks (both domestic and wild dogs), drought, bushfires, disease (e.g. Chlamydia), and climate change (CSE, 2016). Most koala populations in NSW now survive in fragmented and isolated habitat and in many cases are subject to intense development pressures (CSE, 2016). Koalas are listed as 'vulnerable' in NSW and needing protection under both state and federal legislation.<sup>12</sup> Koala numbers and distribution have declined over time, with an estimate of 36,000 koalas in NSW (CSE, 2016; Adams-Hosking, 2017).

The 2019-20 bushfires in NSW were unprecedented in their scale and intensity. The extended 2019-20 bushfire season has devastated a significant area of koala habitat (as at 3 February 2020, over 3.5 million hectares or 25% of moderate to highly suitable koala habitat had been affected) and we are yet to fully understand what the impact has been on koala numbers. A recent report by Lane, Wallis, and Phillips (2020), that analysed koala records and the extent of the bushfire, found that over the preceding three koala generations the NSW koala population has declined by at least 28.52% and may be as large as 65.95%. The report also notes that the ongoing threat of climate change and its associated impacts (e.g. more frequent and intense bushfires) will severely affect koala populations and increase the risk of localised extinction events. Further work is underway to provide a picture of the impact of the bushfires on koala numbers, distribution, demographics and condition.

### **1.3.1 Campbelltown Koala population**

The Campbelltown koala population is a historically continuous population of (Hagan, Phalen, & Close, In prep.) which is one of the few remaining populations in the Sydney region (Phillips, 2020). This population includes koalas in the Campbelltown and Wollondilly Local Government Areas (LGAs). The likely extent of the population has been estimated to be east to the coast, south from Holsworthy until it connects with koalas in the Southern Highlands and some distance to the west (it is unknown if the Hume Highway poses a barrier to movement) (Biosis & Open Lines Environmental Consulting, 2020).

#### **1.3.1.1 Koala Population status and health**

The population is considered to be stable and increasing (Close, Ward, & Phalen, 2017), recovering from historical impacts. The population is small, between 250 and 500 individuals and is found at low density (~0.1 koalas per hectare) (Hagan et al., In prep.). These

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<sup>12</sup> Note legislation and that they are also listed as vulnerable in Queensland and the ACT.

estimates were made prior to the 2019/20 bushfires, however the majority of the region was not affected.

As with many koala populations across Australia, the Campbelltown population is genetically distinct from others. The most closely related population to Campbelltown is the Southern Highlands, showing gene flow between these populations but it is separate from the Blue Mountains population (DPIE, 2020c). Although the Campbelltown population has lower genetic diversity than the Blue Mountains (from 4,606 single-nucleotide polymorphisms, SNPs) it has less inbreeding than the Blue Mountains population indicating gene flow with the Southern Highlands (Kjeldsen et al., 2019).

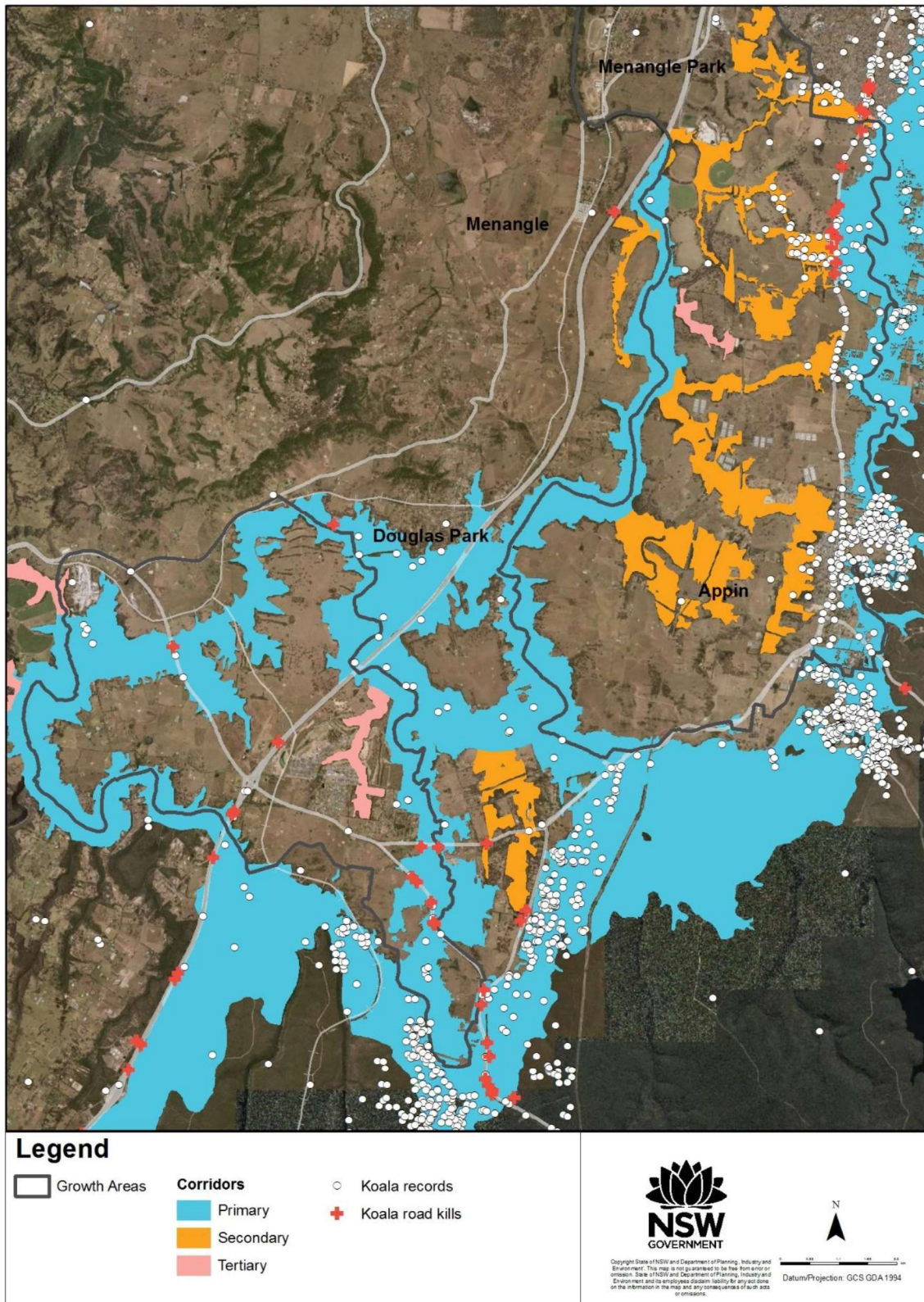
The population has remained relatively free from Chlamydia infection (Hagan et al., In prep.). However, there is widespread infection in the Southern Highlands population, and it is believed that this infection could move north into the population due to connectivity between the populations. The koala retrovirus, KoRV-A is prevalent in the population, however KoRV-B is found at low (Hagan et al., In prep.).

### 1.3.1.2 Local koala habitat

The *Conserving Koalas in the Wollondilly and Campbelltown Local Government Areas* (DPIE, 2019c) identified high-quality koala habitat, core koala habitat, koala movement corridors and koala roadkill hotspots in the region (Figure 4). The report found:

- A long-established association between koala presence and vegetation that grows on high fertility soils, such as shale and shale transition soils and the habitat that is present on these soils are considered high quality habitat.
- There are seven preferred food tree species in the region: grey gum (*Eucalyptus (E.) punctate*), white stringybark (*E. globoidea*), woollybutt (*E. longifolia*), forest red gum (*E. tereticornis*), grey iron bark (*E. paniculata*), blackbutt (*E. pilularis*) and green wattle (*Acacia decurrens*).
- The koala habitat in the region is highly fragmented with large patches of core habitat on the eastern edge of the Cumberland Plain.
- The only other core habitat is the remaining areas of Shale Sandstone transition forest along the Nepean River and its tributaries, but this habitat is more limited in extent and in linear in configuration. There are a number of resident koalas in this habitat and it is therefore thought this habitat is important for koala persistence in the region.

This report also identified primary, secondary and tertiary koala movement corridors that have been determined for the region, based on metrics including the area of core koala habitat it contained, width, and level of connectivity (Figure 4). These are described further in Section 2.3.



**Figure 4: Rankings for koala corridors across the Wilton and Greater Macarthur Growth Areas**

Note that koala records shown are sightings and do not indicate koala densities  
 Source: DPIE (2019c)

## Threats and stressors

The current main threats and stressors to the population are:

- **Habitat fragmentation and loss:** Agriculture and urbanisation has led to the loss and fragmentation of habitat across the region. Local core koala habitat is currently maintaining the population and the rural landscape is permitting koalas to move between these core koala habitats. A principal threat to the biodiversity values of the Cumberland subregion is the further loss and fragmentation of habitat from clearing for urban development and agricultural land uses (DECCW, 2011; Biosis & Open Lines Environmental Consulting, 2020), including illegal clearing. High density residential development, as opposed to the current rural landscape, in much of the area between core habitats will place significant pressure on smaller, narrower corridors that link koala populations.
- **Vehicle strike:** Vehicle strike hotspots occur where roads dissect koala habitat, areas of heavy traffic flow and higher speed limits and along koala dispersal routes. There are a number of identified hotspots along Appin Road (Figure 4). This is currently one of the main reasons for admission (41%) to the Avian, Reptile and Exotic Pet Hospital Camden and the main cause of death for koalas in the area (Hagan et al., In prep.).
- **Dog attacks:** Another main cause for hospital admission (11%), with dispersing males and younger (i.e. less than 3 years of age) koalas subject to greater predation risk by domestic dogs (Hagan et al., In prep.).
- **Disease (*Chlamydia*):** The population is healthy and *Chlamydia* infection has not been detected (Hagan et al., In prep.). However, there is widespread infection in the Southern Highlands population, and it is believed that there is the potential for the infection to move north into the Campbelltown population.
- **Stressors:** light and noise can pose indirect threats to koalas by increasing stress levels which in turn can lead to changed patterns of behavior, avoidance of exposed habitat, increased propensity to disease.

## 1.4 KOALAS AND URBAN DEVELOPMENT

Threats in urban areas for koalas in urban areas include: habitat loss and fragmentation; increased risk of predation by both domestic and roaming dogs; increased risk of vehicle strike mortality, potentially increased risk of disease expression, and backyard swimming pools (with the risk of drowning). Many of these threats are greatest and further exacerbated at the interface between native habitat and anthropogenic land use.

There is good evidence that where urban development interfaces with koala populations and their habitat that this results in declines in koala populations. In particular, rapid declines in koala numbers have been experienced in NSW and Queensland in high-density urban and remnant source populations that have undergone conversions from agriculture to urban environments (McAlpine et al., 2006; Adams-Hosking, 2017).

In South East Queensland populations of koalas have declined rapidly over the past 20 years due to urban development. Rhodes et al. (2015) show that some koala populations in South East Queensland have declined as much 80% over the preceding 20 years, despite attempts to reduce habitat loss through the planning regulation. Rhodes et al. (2011) and Beyer et al. (2018) show that high threat levels from disease, dog predation, and vehicle collisions associated with urban development, on top of habitat loss, are key drivers of decline in these urban environments. In particular, these studies highlight that it is the cumulative effect of multiple threats that drives declines in koala populations. Although, Beyer et al. (2018) show that these populations can be recovered by intensive management



of multiple threats, such intensive management is unlikely to be feasible in the long-term, especially over broader areas.

Research in NSW also shows evidence of declines in koala populations in urban areas (Smith & Smith, 1990; Lunney et al., 2002), but these declines may be potentially mitigated to some extent when urban areas are connected to large areas non-urban occupied koala habitat (Lunney et al., 2010; Lunney et al., 2016).

Threats to koalas inhabiting an increasingly urbanised environment are also further complicated by climate change and extreme climatic events, in particular drought and prolonged high temperatures. Current climate change projections predict hotter and drier climates, and this can limit the koalas current range. The koala's range is predicted to contract east and south to more mesic regions (Adams-Hosking et al., 2011). Riverine vegetation is critical refugia habitat in times of drought and is the source habitat for koala populations post-drought. In landscapes where the primary habitat is limited by habitat loss and fragmentation, population decline is imminent.

From these findings above, we can conclude that there is a need to promote efforts in the GMGA to: maximise habitat area; minimise habitat fragmentation; increase habitat quality and resilience of habitat to climate impacts; minimise edge lengths and interface with threats; monitor and mitigate predation from dogs and threats from roads.

The riverine characteristics of the corridors along the Nepean and Georges Rivers, as well as the creeks running through the landscape are noteworthy and underpin some of the important contribution that this landscape could play to the Campbelltown koala population and their role in future droughts, warming climate and bushfire, with connectivity providing routes of escape from threats. Maintaining connectivity of habitat helps avoid the creation of dead ends where koalas face threats without routes of escape, and thus become population sinks where koalas continue to move into an area but are killed by threats.

## **1.5 PANEL AND REVIEW PROCESS**

An Independent Expert Panel was established to provide advice. The Panel, consisted of some members of the Independent Expert Advisory Panel for the NSW Koala Strategy and included:

- Dr Chris Armstrong PSM, Deputy Chief Scientist & Engineer (Chair)
- Professor Kathy Belov AO, Professor of Comparative Genomics and Pro Vice-Chancellor Global Engagement, School of Life and Environmental Sciences, The University of Sydney
- Dr Carolyn Hogg, Senior Research Manager, Australasian Wildlife Genomics Group, School of Life and Environmental Sciences, The University of Sydney
- Professor Jonathan Rhodes, School of Earth and Environmental Sciences, Faculty of Science, The University of Queensland

The Office of the Chief Scientist and Engineer provided secretariat support.

In providing its advice the Panel has reviewed a number of reports and documents, this has included those listed in the Terms of Reference as well as the draft CPCS, supplementary material and reports provided by Lendlease, the draft Campbelltown CKPoM (Phillips, 2018), draft Koala Habitat Protection Guidelines (developed under the new SEPP Habitat Protection 2019) and other relevant reports and research articles.

On 14 February 2020 the Panel conducted a site visit to the proposed Mount Gilead development site. The Panel also met with representatives from the Department (Biodiversity and Conservation Division, Climate Change and Sustainability group, and the Conservation and Analysis Unit), Campbelltown City Council (including Dr Stephen Phillips

as the author of the draft Campbelltown CKPoM), Lendlease and their consultants including Eco Logical Australia and EMM Consulting.

The Panel would like to thank Associate Professor David Phalen and Jessica Hagan from the Koala Health Hub, School of Life and Environmental Sciences, The University of Sydney for providing background information and data on the Campbelltown Koala population.

An Inquiry into Koala Populations and Habitat in NSW is currently being conducted and is due to report by 15 June 2020 (Parliament of New South Wales, 2020). As part of this, on 25 October 2019 the Committee visited the proposed Mount Gilead development sites and hearings on that day discussed the development (Parliament of New South Wales, 2019). A number of submissions to the Inquiry relevant to the Mount Gilead development were also received. Hearings by and submissions to the Inquiry relevant to the Panels Terms of Reference have been considered.



## 2 ANALYSES OF MITIGATION APPROACHES PROPOSED FOR KOALAS IN THE GREATER MACARTHUR GROWTH AREA

The Review Terms of Reference requests advice on the ‘adequacy’ of the proposed measures for koala conservation. The Panel has defined ‘adequacy’ in terms of the primary objective of the NSW Koala Strategy, which is for protection measures to “*stabilise and increase koala numbers over the longer-term, ensuring genetically diverse and viable populations across New South Wales*” (NSW Government, 2018).

This Chapter sets out the Panel’s assessment of the proposed koala protection measures put forward by Lendlease proponents for the proposed MGS2 development, and as set out in the draft CPCP documentation. For clarity of the discussion, the overall assessment and approach is presented first, Section 2.1 provides a wholistic view of the risks, mitigations and a number of possible scenarios to be considered through implementation. This is followed by a discussion and assessment of measures to offset and protect koala habitat, to support koala habitat corridors, connectivity and minimise edge effects as well as monitoring and adaptive management.

### 2.1 RISK BASED ANALYSIS AND ASSESSMENT OF POSSIBLE SCENARIOS

To promote the longevity and health of koalas in the Campbelltown region, with the goal of maintaining and improving the population (as established in the NSW Koala Strategy), the Panel views it as important to minimise the contact of koalas to hazards and threats, and also to maximise as far as possible the availability of koala habitat.

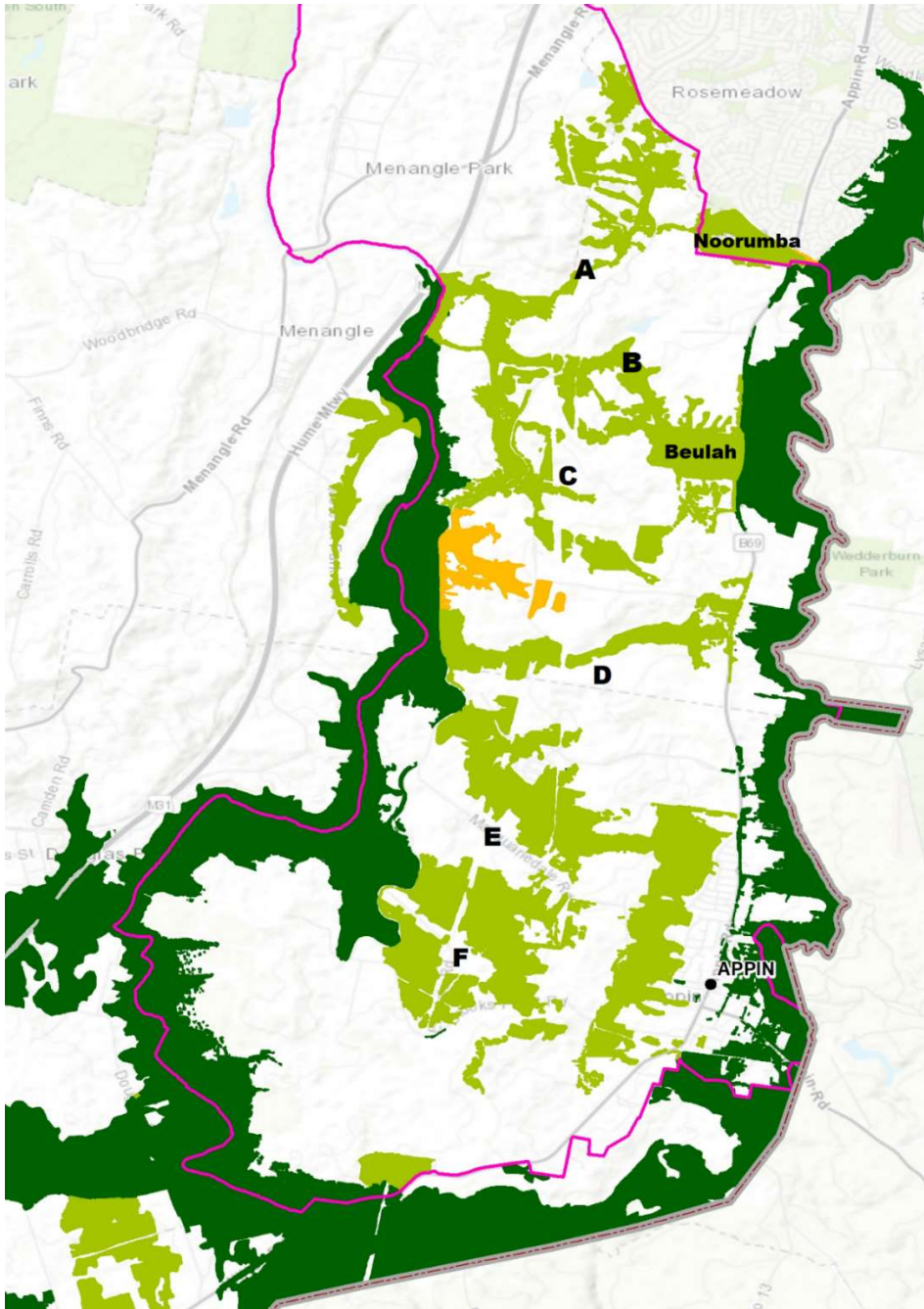
No matter what approach is taken, a fundamentally important step forward will be to fence off access by koalas to the surface of Appin Road from the east and west side. This stretch of road is a major contributor to koala mortality in the region. Further discussion below assumes that exclusion fencing is used on both sides of Appin Road.

The goal of the biodiversity certification for the MGS2 and CPCP is to enable the koala populations to exist in this increasingly urban environment and deploy a range of habitat of protection and hazard reduction mitigations (See Sections 2.2, 2.3 and 2.4 for more details). Section 2.1.1 illustrates the cumulative benefit of using a range of habitat and connectivity measures, as well as risk management process to reduce threats. Section 2.1.2 goes into more detail on the factors the Panel sees as important for success if koalas are to be kept across the landscape, and Section 2.1.3 provides a scenario framework for mitigations, in the light of possible future outcomes of choices - related to: the securing safe and efficacious crossings across Appin Road; and the implementation of exclusion fencing along corridors.

#### 2.1.1 Approaches whereby koalas remain in east-west corridors

The Terms of Reference for the review, requests in part, that the Panel to provide advice on “*whether east-west corridors linking the Nepean and Georges Rivers can contribute to the conservation of the Campbelltown koala population*”. The identified corridors are shown in Figure 5.

Access to increased (or retained) koala habitat has *prima face* benefits for koalas, however, key is whether the retained habitat is managed in a way that exposes koalas to the increased threats that urbanisation will bring to the region (traffic and dogs), or whether the installation, upkeep and management of mitigation measures will occur so that the koalas are separated from these threats in perpetuity.



**Figure 5: Potential wildlife corridors connecting Nepean River to Georges River**

A) Menangle Creek to Noorumba B) Woodhouse Creek to Beulah C) Nepean Creek to Beulah D) Mallaty Creek to Georges River E) Ousedale Creek to Appin North F) Elladale Creek and Simpsons Creek to the colliery  
 Source: DPIE (2020e)

If the removal of key risks cannot be accomplished, then the better management approach would be to monitor the impacts on the koala population and if it declines then consider active management which could include moving koalas between sites for breeding or relocation to safe areas, etc, preferably in the local region where there are ‘safe’ places. However, if separation from threats can be achieved in the landscape and maintained over the long term, then the better outcome for the koalas, and other flora and fauna, would be to retain the east-west corridors.

The scenarios in Figure 6 provide options based on the willingness of stakeholders to invest in ongoing threat mitigation infrastructure and management approaches and the likely impact on the koala population.

### 2.1.1.1 Koalas remain – east-west corridor and north-south corridors

**Figure 5** illustrates the range of planning mitigations that can be deployed with increasing effectiveness. All options assume exclusion fencing on both sides of Appin Road.

- **Pathway 1** - habitat is protected, but there are not crossings over or under Appin Road and corridors are not fenced – as a result koala numbers would decline due to reduced connectivity and increased threats.
- **Pathway 2** - habitat is protected and there are utilised connectivity structures (e.g. underpass) at Appin Road, but there is not exclusion fencing for the corridors. Koala numbers would still decline as dog and car threats are still in place without exclusion fencing within the developments.
- **Pathway 3** - habitat is protected, there are connectivity structures for Appin Road and exclusion fencing protects the corridors. The Panel believes this would maintain koala numbers at approximately current levels.
- **Pathway 4** - includes the interventions for 3, but also includes active management within the fenced koala habitat area, including removing any dogs that enter the fenced area, monitoring and managing disease, identifying and addressing specific stressors in the area from light and noise. The Panel believes that this approach above all would lead to growing koala numbers in the region.

Each of the pathways has certain risks that rise or fall as you move down the figure with increasing efforts. Risks include the cost of fencing installation and upkeep; risks to koalas from dogs and cars; risks that certain pathways across Appin Road cannot be secured. These issues are discussed more in Section 2.1.2 and a high-level adaptive management approach to the implementation of these mitigation choices is set out in Section 2.1.3, with adaptive management of the ongoing operations described in 2.1.4.

The location of the Campbelltown koala population in the GMGA, including within the existing national park and protected areas, the habitat in the proposed Mount Gilead development, biobank sites such as Beulah, habitat in the CPCP area, are all connected. In managing this region, these locations and the movement of koalas needs to be thought of holistically – a koala moving from the Georges River corridor could end up in either the Mount Gilead or CPCP domains, illustrating that in respect of the koala population the areas can be seen as one.

Such holistic management requires planning for connectivity, monitoring that occurs in one area being comparable with that in the other areas, and adaptive management approaches designed and implemented with consideration of the region as a whole.

Understanding the function that corridors, ‘stepping-stone habitat’<sup>13</sup> and patches have in enabling koalas to move through the landscape is important. Biolink (2018) undertook an analysis for Campbelltown City Council, using a least-cost modelling approach, to model likelihoods of how koalas would move between the Georges and Nepean Rivers. The use of the modelling assists with planning and management decisions and can be further enhanced when it is underpinned by koala monitoring data.

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<sup>13</sup> Discontinuous areas of habitat such as paddock trees, wetlands and roadside vegetation (DIPNR, 2004)

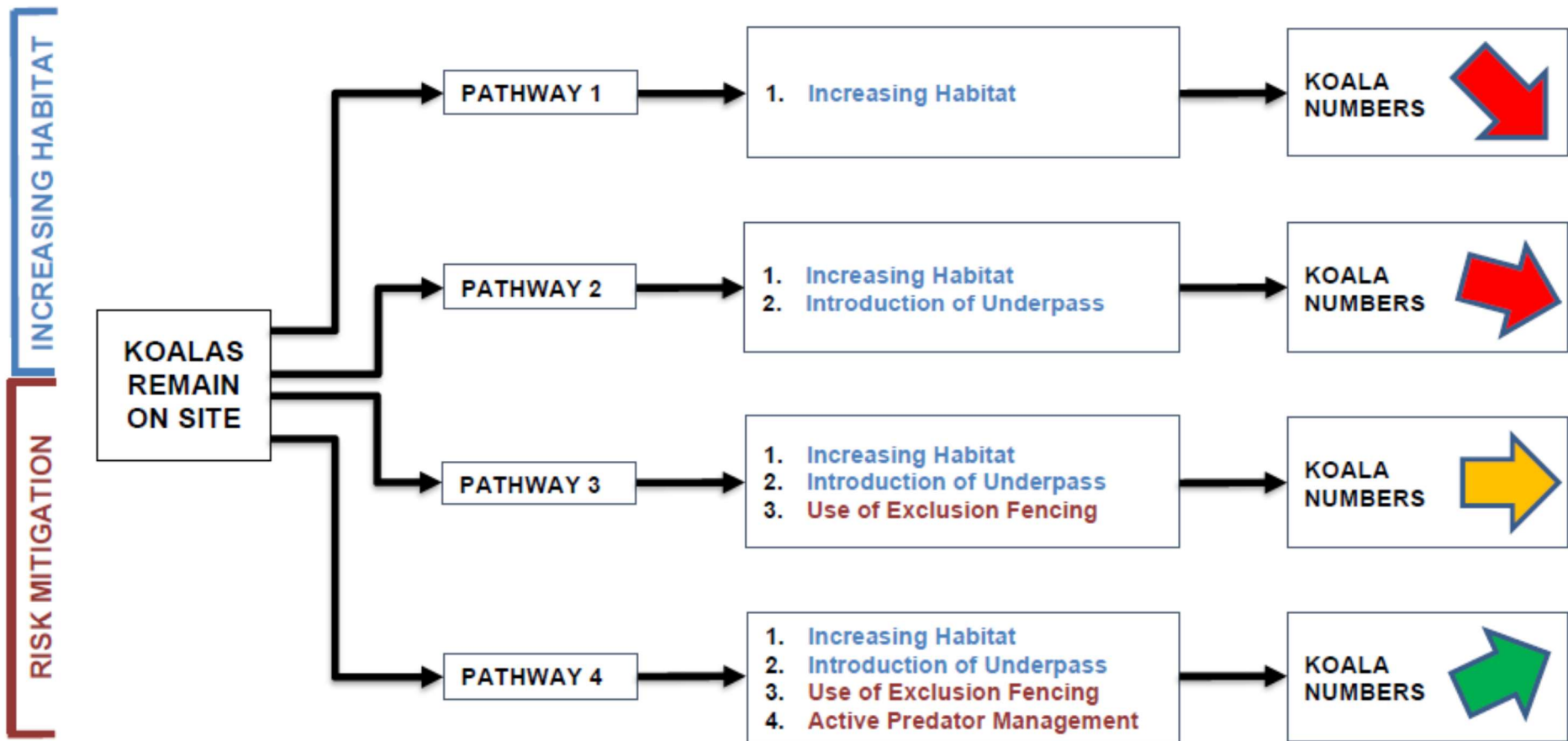


Figure 6: Mitigation options and impact on koala population

### **2.1.1.2 Preventing the northern end of the Nepean River Corridor from being a population sink**

In preserving koala habitat, being mindful of the potential risks of some landscape structures is important in decision making. Ensuring, as far as possible that habitat is connected to other habitat in multiple directions, and that the presence of koalas in the habitat does not expose them to risks. A negative outcome would be for habitat to be preserved as a dead-end, and the dead-end habitat to be open to threats such as accessible roads or predatory dogs; this scenario creates a population sink where koalas continue to move into the habitat, only to be killed by threats, creating a koala vacancy and therefore enticing more koalas to move in.

This illustrates the importance of maintaining the koala corridors through the Mount Gilead site. The Nepean River north-south corridor has been identified in the CPCP as a 'primary corridor' through the landscape, running from the south near Wilton, along the Nepean River in the GMGA, and functionally ending adjacent to or in the Mount Gilead site. Maintaining a functional corridor through Mount Gilead to the Nepean means that koalas moving north along the Nepean River do not reach a dead-end, which can present risks of a population sink, or a lack of escape routes should fire move along the Nepean corridor. Mount Gilead offers an easterly escape route, but also an efficient route to maintaining genetic connectivity with the other members of the Campbelltown koala population near the Georges River corridor (including in the proposed Georges River Koala Reserve).

### **2.1.2 Planning for the long term, and dealing with uncertainty**

The whole program of works and development in the region is scheduled to occur out to 2056, and with cycles of planning of urban facilities, development and construction, habitation and repeating those cycles for different locations and infrastructure. The approach of undertaking regional planning upfront and on the broad scale through the CPCP and for Mount Gilead is beneficial in that it allows restrictions and requirements to be established now in planning policies and approval conditions that can help improve outcomes for natural assets and environmental values across a wide area of land.

However, nothing is guaranteed, and both chronic and acute threats can emerge in a landscape to deteriorate the situation for koalas. There will be uncertainty about what hurdles will emerge in implementing a proposed pathway forward, and unforeseen events are also possible; these uncertainties will present challenges to decision makers and land managers.

Therefore, the Panel recommends using principles of adaptive management for koalas (and other species) in the GMGA, with a program of monitoring (including baseline) of koalas, threats and habitat put in place. Monitoring indicators can serve functions of tracking long-term conditions of the koalas in the landscape (health, demographics, presence/absence) and monitoring leading indicators such as immediate threats that need to be responded to.

The long term and ongoing program of urban development, out to 2056, will result in future unknown events and risks, and possibly opportunities, so scenario planning and mitigation options should be a core component of adaptive planning for preparedness and resilience.

The Panel has been provided with some early conceptual layouts and designs for the proposed development in MGS1 (approved) and MGS2 which is a focus of this report. This includes information such as MGS2 documents, calculations of carrying capacity and illustrations of a koala connectivity structures (Figure 7). The Panel has also been provided with draft CPCP documentation, including the overarching plan, koala subplan, monitoring subplan, etc.

There are a number of definitive findings and recommendations that the Panel has made, and also a set of options that could be considered, depending on the success of a range of proposed approaches. These options are set out in the following Section 2.1.3 for both the

MGS2 and CPCP areas. The section has been developed to inform adaptive management decisions during the planning and implementation phase of the urban developments in the GMGA, including the proposed MGS2. A key factor in which scenario emerges will be whether and where functional connectivity can be secured across Appin Road, and whether exclusion fencing can be widely rolled out to separate koalas from threats in the east west corridors.

Key to minimising interaction of koalas and threats will be the installation of barriers between koalas and the risks from cars and dogs, which can be achieved by using koala exclusion fencing. Connectivity will be ensuring the long-term stability of the koala population and providing for safe crossing structures above or below Appin Road is key to this.

Table 2 sets out a summary of the proposed protections for both the MGS2 development and the CPCP at the early planning and development phase. The Panel is aware that there are constraints (financial, geographic etc.) that are being considered, and these are reflected to some extent by the scenarios presented by the Panel. As described above, minimising the exposure of koalas to direct and indirect threats is a key issue and this will be most effectively enabled through koala exclusion fencing. However, the Panel does note that the installation and ongoing maintenance and replacement of koala fencing is not a trivial expense, with rough estimates by the Panel of \$400,000 per kilometre (net present value) for installation and maintenance (Santika et al., 2015; Horsfall, 2017)

#### **2.1.2.1 Adaptive management approaches for the development & construction phase at Mount Gilead**

Documents for the proposed MGS2 (Biodiversity certification report and supplementary material) and the draft CPCP present approaches for implementing habitat protection and managing risks. These are summarised in Table 2. A full description of the corridors, protection measures and panel comments are at Table 5. These include protection and improvement of habitat in the local area, deployment of some exclusion fencing for corridors and roads as part of the CPCP, post and rail fencing with buffering for MGS2, and two Appin Road crossings for MGS2, and at least one Appin Road crossing for CPCP.

In relation to the establishment of crossings for Appin Road, preferred methods and locations for crossings have been identified, however the Panel notes:

- there is uncertainty for MGS2 as to whether the koala crossing ridge to Noorumba will be used by koalas, or whether alternative crossing structures at Noorumba can be implemented that koalas may be more likely to use (see Section 2.3)
- for MGS2, further certainty is required about the planned crossing adjacent to Beulah across Appin Road. This is a very important component of the east-west corridor and ensuring there is no sink at the top of the Nepean corridor.

**Table 2: Summary of mitigation and protection measures**

Corridor	Biodiversity certification area	Current proposals
<b>Georges River Corridor</b>	CPCP	Fencing Appin (East, West), establishment of Georges River Koala Reserve, pre-clearance fauna protocol developed and monitoring of performance measures
<b>Nepean River Corridor</b>	CPCP	Fencing, strategic conservation area, Nepean and Medhurst offset site, pre-clearance fauna protocol developed and monitoring of performance measures
<b>Corridor A Menangle Creek to Noorumba</b>	MGS2	Protected by biodiversity offsets; tree-top bridge across Appin; post fence, two creek crossings, possible third across transport corridor, elevated bridge with over 10m clearance, pre-clearance fauna protocol developed and monitoring of performance measures, Noorumba Biobank Site (part of corridor)
<b>Corridor B Woodhouse Creek to Beulah</b>	MGS2	Protected by biodiversity offsets; koala underpass under Appin road; post fence east side and west side; multi-use buffer east side, revegetation programs, Woodhouse creek biobank site, pre-clearance fauna protocol developed and monitoring of performance measures, Beulah Biobank Site
<b>Corridor C Nepean Creek to Beulah</b>	MGS2/ CPCP	Habitat conserved, fenced on the south side
<b>Corridor D Mallaty Creek to Georges River</b>	CPCP	Habitat conserved, fenced to keep out koalas
<b>Corridor E Ousedale</b>	CPCP	Habitat conserved; koala fencing for threats; revegetation in some areas, cross Appin Road to be considered, land purchases considered to complete corridor
<b>Corridor F Elladale Creek and Simpsons Creek to the colliery</b>	CPCP	Habitat conserved, koala fencing for threats; revegetation in some areas,

### 2.1.2.2 Panel suggestions

#### **MGS2 Scenarios**

MGS2 Scenario 1 is the preferred approach of the Panel.

**MGS2 Scenario 1** assumes connectivity structures across Appin Road (facilitating access to habitat) are achievable and are used by koalas (proposed tree-top bridge at Corridor A and the proposed Corridor B underpass as shown in Figure 7 is constructed) and there are no constraints on the ability to deploy and upkeep koala fencing:

- **Georges River Corridor** - koala fencing installed and maintained along both sides of Appin Road, connectivity structure within the corridor (at the bridge over the Georges River on Appin Road)
- **Nepean River Corridor** - koala fencing installed and maintained between Nepean corridor and development to the East; Picnic area with koala fencing
- **Corridor A** – protected habitat; tree-top bridge across Appin Road is feasible and is utilised; koala fencing both sides of the corridor’s full length, in particular where adjacent to dwellings



- **Corridor B**- protected and restored habitat; koala underpass under Appin Rd adjacent to Beulah proceeds and is successfully used by koalas; Corridor B should be wider, there should be a 30 m buffer both sides of Woodhouse Creek, and exclusion fencing at the edge of the buffer with the use of grids and gates within fencing to allow people to enter; using koala feed tree planting close to koala exclusion fence with care taken that falling limbs do not damage the fence. The APZ should not be in the habitat buffer, but should be on the development side of the exclusion fence and in the development footprint; Traffic speed limit 50 km/h.

Panel suggestions in Scenario 1 above may not be feasible, if the koala bridge approach across Appin Road at Corridor A is not utilised (there is no evidence that koalas use tree-top bridges), if no other Appin Road crossing at the Noorumba Reserve can be executed, if there are issues with developing a crossing at Beulah Biobank, and also if the CPCP crossing at Corridor E cannot be realised. Scenario 2 presents a potential way forward in response to these challenges.

**MGS2 Scenario 2** assumes fencing is unrestricted and can be used where needed, but Appin Road connectivity is not achieved in the north of the Mount Gilead site near the Noorumba Reserve. Connectivity is assumed across Appin Road at Beulah Biobank – although the MGS2 BCAR indicates that this fauna underpass is subject to on-going consultation with the Department and TfNSW, the Panel sees it as vital to maintain an east-west corridor at the northern end of the Nepean Corridor.

- **Corridor A** habitat protected; tree-top bridge across Appin is not utilised by koalas, then the development of an underpass or culvert under Appin Road, or a gantry bridge above Appin Road (see Mona Vale example) should be explored, and these supported by other devices such as grids in the road to stop the movement of koalas around fencing. If a crossing is still not achievable over Appin Road, then the koala population in Noorumba Reserve would be functionally isolated in fragmented habitat, so koala fencing both sides of Corridor A should be installed as far along the corridor as possible, within which the koala population should be actively managed including breeding or relocation of koalas to manage genetic diversity.
- **Corridor B** habitat protected; koala underpass under Appin Rd adjacent to Beulah and koala fencing both sides of corridor B is deployed; koala buffer both sides of corridor: buffer width = 30 m additional to the corridor, with koala feed trees planting in the buffer zone close to the exclusion fence, with care taken that falling limbs do not damage the fence. APZ in the development area. If there are locations along the corridor that cannot be protected with exclusion fencing because of steep terrain, then a wider buffer should be deployed (~60 m) using non feed trees, and with Traffic speed limited to 40 km/h in that area. Extra planting required to the exclusion fencing, including koala buffer would contribute to the additional koala habitat credits required by the proponents (See Section 2.2). If connectivity between the north end of Corridor B and Nepean Corridor (at Menangle Creek) is temporarily closed to koalas or not utilised by koalas in the term, the Corridor C should be considered for connection to Nepean.
- The habitat between Noorumba Reserve and Nepean River is no longer assumed to be useful koala habitat, so the picnic area adjacent to the Nepean would be replanted with koala feed trees to help address this habitat reduction.
- While the BCAR indicates Beulah underpass is being considered, this is such an important crossing that the Panel believes it needs to go ahead for this to be an effective corridor. Otherwise there would need to be a largescale long-term active management protocol for the area.

## **CPCP Scenarios**

### Key points

- for the CPCP area, there is uncertainty as to whether an Appin Road crossing is achievable in the vicinity of Appin village (linking corridor E);
- for CPCP, can an alternative location be secured such as corridor D, where there appears to be better access to the roadway;
- further consideration on work to ensure koalas can cross under Appin Road further south within the Georges River Koala Reserve (at bridge over Georges River).

**CPCP Scenario 1** assumes Crossing at Appin road as underpass at Corridor E.

- **Georges River Reserve** - Koala fencing installed and maintained along both sides of Appin road; Connectivity structure developed within the corridor at Georges River (Kings Falls Bridge) east of Appin township.
- **Nepean River corridor** - Koala fencing installed and maintained between Nepean corridor and development to the East;
- **Corridor C** - habitat conserved; fence along both sides to keep out threats.
- **Corridor D** - Habitat protected until and unless Corridor E underpass is secured, and linkage is constructed and vegetated and used; koala fencing along Appin road and Nepean keeps koalas out of corridor;
- **Corridor E** - Habitat protected; koala fencing for threats; crossing under Appin Road secured and utilised;
- **Corridor F** protected; koala fencing for threats; replanting undertaken.
- Exclusion fencing both sides of Corridors E and F with koala buffer both sides of corridor use of grids and gates within fencing; buffer width = 30 m each side (total 60m) using koala feed tree planting up to koala exclusion fence, with care taken that falling limbs do not damage the fence. APZ extends from exclusion fence additional into the development footprint. Traffic speed limit 50 km/h.

The Scenario 1 particularly differs from the proposed approaches by the MGS2 proponents and the CPCP drafters including:

- use of exclusion fencing (not post and rail) between development and koala habitat in Mount Gilead;
- differentiation of the concept of APZ (to protect houses from fire), and habitat buffer (to protect habitat and koalas from stressors and threats from development), with the APZ starting at the exclusion fence and in the development footprint;
- monitoring and adaptive management strategy (including the assessment of whether or not installed mitigations are functioning as required)
- in the CPCP Area, Corridor D to be protected until and unless a connection structure across Appin Road for Corridor E can be developed and is used by koalas.

**CPCP Scenario 2** assumes Appin Road crossing occurs at Corridor D, and is not feasible in the south near Appin for Corridor E. As with all scenarios, it is assumed that Georges River Koala Reserve north-south Corridor has exclusion fencing installed and maintained along both sides of Appin Road including at Kings Falls Bridge, and there is koala fencing installed and maintained along the Nepean corridor facing development to the East.

Corridors in the CPCP have an equivalent approach to buffers and APZ as occurs in the MGS2, where koala buffer is 30 m wide additional to the corridor reaching to the exclusion fence, and the APZ is distinct to the buffer on the road/development side of the exclusion fence. If there are locations along the corridor that cannot be protected with exclusion

fencing because of steep terrain, then a wider buffer should be deployed (~60m) using non feed trees, and with traffic speed limited to 40 km/h in that area.

- **Corridor C** protects as much habitat connected to Beulah as possible. Corridor C should be re-examined for maintaining connections to Nepean Corridor if the MGS2 connectivity at the Menangle Creek and Nepean River confluence is compromised with road infrastructure.
- **Corridor D** is designated as the main east-west connection in the CPCP and an underpass linkage is constructed and vegetated and used by koalas; fence along both sides of Corridor D to keep out threats.
- **Corridor E** protected habitat; koala fencing for threats; managed population to ensure healthy genetics of the koalas and ongoing exclusion of threats.
- **Corridor F** protected habitat; koala fencing for threats; managed population to ensure healthy genetics of the koalas and ongoing exclusion of threats.

**CPCP Scenario 3**, where crossings under Appin Road are not feasible; assumes Georges River koala fencing installed and maintained along both sides of Appin Road, and the Nepean Corridor. Koala fencing installed and maintained along the Nepean corridor facing development to the East.

- **Corridor C** protects as much habitat connected to Beulah as possible.
- **Corridor D, E and F** where underpass crossings at corridor D and E are both not feasible (or ineffective if bridge crossings are deployed but not used). In this case the populations in Corridors E and F need to be actively managed for breeding, genetics and population growth using translocation from the Georges River Koala Reserve, and active management to ensure habitat availability and exclusion of threats.

### 2.1.2.3 Further infrastructure development and property construction

It is understood that over the coming decades, further development of the region is envisaged to deliver housing, town centres, utilities and services to the community, this includes development of roads and transport corridors that may run parallel to corridors, or may cut through corridors (Figure 1).

In the case that lineal infrastructure is planned that runs parallel but outside a corridor, then consideration should be given in the planning, construction and operational phases to increased influence of light and noise. Relevant mitigations should be put in place with suitable time prior to construction along corridors, and monitoring put in place to measure the intensity of the stressor and the impact on the local koala population. The approach to managing koalas during construction will also depend on whether it happens in a graduated way in stages or all at once.

It is noted that the MGS2 proponents are planning the use of best practice guidelines for construction. A construction management plan and a Koala management Plan would be developed and approved through a Commonwealth process

For infrastructure that cuts across corridors temporarily, this should be taken into account in the planning, and mitigations put in place, such as through the building phase. Prior to the construction phase, koalas may be required to be nudged out of the area, or temporarily relocated to another location potentially a sanctuary.

Infrastructure that will cut across a designated corridor should include underpass or overpass structures to enable the movement of koalas along the corridor, with suitable fencing, light and noise barriers put in place early enough through the process so that it is at scale by the time the infrastructure is constructed.

### **2.1.3 Adaptive management approaches for the operational phase**

On-going monitoring of leading and training indicators will be required to understand the success of mitigations, and the response to the koalas of these efforts. Trailing indicators such as koala presence/absence, and koala health (genetics and disease) will monitor the impact of development on the local koala population.

Some leading indicators can be set up as triggers to inform when further mitigations need to be considered – additional fencing, noise or light barriers, communication to residents, road furniture, or more than consideration should be given to translocating koalas to a dedicated managed location or alternative site.

Performance indicators and triggers can be used to inform when additional mitigations are needed, and expert advice should be sought. Further scenario planning should also occur.

Mitigations such as active management are feasible (described in Section 2.1.4), and potentially lend themselves to the development of a local koala or wildlife sanctuary, which could bring additional tourism and/or research benefits. Translocation of koalas out of the area could also be a long-term option, if the population does not thrive and that becomes the preferred approach. Further discussion of adaptive management approaches in Section 2.1.4.

### **2.1.4 Active koala management - if koalas are to remain in fragmented patches**

A significant threat to isolated or near-isolated populations of koalas could include unforeseen problems of over-browsing (associated with reduced habitat and low dispersal rates) and low genetic diversity leading to inbreeding depression. There may therefore be a greater need for a strategic approach to the management of these potentially isolated koala populations, or those that are at greater risk of becoming isolated due to urban sprawl and development. The active management of koalas in such scenarios may afford for the opportunity to manage populations to ensure genetic diversity and resilience.

An active management approach may involve the monitoring of disease, checking the genetic health of the population, possible relocation of koalas for breeding and the captive management of sanctuaries to provide a long-term insurance population. Here, in this captive management scenario, the koalas would not be able to roam freely and there would be on-ground action for the maintenance and restoration of their enclosed habitat, with breeding by arrangement and informed by genetics. The NSW Koala Strategy is consistent with this approach and suggests the relocation of koalas to unoccupied koala habitat, which may include habitat sectioned as conservation sanctuaries (NSW Government, 2018).

The Mulligans Flat is an example of a strategic active management approach to wildlife conservation. The Mulligans Flat and Goorooyanoo Nature Reserve are two adjacent nature reserves located on the outskirts of Canberra. These reserves are a part of a national effort to conserve endangered woodlands and were set up by the ACT Government to protect box-gum woodlands around Canberra. Together, they total 1,623 ha of land and contain 1,146 ha of Yellow Box – Blackely's Red Gum Grassy Woodland, which represents some the largest protected areas of Yellow Box – Blackely's Red Gum Grassy Woodland in the ACT (Woodlands and Wetlands Trust, 2020).

In 1994, Mulligans Flat was established as nature reserve in a bid by the ACT government to protect the area in response to increasing residential development. In 2002, the Mulligans Flat – Goorooyarroo Woodland experiment arose in direct response to the Woodlands for Wildlife ACT. The Lowland Woodland Conservation Strategy Action Plan was announced that ensured the active recovery and protection for the Yellow Box-Red Gum Grassy Woodland (endangered ecological community) present in the nature reserves (Shorthouse et al., 2012).

The two reserves required restoration interventions to ensure their long-term ecological function and protection of this critically endangered ecological community. The Mulligans Flat – Goorooyaroo experimental restoration project was established as a collaboration between ACT government researchers, ACT government land managers and university researchers. The project was designed to integrate a restoration project with research in a highly accessible way (Shorthouse et al., 2012). The key aim of the project is to restore critically endangered grassy box-gum woodland that has degraded over time. The area has a strong previous history (over 150 years) of livestock grazing, patch cropping, pasture improvement and removal of timber for fencing, firewood and reducing rabbit harbour, which has altered soil condition, contributed to species decline, changed the vegetation structure, introduced weeds and eroded water courses. Furthermore, native plant recovery has been hindered due to grazing pressure by increased eastern grey kangaroo presence in response to urban development within the region. These combined and accumulated effects have led to a declining wildlife population within the nature reserves, and in some cases, local extinctions(Shorthouse et al., 2012).

The research component of the project also provides an opportunity for gaining insight into the efficacy of the range of restoration techniques used in the project and answering some theoretical questions posed. In 2010, baseline data was recorded, and initial treatments implemented. The experiment involved systematic trialling of a range of treatments that could provide insights into the complexities of rehabilitation. By doing so, an adaptive style approach could be taken whereby refinement of management approaches could occur based on the experimental outcomes. In brief, the experimental design involved the identification of 24 areas of vegetation, within which four 1 ha ‘sites’ were established. These 96 sites were subjected to a range of management treatments and contain ‘plots’ where the monitoring is undertaken. The treatments included; exclusion of kangaroo grazing, addition of deadwood, prescribed burning, varied tree and shrub densities and the exclusion of bettong digging in Mulligans Flat (Shorthouse et al., 2012).

The project is ongoing and has made considerable progress to date. There has been a positive response from invertebrates (Barton et al., 2011) and reptiles (Manning et al., 2011). Ground layer vegetation also showed signs of recovery as well as the effective eradication of foxes, cats and rabbits. The successful reintroduction of the first Eastern Bettongs seen in a wild situation on the mainland for over 80 years was undertaken as well as the reintroduction of the New Holland Mouse. Along with the active management of the nature reserves, evidence from the ecological research will continue to inform and exert some influence on the ACT Parks and Conservation Service’s land management policies and programmes (Shorthouse et al., 2012).

## **2.2 OFFSETS AND PROTECTED HABITAT**

Offsets are designed to provide a compensatory mechanism for the negative environmental or biodiversity impacts of development at one site, which cannot be avoided or minimised further, to be offset by positive activities at another site. Offsets otherwise known as biobank sites (TSC Act) or biodiversity stewardship sites (BC Act) are a last resort mechanism to protect, in this case koala habitat, in perpetuity. Based on the area and type of impact an assessment method is used to determine the level of offsetting required. When acquiring species or ecosystem credits under this system, they can be obtained state-wide, and do not need to fall within the locality of the development.

Table 3 provides an overview of the proposed offsetting measures in MGS2 and the draft CPCP and provides panel commentary on those measures.

**Table 3: Proposed offset measures in MGS2 and CPCP**

Plan	Proposed Measures	Panel comment
Mount Gilead Stage 2 Development	<p>The BCAR states that there would be direct impact to 332.17 ha of the assessment area. 201.81 ha of habitat will be permanently protected and managed for conservation. Of this, 197.46 ha would generate ecosystem credits and the remaining 4.3 ha would be red flag vegetation conservation area buffers. These would be conserved through the five registered Biobank sites on site (Browns Bush, Mount Gilead Homestead, Woodhouse Creek, Nepean and Medhurst sites).</p> <p>1,901 species credit for the koala are required, the five Biobank sites generate 1,202 credits. This leaves a deficit of 699 koala credits. This would be met by the purchase of additional credits from registered biobank sites in the region or via the Biodiversity Conservation Trust.</p>	<p>Preference for local offsets to ensure protection of koala habitat for the Campbelltown population. However, given the 2019/20 bushfires protection of koala habitat in areas to recover koala populations is also of key importance.</p>
Cumberland Plain Conservation Plan	<p>Establishment the Georges River Koala Reserve. The Office of Strategic Lands owns 60% of the land and is establishing BSAs over some of its holdings.</p> <p>The Office of Strategic Lands will manage the voluntary land acquisition program under the plan and once all land is acquired, will establish BSAs to generate biodiversity credits that will be used to cover costs associated with future management of the reserve. Ownership and management of the reserve will be transferred to the NSW National Parks and Wildlife Service.</p> <p>Around 6,000 ha of important koala movement corridors and habitat have been identified within the strategic conservation area that are candidates for reservation or BSAs.</p>	<p>The strategic certification under the CPCP has no requirement for 'like for like' and provides a flexible offsetting arrangement whereby the proponent can propose an alternative conservation measure, that the Minister agrees <i>adequately</i> addresses impacts on biodiversity values.</p> <p>The Panel notes that adequate should meet the objective of the NSW Koala Strategy.</p>

## 2.3 CORRIDORS, CONNECTIVITY AND MINIMISING EDGE EFFECTS

A wildlife corridor is a stretch of habitat that joins two or more areas of similar habitats. They can be in the form of a sequence of stepping stones across the landscape or as a continual lineal strip of vegetation and habitat (DIPNR, 2004). As habitats are increasingly cut off from each other due to various contributing factors including urban development, corridors play an important role in partially compensating for habitat loss and fragmentation by linking habitats and helping to maintain ecosystem health

It is critical to ensure connectivity between important patches of koala habitat. Large connected areas linking various koala habitats sustain populations by facilitating dispersal of populations, supporting breeding, providing resources for feeding and protecting against localised extinctions (NSW Government, 2020c). Ensuring as far as possible that the habitat has multiple connections can help to prevent the formation of dead ends and population sinks and ensure that koalas (and other species) have routes to escape threats such as bushfires.

Vehicle strike is a major cause of death for koalas in Campbelltown, with hotspots identified on Picton Road between Cordeaux Dam and Wilton, Macarthur Drive, Easter end of Wilton Road, Appin Road between Appin and Campbelltown and the Hume Highway at the Bargo

exit (DPIE, 2019c): These identified hotspots occur where a major road intersects a primary koala corridor, typically at the headwaters of a watercourse.

Factors that make koalas so susceptible to vehicles strikes include their inability to recognise roads and traffic as a potential threat, making them likely to crossroads, even in dangerous environments. Furthermore, koalas are a highly mobile species prone to dispersal, increasing the likelihood of them crossing barrier in search of areas of new habitat and because they are largely nocturnal, their visibility to motorists whilst crossing roads is low (Biosis & Open Lines Environmental Consulting, 2020). The highest proportion of vehicle strikes have been found to be juvenile koalas, with a strong male-bias, indicating their vulnerability from dispersal.

Exclusion fencing and the establishment of underpasses (e.g. Figure 7) or overpasses (e.g. land bridges) are required to protect wildlife and ensures connectivity between habitats and reduces interaction with busy highways. In Australia, the Pacific Highway upgrade in Ballina<sup>14</sup> and the Compton Road widening project in Brisbane<sup>15</sup> are examples where connectivity structures have been utilised to protect koalas and other species of mammals and reptiles. The movement of koalas can also be impeded by other man-made infrastructure (e.g. the Upper Canal, easements along the gas supply line and transport corridors). Although exclusion fences and under passes require ongoing maintenance, they are considered the most effective roadkill mitigation measure on major roads.

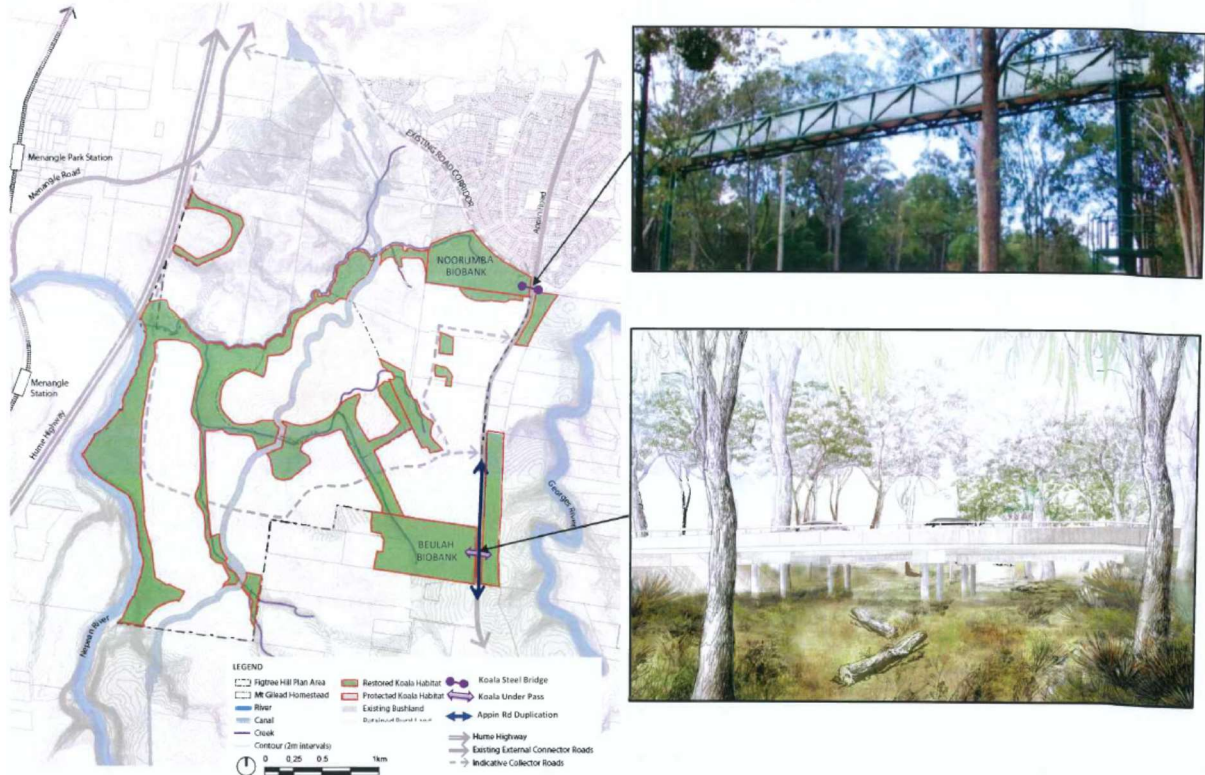
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<sup>14</sup> The Woolgoolga to Ballina Pacific Highway upgrade includes a Koala Management Plan with commitments from Transport for NSW towards no koala road-kills occurring as a result of the upgrade. The three main mitigation measures resulted in koala-proof fencing along the length of the upgrade, twelve culverts under the upgrade, and koala food tree plantings. Monitoring programs in 2018 and early 2019 indicated that apart from koalas, several species were also using these culverts (Sandpiper Ecological Surveys, 2019)

<sup>15</sup> In 2004, Compton Road that traverses through large bushlands in Brisbane was upgraded from two lanes to four. In order to mitigate the impacts to local fauna, Brisbane City Council constructed infrastructure which included glider poles, rope ladders, fauna-friendly culverts, escape poles and exclusion fencing (Brisbane City Council, 2020). The fences were designed in such a way that it acts as a funnel directing wildlife towards these crossing structures. 18 species of mammals including koalas, kangaroos, wallabies, bandicoots, birds, echidnas, frogs, skinks, snakes, lizards etc. were recorded as having used the connectivity infrastructure (Griffith University, 2020)



GILEAD STAGE 2



**Figure 7: Proposed bridge at Noorumba Reserve (top right) and underpass (40 m wide) at Beulah (bottom right) at Appin Road**

Source: Lendlease

Note: The bridge has not been proven effective for koala crossing.

The Division of Environment, Energy and Science, within the Department identified the most important connections of koala habitat in the Campbelltown and Wollondilly region and defined these as primary, secondary or tertiary corridors (Table 4 and Figure 4). The process to identify the corridors and further information on them is in the *Conserving koalas in the Wollondilly and Campbelltown Local Government Areas* report (DPIE, 2019c).

**Table 4: Types of corridors defined by the Department**

Source: DPIE (2019c)

Term	Definition
Primary corridors	Corridors that contained 'core' koala habitat which were contiguous (gaps between trees less than 100 m) and were greater than 380 ha in size.
Secondary corridor	Corridors that contained 'core' habitat patches and smaller habitat patches or scattered trees that were separated by more than 100 m (were not contiguous) or were narrow or had pinch points less than 50 m wide and contained between 100 ha and 380 ha of 'core' habitat. Secondary corridors sometimes comprised 'core' habitat that totalled more than 380 ha and were wider than 50 m, but where this was the case, they were classified as secondary corridors if they did not connect to primary corridors on both ends.
Tertiary corridor	Corridors that contained patches of high-quality habitat that were poorly linked to primary corridors, contained between 30 ha and 100 ha of high-quality habitat, and did not connect to primary corridors on both ends. Tertiary corridors sometimes contained more than 100 ha of habitat, but where this was the case, they were classified as tertiary corridors if they did not connect to other corridors on both ends.

Biolink calculated the optimal average corridor width for koalas in Campbelltown to be 425 m. This is based on the home range size requirements for female koalas and the region's low carrying capacity (Phillips, 2018).

Eco Logical notes that studies indicate that the 425 m width is an overestimate of the width required for female koalas, and that Biolink has undertaken its calculations based on female koalas having a home range that is circular in shape. Eco Logical notes a study by (Lunney et al., 2010) that identified various home range shapes of koalas in the region including long narrow home ranges. Additionally, with regards to the 425 m corridor width, Eco Logical also notes the Biolink statement that it is *“evident from available studies in CCC LGA that koalas will use areas with a narrower width than this”* (Biolink, 2018).

There are two primary corridors that have been identified, the Georges River and Nepean River corridors. There are six secondary corridors identified in the GMGA that have the potential to provide east-west connectivity between the Nepean and Georges rivers. These corridors are shown in and described in Table 5. Corridors A and B and part of Corridor C are within the proposed Mount Gilead development and Corridors C to F are part of the draft CPCP.

The assessment criteria for these potential movement corridors are (DPIE, 2020d):

- proximity of corridor to current and future infrastructure, and planned urban areas
- threat from other animals including domestic dogs
- corridor’s topography and vegetation
- extent of land unattractive or dangerous for wildlife to cross
- minimum width of corridor after setting aside land marked for development
- potential for wildlife crossing to be built across Appin Road.

It is noted in the draft CPCP that regardless of whether potential secondary east–west koala movement corridors are protected for koalas over the long term, native vegetation will be secured and enhanced under the CPCP, benefitting other threatened species and ecological communities. This also supports the possibility of securing and enhancing potential corridors such as Ousedale Creek to Appin North for koalas in the long term.

Urban development in proximity to fauna habitat has increased the potential ‘edge effects’ that species such as koalas experience. In this context, ‘edge effects’ has been described as the interaction as a result of a transition between two different ecosystems where the threats to fauna is most pronounced, such as that experienced in the Campbelltown region where clearing of native fauna habitat has created an ‘edge’ (also often referred to as the habitat perimeter) with, and interaction between, the anthropogenic land uses (such as agriculture and, increasingly, urban development) (Benitez-Malvido & Arroyo-Rodríguez, 2008).

Edge effects can include both direct (i.e. vehicle strike and dog attacks) and indirect (i.e. light and noise pollution, urban storm runoff) impacts on fauna and flora, and can result in altered behaviour (for example, changes in home ranges or in how species disperse throughout a landscape) that can have longer term repercussions. The magnitude of edge effects and how it impacts fauna residing within the habitat is primarily a factor of the remaining habitat area, and includes factors such as the smoothness of the border (i.e. jagged habitat borders can result in an increased edge:area ratio), the length of the ‘edge’ and the narrowness of the remaining habitat.

There are a number of strategies and methods that can mitigate the impact on koalas, particularly at the interface of urban and native environments. This includes, but it is not limited to, vegetated buffer zones and managed habitat areas, koala exclusion fencing (includes fencing at the interface to roads, but also around pools and yards), predator and pest management (including weeding programs), vehicle-strike mitigation measures (under- and overpasses, road grids, traffic calming devices and road design, signage, speed limits, etc.), and community awareness programs.

### **Panel comments**

- Specific Panel comments on each of the corridors and proposed koala protection measures is at Table 5.
- With primary corridors along Georges and Nepean rivers, it is important to provide koala populations with the ability to move freely and safely along the east-west corridors to ensure genetic diversity and population dispersal.
- There is only a buffer on one side of the corridor in the MGS2 BCAR (Figure 9). The Panel views this is insufficient as koalas will need to have protection from threats on both sides of the corridor. Buffers, exclusion fences and APZ should be located on both sides of Woodhouse Creek, as the current proposed buffer zone in MGS2 is for the northern side of the Woodhouse Creek corridor only.
- The buffers in the proposed MGS2 development serve the dual purpose as a buffer for the Woodhouse Creek (and other) koala habitat corridor and as an APZ for the development, with infrastructure such as byroads and walking trails including in the outer buffer zone (Figure 10). The Panel sees the design as suboptimal as it permits threatening activities in close proximity to koalas with no barrier to interaction between the koala and the hazard. There is also the inclusion of stormwater retention ponds within the buffer zone.
- Buffer zones provide a mechanism to minimise edge effects – they reduce interactions between koalas and the urban environment. The Panel notes that buffer zones should:
  - provide separation between the built environment and other associated infrastructure (including roads)
  - be wider when it is not feasible to have an exclusion fence at the edge of the buffer
  - not include APZs (as per the SEPP Guidelines), particularly when subject to revegetation
  - not include roads, playgrounds and picnic areas
  - facilitate the complete avoidance of direct impacts (i.e. road strike)
  - mitigate the impact of indirect impacts, such as attenuating noise and light pollution from the urban development, for native species within the environment
  - prevent koalas moving into urban areas and prevent threat such as dog attacks
  - give consideration to the long-term maintenance of the koala habitat and any proposed mitigation strategies (such as fence maintenance in perpetuity)
- If there are not adequate measures to prevent koalas entering the urban environment, revegetation should discourage koalas utilising these buffer zones, this could be achieved by revegetating the buffer with native vegetation that include no koala preferential feed trees. In some locations such as steep terrain, exclusion fencing may not be feasible, and in these cases wider buffers would be required (~60 m), that don't include koala feed trees, and monitor for predators.
- The Panel also recommends that if the preferred method of koala exclusion fencing is used, the buffer zone should be revegetated with preferred koala feed and shelter tree species, with thought given to how far back from the fence line revegetation occurs to ensure that the fence is still effective and that treefall does not pose a risk to its integrity.
- There is also the opportunity to explore dog-free trails and double-gated entry points into the corridor.

**Table 5: Primary and secondary corridors**

Corridor	Name	Description	Proposed measures	Panel comments
Primary CPCP	Georges River Koala Reserve	<ul style="list-style-type: none"> <li>allow koalas to move north-south, from Appin in the South to Kentlyn in the North.</li> <li>intended to protect and manage approximately 1,800 ha of koala habitat, out of which 800 ha of publicly owned land along the south-eastern edge of the Cumberland Plain has been announced as part of the future reserve.</li> </ul>	<p>CPCP</p> <ul style="list-style-type: none"> <li>The program aims to deliver an additional 1,050 ha as part of the reserve and restore 250 ha as important koala habitat (NSW Government, 2020c).</li> <li>The high fertility shale and shale-influenced soils in the region will enable the restoration project to focus on plant community types such as grey box, grey gum, narrow-leaved ironbark trees that are preferred by the Southern Sydney Koala population (NSW Government, 2020c).</li> <li>Proposed measures to discourage koalas from crossing Appin Road is the instalment of koala exclusion fencing on both sides of the road in identified movement corridors with the aim of reducing fauna mortality.</li> <li>Measures described in Table 3</li> </ul>	<ul style="list-style-type: none"> <li>Support fencing both sides of Appin Road to prevent vehicle strike</li> <li>Connectivity and threats should be considered within this corridor. Fencing should be placed on Appin Road and a connectivity structure be developed with the Kings Falls Bridge over the Georges River.</li> <li>Support the establishment of the Georges River Koala Reserve is extremely important to safeguard the vital koala population along the Georges River.</li> </ul>
Primary CPCP	Nepean	<ul style="list-style-type: none"> <li>Contains the remaining areas of Shale Sandstone transition forest along the Nepean River and its major tributaries provide the only other core habitat for koalas in these areas.</li> <li>This habitat is more limited in extent and linear in configuration.</li> <li>Supports significant numbers of resident koalas and is therefore vital to the persistence of the regional koala population (NSW Government, 2020c)</li> </ul>	<p>CPCP</p> <ul style="list-style-type: none"> <li>Identified to be protected as a strategic conservation area</li> </ul>	<ul style="list-style-type: none"> <li>The corridor should be protected, and connectivity to the east needs to be ensured to stop the development of dead ends/sinks</li> </ul>
Secondary A Mount Gilead development	Menangle Creek to Noorumba	<ul style="list-style-type: none"> <li>Connects northernmost point of the Nepean riparian vegetation, before passing under motorway and heading west to Razorback</li> <li>Creek is fourth order below aqueduct, and requires 40 m riparian buffer on each side</li> <li>Fauna crossing structure on Appin Road will need wide run-</li> </ul>	<p>Mount Gilead Development</p> <ul style="list-style-type: none"> <li>Tree-top bridge across Appin Road to provide connectivity for koalas</li> <li>Noorumba Biobank Site (part of corridor)</li> </ul>	<ul style="list-style-type: none"> <li>This corridor will provide little protection for koalas into the future if it is not fenced as it is very narrow with limited capacity to revegetate the buffer zone</li> <li>The proposed tree-top bridge is not likely to be adequate and would not be used by koalas. The feasibility of a pedestrian style bridge should be</li> </ul>

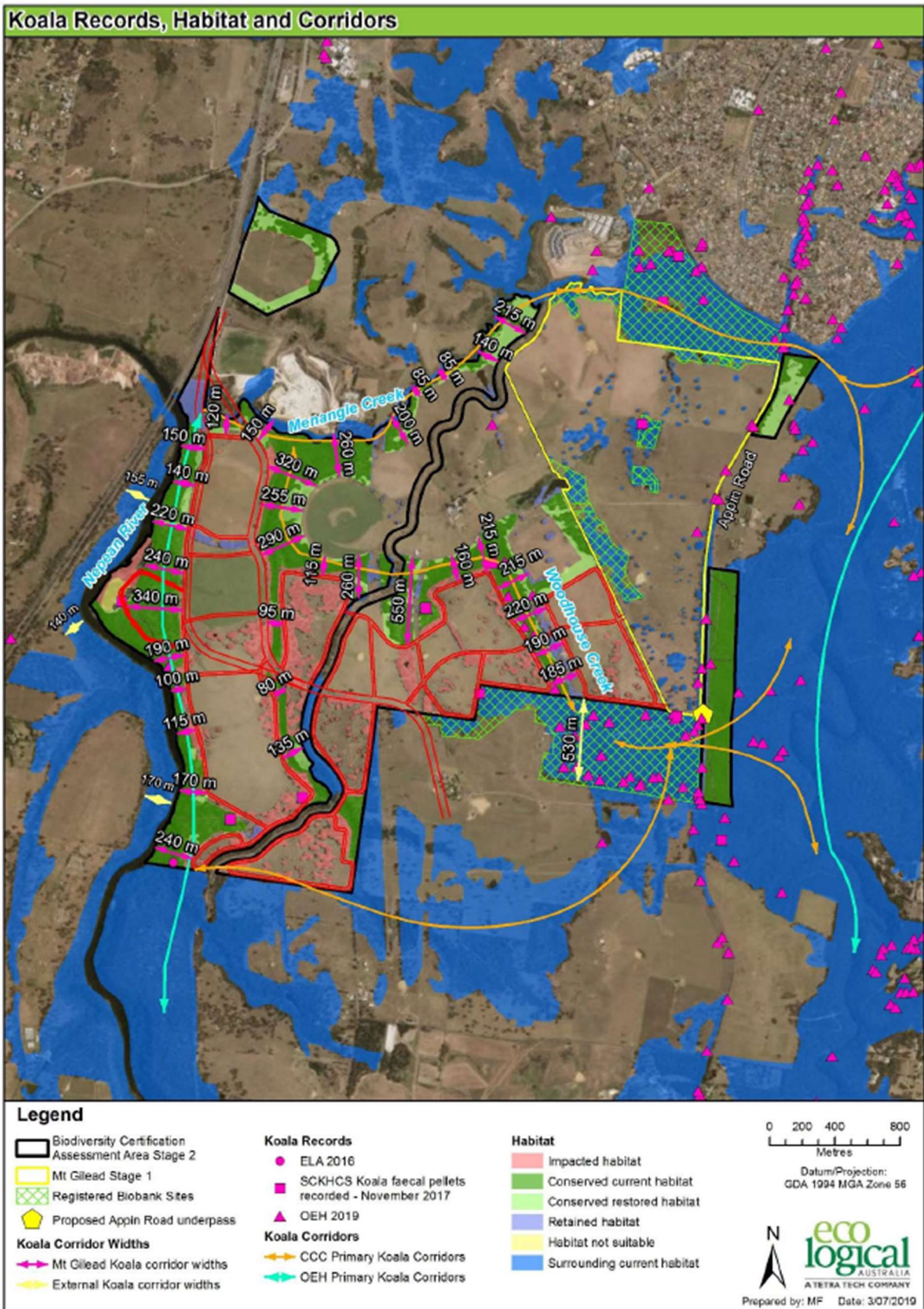
		<ul style="list-style-type: none"> <li>up, and will impinge on biobanked land on western side</li> <li>Menangle Creek main channel (northern stream) is third order below aqueduct and steep on the sides near southern tunnel entrance of the aqueduct</li> <li>Areas of vegetation are dominated by species other than Eucalypt (instream is <i>Casuarina</i>)</li> <li>After development, vegetated areas at higher elevations likely to be too narrow</li> <li>Middle section is crossed by two adjacent high-voltage powerlines and a gas main</li> <li>Addition of busway near gas main route will increase width of hostile land without trees</li> </ul>		<ul style="list-style-type: none"> <li>considered to allow koalas and other fauna to cross Appin Road.</li> <li>If the crossing is not feasible, the koala habitat at Noorumba Reserve will be isolated and not function as connected koala habitat, therefore should be fenced off at Appin Road. In this case, the koalas within this fragmented area should be actively managed.</li> </ul>
<p>Secondary B</p> <p>Mount Gilead development</p>	Woodhouse Creek to Beulah	<ul style="list-style-type: none"> <li>Meets Menangle Creek at its western end (Corridor A) to become third order stream</li> <li>Third order section (north-south) is only 750 m; both streams above this confluence (Nepean and Woodhouse Creeks) are only second order, which means that riparian corridor is 40 m</li> <li>Remaining east-then-south connection to Beulah is a first order stream and requires only 20 m total width</li> <li>A gas main, power line and Upper Canal aqueduct cross the stream in close proximity</li> <li>The future busway may be located nearby leading to a wide hostile area in the crossing</li> <li>The total width of the riparian zone may be further narrowed by development</li> </ul>	<p>Mount Gilead development</p> <ul style="list-style-type: none"> <li>buffers to mitigate negative indirect impacts on protected 'red flag' areas from development, including koala habitat and corridors. This buffer zone is broken down into a 15 m outer buffer zone (includes local road, residential dwellings, collector road, managed open space and landscaped stormwater detention basins) and a 15 m inner buffer zone (actively managed vegetated areas for conservation, as part of registered Biobank Agreement sites. The buffer zones will also serve as bushfire APZ and will include infrastructure such as stormwater retention basins and walking/cycling paths.</li> <li>a fauna underpass on Appin Road at Beulah. This is intended to reduce significant roadkill in the region. See Figure 7</li> <li>two creek crossings (Woodhouse and Nepean Creek) and a possible third across a transport corridor, with each of these crossings having an elevated bridge with over 10 m clearance to ensure connectivity and movement (Eco Logical Australia, 2017).</li> </ul>	<ul style="list-style-type: none"> <li>Corridor B has been identified as a priority koala corridor within MGS2, linking the primary koala corridor to the east of Appin Road to Nepean River corridor in the west, through Woodhouse Creek, Beulah Biobank site and Menangle Creek.</li> <li>Corridor B is a continuous corridor that has a mean width of 316 m, a minimum width of 100 m and no part of the corridor separated by more than 220 m (minimum distance between stepping stone habitat areas (Figure 8)). It is noted that previous studies identified a minimum width of 200 m, opportunities to widen this corridor should be explored</li> <li>With appropriate koala exclusion fencing and buffer zones (30 m each side of the corridor) this corridor should provide appropriate east-west movement for koalas at the northern</li> </ul>

		An overpass is required at Beulah across Appin Road, with a wide run-up on either side	<ul style="list-style-type: none"> <li>Beulah Biobank Site will link to the proposed Browns Bush Biobank site</li> </ul>	<p>end of the Nepean River and Georges River corridors.</p> <ul style="list-style-type: none"> <li>Ongoing monitoring will be essential to the management of this corridor to ensure koalas are still utilising it and not coming into contact with direct and indirect threats.</li> <li>The underpass near Beulah, as proposed by Lendlease, should be constructed.</li> <li>Particular care needs to be paid to the design and construction of the habitat at the confluence of the Menangle Creek and Nepean River where a number of road bridges are planned, to ensure koalas will use the connection.</li> </ul>
Secondary C MGS2/ CPCP	Nepean Creek to Beulah	<ul style="list-style-type: none"> <li>Extends in a south-then-east direction, lower confluence to Menangle Creek</li> <li>Corridor extends southwards and then broad arc in north-east direction (upper end of Woodhouse Creek above Beulah)</li> <li>Flat topography means that development could create narrow corridor</li> <li>Power lines, gas line and proposed busway will create reasonably wide hostile area</li> <li>Very little vegetation over gas main crossing</li> <li>Difficult to create fauna crossing over Appin Road due to terrain</li> </ul>	<p>CPCP</p> <ul style="list-style-type: none"> <li>Habitat is to be conserved</li> <li>Fencing on the south side (CPCP)</li> </ul>	<ul style="list-style-type: none"> <li>This corridor will have a significant edge effect from the urban development surrounding all aspects of it.</li> </ul>
Secondary D CPCP (second most)	Mallaty Creek to Georges River	<ul style="list-style-type: none"> <li>Mallaty Creek is third order except for the eastern third where it is second order.</li> <li>At 5 km upstream of the Hume Motorway bridges, the creek meets the Nepean River in a deep gorge section.</li> </ul>	<p>CPCP</p> <ul style="list-style-type: none"> <li>Habitat is to be conserved</li> <li>Fencing at eastern and western edges to prevent koala entry</li> </ul>	<ul style="list-style-type: none"> <li>This corridor is suitable for koala movement and should be protected with exclusion fencing and additional buffer zones</li> <li>The corridor provides the second-preferred route if Corridor E cannot traverse Appin Road</li> </ul>

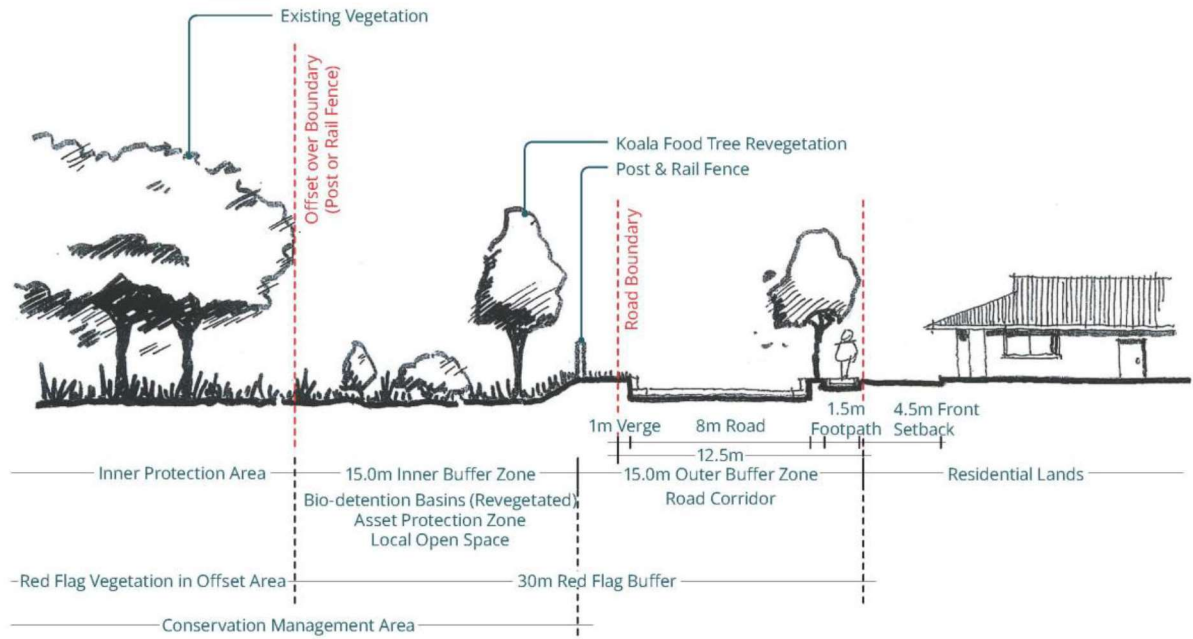
preferred corridor		<ul style="list-style-type: none"> <li>• Wide corridors up to 500 m at several points</li> <li>• Northern side of the creek well vegetated</li> <li>• Power lines, gas line and proposed busway will create reasonably wide hostile area</li> <li>• Very wide overpass structure needed at Belltrees Kennels, where Georges River is nearest to Appin Road</li> <li>• Aqueduct at western end crossing the creek will create a strong pinch-point for animals</li> </ul>		<ul style="list-style-type: none"> <li>• While this section is well vegetated and nutritious, particularly at the north, and the corridor widens to 500 m at various points, higher-nutrient vegetation is limited at other areas.</li> <li>• The area is also traversed by power and gas lines, with a proposed busway bisecting the corridor. The western end where the aqueduct crosses the creek is also expected to be a pinch-point for animals (DPIE, 2020d).</li> </ul>
Secondary E  CPCP: preferred corridor	Ousedale Creek to Appin North	<ul style="list-style-type: none"> <li>• Fourth order from an upstream confluence with Nepean River; becomes third order upon joining Lily Ponds Creek and therefore 80 m and then 60 m riparian corridor required</li> <li>• Power lines and gas corridors widely spaced, making hostile crossing narrow</li> <li>• Most well-vegetated among all options, with ample vegetation along either side of riparian corridor</li> <li>• Area of corridor considered to be less attractive prospect for development</li> <li>• Designing fauna crossing expected to be easier than other options</li> <li>• Busway is expected to be near the Lilly Ponds-Ousedale creeks confluence, but stream can be bridged easily</li> <li>• Location too far south to be useful for animals moving northwards</li> </ul>	CPCP <ul style="list-style-type: none"> <li>• Habitat conservation and restoration in some areas</li> <li>• Fencing either side</li> <li>• Crossing options across Appin Road are being explored</li> <li>• Land purchases being explored to complete the corridor</li> </ul>	<ul style="list-style-type: none"> <li>• This corridor is suitable for koala habitation and should be protected with exclusion fencing and additional buffer zones as outlined for MGS2.</li> <li>• Suitability as a primary corridor will be contingent on a crossing being secured across Appin Road.</li> </ul>



<p>Secondary F CPCP</p>	<p>Elladale Creek and Simpsons Creek to the colliery</p>	<ul style="list-style-type: none"> <li>• Southernmost corridor</li> <li>• Poorly connects west of Appin village to the east through the vicinity of Brooks Point Road</li> <li>• Corridor has a large area of vegetation that is well populated with fauna and has high-nutrient shale soils</li> <li>• Traffic is light on Wilton Road</li> <li>• Area connecting Ousedale Creek and corridor is forecast to have busway transect it, and possibly a future urban centre</li> <li>• Corridor has poor linkage to east</li> <li>• Originates further south along Nepean Gorge, giving it little advantage over existing Cataract Gorge connection between Appin and Wilton</li> </ul>	<p>CPCP</p> <ul style="list-style-type: none"> <li>• Exclusion fencing</li> <li>• Habitat conservation and restoration in some areas</li> </ul>	<ul style="list-style-type: none"> <li>• This corridor is suitable for koala habitat and should be protected with exclusion fencing and additional buffer zones as outlined for MGS2.</li> <li>• Active management efforts will be required, informed by monitoring, if threats such as bushfire and predators are identified to avoid a population sink in this corridor</li> </ul>
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**Figure 8: Corridor widths in the proposed MGS2 development**  
Source: Eco Logical Australia (2020)



**Figure 9: Example of buffer zone at proposed Mount Gilead Stage 2 development**  
 Source: Eco Logical Australia (2020)





**LEGEND**

- 01 Shared Path
- 02 Nature Trail
- 03 Fitness Nodes
- 04 Drainage Swale
- 05 Online Detention Basin
- 06 Shelter & Picnic
- 07 Nature Play/ Exploring Trail
- 08 Kick About
- 09 Beulah Biobank Site
- Core Habitat/ Conservation
- Homestead Conservation
- Inner Protection Area – on development side (19m)
- Outer Protection Area – of creek side (10m)
- Existing Tree
- Proposed Tree
- Proposed Koala Habitat Tree

**NOTE:**

The **Inner Protection Area** prescriptive requirements:

**Trees:**

- canopy cover should be less than 15% (at maturity)
- trees (at maturity) should not touch or overhang the building
- lower limbs should be removed up to a height of 2m above ground
- canopies should be separated by 2 to 5m
- preference should be given to smooth barked and evergreen trees.

**Shrubs:**

- create large discontinuities or gaps in the vegetation to slow down or break the progress of fire towards buildings

The **Outer Protection Area** prescriptive requirements:

- shrubs should not be located under trees
- shrubs should not form more than 10% ground cover
- clumps of shrubs should be separated from exposed windows and doors by a distance of at least twice the height of the vegetation.

**Grass:**

- should be kept mown (as a guide grass should be kept to no more than 100mm in height)
- leaves and vegetation debris should be removed.

The **Outer Protection Area** prescriptive requirements:

**Trees:**

- tree canopy cover should be less than 30%
- trees should have canopy separation
- canopies should be separated by 2 to 5m

**Shrubs:**

- shrubs should not form a continuous canopy
- shrubs should form no more than 20% of ground cover

**Grass:**

- should be kept mown (as a guide grass should be kept to no more than 100mm in height)
- other debris should be mown, slashed or mulched.

**Figure 10: Mount Gilead Stage 2 Woodhouse Creek Koala corridor**  
Source: Eco Logical Australia (2020)

### 2.3.1 Mitigation of threats within developments

Without mitigation, the risk of vehicle strike to koalas will increase substantially as development proceeds. There is a number of examples of measures that will minimise and mitigate the impacts from roads and transport projects. These include designing fencing to prevent animal entry to roads or transport corridors, avoid locating new roads in environmentally sensitive areas and ensuring that fauna-sensitive road design elements are employed and maintained during and after road construction.

There are a number of measures proposed for the proposed MGS2 development and the draft CPCP to mitigate against threats within the urban region. These are described in Table 6.

**Table 6: Proposed measures to protect koala from threats within developments**

Plan	Proposed Measures	Panel comment
Mount Gilead Stage 2 Development	<ul style="list-style-type: none"> <li>• Development of a Construction Environmental Management Plan to avoid and mitigate potential construction impacts to offset sites. E.g. include temporary fencing around identified conservation areas, pre-clearance fauna protocols, and dewatering plans for existing dams. Pre-clearance Tree Clearing Protocol to achieve the aim of no death or injury to koalas during the construction phase, movement of tree residue that could provide habitat into the retained offsets, and pathogen and weed control protocols.</li> <li>• Identification and avoidance of conservation areas, with permanent protection and management for Biobank sites</li> <li>• Design measures to mitigate the risk of predation by domestic dogs: dog proof fencing on all residential lots, enforced prohibition of dogs within all Biobank sites, alternative dog-friendly open space areas, and community awareness programs (signage, etc.)</li> <li>• Traffic controls (onsite and road): speed limits (50 km/h) on local roads adjacent to conservation areas, signposted (in accordance with specifications set out by various NSW Government agencies and the Council), traffic calming devices and vegetation clearance adjacent to road</li> <li>• Education and awareness, with programs designed for construction and for the Mount Gilead community (process of managing injured koalas, best practice dog ownership, tree planting days, etc.)</li> </ul>	Areas of koala habitat should have exclusion fencing, where this occurs a 50 km/h speed limit is suitable. However, if koala fencing is not able to be used, a lower speed of 40 km/h should be observed with traffic calming devices and signage.
Cumberland Plain Conservation Plan	<p>The draft CPCP includes a number of commitments aimed at minimising the impacts from adjacent land-uses on conservation areas and to mitigate the impact from increased road development and movements. Specific actions that are highlighted include the preparation of a Koala Management Area Guideline that would incorporate planning, designing and development controls for the management of the impacts identified, the identification of areas where buffers are critical to protect conservation areas, and increase public awareness of the biodiversity values of the conservation sites.</p> <p>These actions will be undertaken in collaboration with the council and local landholders, as land holders in the area, with the CPCP also establishing a working group to provide advice on koala management and mitigation actions. This working group will also be tasked with reviewing mitigation measures within the Koala Management Area Guideline.</p> <p>The CPCP also identifies the need to amend Growth Centre SEPPs to stipulate adherence to the Koala Management Area Guideline for managing impacts within these areas.</p>	Areas of koala habitat should have exclusion fencing, where this occurs a 50 km/h speed limit is suitable. However, if koala fencing is not able to be used, a lower speed of 40 km/h should be observed with traffic calming devices and signage.

## 2.4 MONITORING AND MANAGEMENT

The uncertainty around how land and population changes and management actions will impact the koala population (either positively or negatively). This uncertainty can be addressed by: understanding the current koala population including how koalas use the landscape and their population attributes; putting in place a monitoring program to track this population over time; and adopting an adaptive management approach that is informed by real-time monitoring so that amendments and improvements can be made to mitigation measures as needed.

An adaptive management approach informed by monitoring and data capture will help chart a way forward for managing the koala population, at the construction phase as well as through the ongoing management phases. These principles are set out in the SEPP KOALA and in the NSW Koala Strategy. Principle 7 of the draft guidelines released as part of the new Koala SEPP sets out the use of adaptive management of koalas

Adaptive management is an iterative approach that uses ongoing monitoring to adjust or change management actions if they are proving ineffective or, conversely, if one action is having a greater benefit. It allows for the implementation of actions in a structured, yet flexible, manner to achieve a desired outcome. It is, more broadly, a method that ensures risk management is at the forefront on any decisions. It is based on the collection and analysis of data against a set of pre-determined questions/criteria.

An important aspect of adaptive management is the timeframe of actions and the response time to those actions (either positive or negative). For example, there are actions that may take time to be introduced and mature prior to becoming effective. Similarly, the benefits of revegetation on populations potentially would not be seen until several years after.

Linked to this is the need to monitor actions over time and implement strategies to ensure their continual effectiveness. For example, ensuring fence integrity in perpetuity or ensuring that no new predators have entered the habitat.

As part of the NSW Koala Strategy an NSW Koala Monitoring Framework is being developed. This Framework will provide structure to the long-term monitoring of koala populations in NSW, advocating for a consistent, best-practice approach across the functional topics of population dynamics, koala habitat, genetic diversity, disease and reproduction, and threats. At the heart of the Framework is adaptive monitoring, ensuring flexibility in ongoing monitoring that is informed by previous information and sets an overall strategic purpose for monitoring efforts, such as the evaluation of the effectiveness of management actions.

The proposed monitoring in the MGS2 development and in the draft CPCS are at Table 7.

**Table 7: Proposed monitoring measures in MGS2 and CPCS**

Plan	Proposed Measures
Mount Gilead Stage 2 Development	<ul style="list-style-type: none"> <li>• fauna assessments and modeling of koala populations have been undertaken as part of the biodiversity certification application process, providing a baseline for the koala population in the proposed development footprint</li> <li>• Monitoring associated with approval and compliance</li> </ul>
Cumberland Plain Conservation Plan	<ul style="list-style-type: none"> <li>• proposed Cumberland Plain Evaluation Program and the monitoring, evaluation, reporting and adaptive management that will support the implementation of the CPCS (NSW Government, 2020b).</li> <li>• proposed systematic collection and storage of data relevant to the three identified priorities:               <ul style="list-style-type: none"> <li>○ koalas at the interface (especially in response to management actions),</li> <li>○ the identification of threats, and</li> <li>○ demographic information (including life history and ecology).</li> </ul> </li> </ul> <p>This will also be evaluated to identify potential changes as a result of management actions (adverse or positive) and analyse how these management actions could be improved or if</p>

there are alternative actions that could be used. This evaluation will occur in the first 15 years of the Plan's implementation.

- Proposed monitoring to better understand the threat from Chlamydia, in light of their disease-free status, whilst noting that the SoS program will support this monitoring.

### **Panel comments**

- The Campbelltown koala population should be monitored. Baseline data is required to understand the current status of the population. This should be matched by ongoing and regular survey and monitoring efforts, to compare population trends over time and inform adaptive management approaches (including the development and understanding of appropriate triggers and responses, including timeframes). The site should be designated as one of the dedicated monitoring sites under the NSW Koala Strategy. Supporting these efforts should form part of the landholder, developer or proponents' responsibilities.
- Parameters that should be monitored include:
  - population dynamics (including age demographics, fertility and sex ratios, mortality and causation, etc.)
  - the identification, changes and effectiveness of mitigation actions for key threats (predators, vehicles, etc.),
  - tracking how individuals and the koala populations use and disperse throughout the environment (including male movement during mating season, changes in territories, etc.)
  - monitoring for the prevalence of disease, such as Chlamydia and KoRV, which should trigger immediate actions such as vaccination if there is a change in levels detected.
  - monitoring koala generations over time to understand whether offspring are less stressed than their parents and more accustomed to urban edge locations.
- Intrinsically linked to triggers under an adaptive management approach is understanding how monitoring is conducted, and whether there is lag time associated with measurements. For example, trailing indicators such as reduced reproduction may present too late for effective management actions that halt the decline to be implemented. Adaptive management should incorporate leading and lagging indicators appropriately
- Tissue sampling of joeys, along with tagging of the Campbelltown koala population will allow insight into the functional genetics of this koala population and how it could lead to increased resilience in NSW. For any koala monitored, efforts should be made to contribute samples in the ascribed manner to the Australian Museum, as the dedicated NSW biobank for tissue samples. The resulting genetic data can inform translocation strategies that may be required if active management procedures are needed for fragmented enclosed populations as discussed above in CPCP Scenario 3.
- There is an opportunity to use new techniques and technologies to study this population and inform management efforts. For example,
  - new implantable sensor technologies, similar to proximity tags used in marine environments, could be used to understand koala movements when combined with passive sensor stations, and could be investigated further by NSW initiatives such as the NSW Smart Sensing Network. Proximity tagging will identify whether there are areas of the landscape that koalas do not use, or avoid, which will inform future decisions about habitat protection.



- Drone technology to detect koala presence
- The population has remained relatively free from *Chlamydia* infection. However, there is widespread infection in the Southern Highlands population, and it is believed that this infection could move north into the population due to connectivity between the populations. Animals that are captured and/or handled as part of a monitoring program or those that are rehabilitated and released back into the Campbelltown population should be vaccinated against Chlamydia.

## ACRONYMS

Acronym	Full Term
APZ	Asset Protection Zone
BAM	Biodiversity Assessment Method
BC Act	NSW <i>Biodiversity Conservation Act 2016</i>
BCAM	Biodiversity Certification Assessment Methodology
BCAR	Biodiversity Certification Assessment Report
BDAR	Biodiversity Development Assessment Report
BSA	Biodiversity Stewardship Agreement
CKPoM	Comprehensive Koala Plan of Management
CPCP	Cumberland Plain Conservation Plan
DPIE	NSW Department of Planning, Industry and Environment (the Department)
EP&A Act	NSW <i>Environmental Planning and Assessment Act 1979</i>
EPBC Act	Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i>
GMGA	Greater Macarthur Growth Area
LGA	Local Government Area
MGS1	Mount Gilead Stage 1
MGS2	Mount Gilead Stage 2
SEPP	State Environmental Planning Policies
SoS	Saving our Species
TfNSW	Transport for NSW (road authority)
TSC Act	NSW <i>Threatened Species Conservation Act 1995</i>

## APPENDIX 1 - TERMS OF REFERENCE

### **Terms of Reference: Advice regarding the protection of the Campbelltown Koala population**

To provide advice to the Minister for Energy and Environment and the Minister for Planning and Public Spaces about:

- The adequacy of the proposed measures for koala conservation proposed by property group Lendlease on land referred to as Mt Gilead Stage 2 (MGS2) and the consistency of these measures with the NSW Koala strategy.
- What, if any, additional conservation measures are considered necessary.
- What, if any, site specific measures for koala species should be incorporated into the Cumberland Plain Conservation Plan for the Greater Macarthur Growth Area to support the long-term viability of the koala population.
- Whether east-west corridors linking the Nepean and Georges Rivers can contribute to the conservation of the Campbelltown koala population; and, if so, which east-west corridors and what measures should be taken to ensure their effectiveness.

In preparing this advice the Chief Scientist & Engineer will review existing science and relevant documentation including;

- NSW Koala Strategy
- Independent Review into the Decline of Koala Populations in Key Areas of NSW, NSW Chief Scientist and Engineer, 2016.
- Conserving Koalas in the Wollondilly and Campbelltown Local Government Areas report, Dept. Planning Industry and Environment, October 2019
- Koala Corridor Project Campbelltown City Council and Wollondilly Local Government Areas: Greater Macarthur Growth Area, Biolink Consultants, October 2018
- South Campbelltown Koala Habitat Connectivity Study prepared for Campbelltown City Council, Biolink Consultants, 2017.
- Fact Sheet CPCP Protecting Koalas on the Cumberland Plain, Dept. Planning, Industry and Environment, September 2019
- Mt Gilead Stage 1 Biodiversity Certification Agreement
- Application for biodiversity certification for Mt Gilead Stage 2, Campbelltown City Council, August 2019
- Biodiversity Certification Assessment Methodology (BCAM). Office of Environment and Heritage, 2011
- Greater Macarthur 2040: An interim Plan for the Greater Macarthur Growth Area, Department of Planning and Environment
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- Any other documentation, science and previous reports that are considered relevant.

**Reporting timeframe**

The advice will be provided in a report by 30 April 2020.

**Expert Panel**

An Independent Expert Panel, chaired by the Deputy NSW Chief Scientist & Engineer, will be established to provide advice.

**Support**

Secretariat support will be provided by the Office of the Chief Scientist and Engineer.

The Department of Planning, Industry and Environment will also provide support. The agency contact is Kate Wilson, Executive Director Climate Change and Sustainability, Environment, Energy and Science.

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# Appendix B

## Drawing package



# CAMPBELLTOWN CITY COUNCIL MR177 APPIN ROAD

## GLEN LORNE AND BROWNS BUSH FAUNA UNDERPASS MOUNT GILEAD TO NOORUMBA RESERVE

### GE-00001 GENERAL CONCEPT DESIGN





LOCALITY PLAN  
NOT TO SCALE

#### PART INDEX

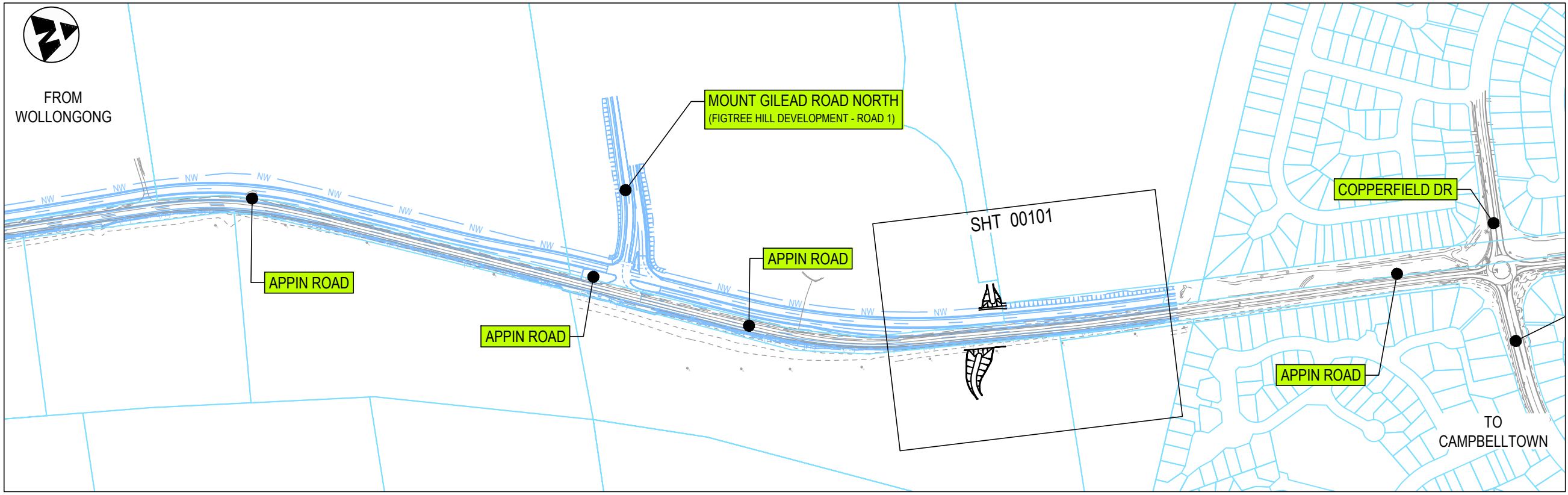
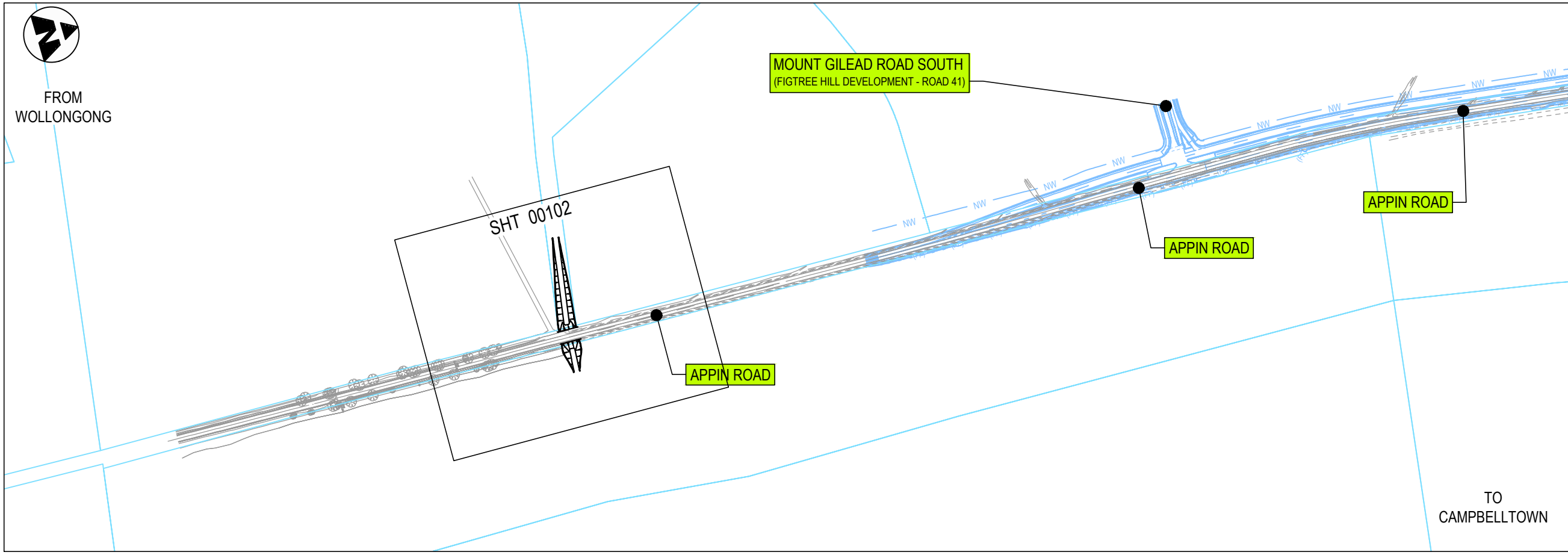
CODE	NAME
GE-00001	GENERAL
PV-00001	PAVEMENT
PW-00001	PROPERTY WORKS
RD-00001	ROAD ALIGNMENT
RF-00001	ROADSIDE FURNITURE, SIGNS AND LINES
SM-00001	STORMWATER MANAGEMENT
CS-00001	CONSTRUCTION STAGING
UT-00001	UTILITIES (WSP AND BY OTHERS)
MS-00001	MISCELLANEOUS STRUCTURES

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150mm ON A3 SIZE ORIGINAL

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PREPARED BY  Level 27, 680 George Street, Sydney GPO Box 5394, NSW 2001, Australia Tel: +61 2 9272 5100 Fax: +61 2 9272 5101 wsp.com		DESIGNED SIGNED ..... NAME <b>MARTIN HENEGHAN</b> TITLE <b>SENIOR DESIGNER</b> DATE <b>30.09.22</b>		REVIEWED SIGNED ..... NAME <b>DANIEL PARK</b> TITLE <b>ASSOCIATE DESIGN MANAGER</b> DATE <b>30.09.22</b>		VERIFIED SIGNED ..... NAME <b>RODNEY CHARLTON</b> TITLE <b>PRINCIPAL DESIGN MANAGER</b> DATE <b>30.09.22</b>		RMS PROJECT MANAGER NAME <b>RUHUL CHOWDHURY</b> TITLE <b>DEVELOPER WORKS LEADER</b> VALIDATION AND ACCEPTANCE OF THESE DRAWINGS AND THE DESIGN SHOWN THEREON IS TO BE CARRIED OUT UNDER SEPARATE PROCESS		PREPARED FOR TBC	
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								RMS REGISTRATION No. <b>DS2019/000540</b>		PART	
								ISSUE STATUS CONCEPT DESIGN		EDMS No. SHEET No. <b>GE-00001</b> ISSUE <b>02</b>	

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				<small>Level 27, 680 George Street, Sydney GPO Box 5394, NSW 2001, Australia Tel: +61 2 9272 5100 Fax: +61 2 9272 5101 wsp.com</small>		<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>TITLE</th> <th>NAME</th> <th>DATE</th> </tr> </thead> <tbody> <tr> <td>DRAWN</td> <td>CATHY ZHANG</td> <td>30.09.22</td> </tr> <tr> <td>DRG CHECK</td> <td>CLAUDIO BIDART</td> <td>30.09.22</td> </tr> <tr> <td>DESIGN</td> <td>MARTIN HENEGHAN</td> <td>30.09.22</td> </tr> <tr> <td>DESIGN CHECK</td> <td>MARTIN HENEGHAN</td> <td>30.09.22</td> </tr> <tr> <td>DESIGN MNGR</td> <td>DANIEL PARK</td> <td>30.09.22</td> </tr> <tr> <td>PROJECT MNGR</td> <td>JONATHAN EPSELIS</td> <td>30.09.22</td> </tr> </tbody> </table>		TITLE	NAME	DATE	DRAWN	CATHY ZHANG	30.09.22	DRG CHECK	CLAUDIO BIDART	30.09.22	DESIGN	MARTIN HENEGHAN	30.09.22	DESIGN CHECK	MARTIN HENEGHAN	30.09.22	DESIGN MNGR	DANIEL PARK	30.09.22	PROJECT MNGR	JONATHAN EPSELIS	30.09.22
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150mm ON A3 SIZE ORIGINAL

SHEET NO.	TITLE		
GE-00001	GENERAL	COVER SHEET	SHEET 1
GE-00002	GENERAL	KEY PLAN	SHEET 1
GE-00006	GENERAL	INDEX SHEET	SHEET 1
GE-00010	GENERAL	GENERAL NOTES	SHEET 1
GE-00011	GENERAL	GENERAL NOTES	SHEET 2
RD-00021	ROAD ALIGNMENT	TYPICAL SECTIONS	SHEET 1
RD-00021	ROAD ALIGNMENT	TYPICAL SECTIONS	SHEET 2
RD-00101	ROAD ALIGNMENT	GENERAL ARRANGEMENT PLAN	SHEET 1
RD-00102	ROAD ALIGNMENT	GENERAL ARRANGEMENT PLAN	SHEET 2
RD-00201	ROAD ALIGNMENT	LONGITUDINAL SECTIONS	SHEET 1
RD-00202	ROAD ALIGNMENT	LONGITUDINAL SECTIONS	SHEET 2
SM-00101	STORM WATER	GENERAL ARRANGEMENT PLAN	SHEET 1
SM-00102	STORM WATER	GENERAL ARRANGEMENT PLAN	SHEET 2
SM-00201	STORM WATER	LONGITUDINAL SECTION	SHEET 1
SM-00202	STORM WATER	LONGITUDINAL SECTION	SHEET 2
PV-00101	PAVEMENT	PAVEMENT PROFILES	SHEET 1
PV-00101	PAVEMENT	GENERAL ARRANGEMENT PLAN	SHEET 1
PV-00102	PAVEMENT	GENERAL ARRANGEMENT PLAN	SHEET 2
RF-00021	ROAD FURNITURE	FENCE DETAILS	SHEET 1
RF-00101	ROAD FURNITURE	GENERAL ARRANGEMENT PLAN	SHEET 1
RF-00102	ROAD FURNITURE	GENERAL ARRANGEMENT PLAN	SHEET 1
RF-00103	ROAD FURNITURE	GENERAL ARRANGEMENT PLAN	SHEET 2
RF-00104	ROAD FURNITURE	GENERAL ARRANGEMENT PLAN	SHEET 3
UT-00101	UTILITIES	GENERAL ARRANGEMENT PLAN	SHEET 1
UT-00102	UTILITIES	GENERAL ARRANGEMENT PLAN	SHEET 1
CS-01101	CONSTRUCTION STAGING	STAGE 1 - GENERAL ARRANGEMENT PLAN	SHEET 1
CS-01102	CONSTRUCTION STAGING	STAGE 1 - GENERAL ARRANGEMENT PLAN	SHEET 2
CS-01103	CONSTRUCTION STAGING	STAGE 1 - GENERAL ARRANGEMENT PLAN	SHEET 3
CS-01104	CONSTRUCTION STAGING	STAGE 1 - GENERAL ARRANGEMENT PLAN	SHEET 4

SHEET NO.	TITLE		
CS-01201	CONSTRUCTION STAGING	STAGE 2 - GENERAL ARRANGEMENT PLAN	SHEET 1
CS-01202	CONSTRUCTION STAGING	STAGE 2 - GENERAL ARRANGEMENT PLAN	SHEET 2
CS-01203	CONSTRUCTION STAGING	STAGE 2 - GENERAL ARRANGEMENT PLAN	SHEET 3
CS-01204	CONSTRUCTION STAGING	STAGE 2 - GENERAL ARRANGEMENT PLAN	SHEET 4
CS-01301	CONSTRUCTION STAGING	STAGE 2 - GENERAL ARRANGEMENT PLAN	SHEET 1
CS-01401	CONSTRUCTION STAGING	STAGE 2 - GENERAL ARRANGEMENT PLAN	SHEET 2
PW-01081	PROPERTY WORKS	LOT 1 DP 603675	SHEET 1
PW-01091	PROPERTY WORKS	LOT 27 DP 239388 AND LOT 2 DP 603674	SHEET 1
PW-01201	PROPERTY WORKS	LOT 11 DP 239388	SHEET 1
PW-01211	PROPERTY WORKS	LOT 2 DP 1218887	SHEET 1
MS-00151	MISCELLANEOUS STRUCTURE	CULVERT PLAN AND SECTION	SHEET 1
MS-00151	MISCELLANEOUS STRUCTURE	CULVERT HEADWALL ELEVATION	SHEET 1
MS-00151	MISCELLANEOUS STRUCTURE	CULVERT PLAN AND SECTION	SHEET 1
MS-00151	MISCELLANEOUS STRUCTURE	CULVERT HEADWALL ELEVATION	SHEET 1

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EXTERNAL REFERENCE FILES	REV	DATE	AMENDMENT / REVISION DESCRIPTION	WVR No.	APPROVAL	SCALES ON A3 SIZE DRAWING	DRAWINGS / DESIGN PREPARED BY	TITLE	NAME	DATE		PREPARED FOR TBC	RMS REGISTRATION No. <b>DS2019/000540</b>	PART				
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	02	30.09.22	UPDATED CONCEPT DESIGN					DRG CHECK	CLAUDIO BIDART	30.09.22								
						CO-ORDINATE SYSTEM MGA ZONE 56		HEIGHT DATUM A.H.D.	DESIGN	MARTIN HENEGHAN								30.09.22
									DESIGN CHECK	STEVE MCKENNA								30.09.22
									DESIGN MNGR	DANIEL PARK	30.09.22							
								PROJECT MNGR	JONATHAN EPSELIS	30.09.22								



**GENERAL NOTES**

- NOTES ARE TO BE READ IN CONJUNCTION WITH THE GENERAL NOTES IN GE-00001.
- REDUCED LEVEL ARE TO AUSTRALIAN HEIGHT DATUM (AHD)
- COORDINATE CONTROL IN ON MAP GRID OF AUSTRALIA (GDA 94 - MGA ZONE 56)
- ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE NOTED. ALL LEVELS, COORDINATES AND CHAINAGES ARE EXPRESSED IN METRES.
- WHERE PROPRIETARY PRODUCTS OR COMPONENTS ARE SPECIFIED ON THE DRAWINGS, ALTERNATIVES MAY BE PROPOSED PROVIDED THEY ARE AN TNSW APPROVED EQUIVALENT.

**SETOUT (ROADS)**

- THE ROADWORKS AND EARTHWORKS FINISHED SURFACE LEVELS SHALL BE SETOUT TO THE DESIGN MODEL PROVIDED (IN 12DA FORMAT).
- IF A DISCREPANCY EXISTS BETWEEN THE DESIGN MODEL AND DRAWINGS THE MATTER MUST BE REFERRED TO THE DESIGN SITE REPRESENTATIVE.

**SPECIFICATIONS**

- THESE DRAWINGS ARE TO BE READ IN CONJUNCTION WITH PROJECT SPECIFIC TECHNICAL SPECIFICATIONS.
- ALL CONSTRUCTION MATERIALS AND WORKMANSHIP SHALL BE IN ACCORDANCE WITH THE PROJECT TECHNICAL SPECIFICATION FOR THE WORKS AND THE REQUIREMENTS OF ALL RELEVANT CODES OF PRACTICE REFERRED TO THERE IN AND THE REQUIREMENTS OF STATUTORY AUTHORITIES WHERE APPLICABLE.

**LINE MARKING**

- RETRO REFLECTIVE RAISED PAVEMENT MARKERS (RRPMs) SHALL BE PLACED ADJACENT TO ALL LANE, EDGE AND BARRIER LINES. SPACING OF RAISED MARKERS SHALL BE IN ACCORDANCE WITH TNSW SPECIFICATION D&C R142.
- PAVEMENT MARKING TO BE PROVIDED IN ACCORDANCE WITH TNSW SPECIFICATION D&C R141.
- LINE MARKING TO BE IN ACCORDANCE WITH TNSW DELINEATION GUIDELINES, THE RELEVANT TNSW TECHNICAL DIRECTIONS, COMPLEMENTARY GUIDELINES, TNSW AUSTROADS AND AUSTRALIAN STANDARDS SUPPLEMENTS, AUSTRALIAN STANDARD 1742 AND TNSW SPECIFICATIONS.
- LINEMARKING MUST BE PROVIDED ON PAVEMENT SURFACES AS FOLLOWS:  
LOCAL ROAD WORKS - WATERBORNE PAINT LINEMARKING; AND  
MAIN CARRIAGEWAY AND RAMPS - THERMOPLASTIC LINEMARKING ON ASPHALT SURFACES AND WATERBORNE PAINT LINE MARKING ON CONCRETE SURFACES

**SIGNAGE**

- MANUFACTURE, SUPPLY AND INSTALLATION OF SIGNPOSTING SHALL BE IN ACCORDANCE WITH TNSW D&C SPECIFICATION R143.

**FENCING NOTES**

- FENCING INSTALLATION MUST BE CARRIED OUT IN ACCORDANCE WITH DETAILS ASSOCIATED TO THESE DESIGN DRAWINGS.
- ALL EXISTING FENCING WITHIN THE PROJECT BOUNDARY TO BE REMOVED UNLESS INDICATED OTHERWISE.
- CLEARING SHOULD BE RESTRICTED TO INSIDE THE CLEARING BOUNDARY FOR THE PROJECT. ANY OVERHANGING VEGETATION DIRECTLY ABOVE THE FAUNA FENCE TO BE CLEARED TO A MINIMUM OF 2m CLEARANCE.
- FENCING SHALL NOT BE FINISHED WITH PLASTIC COATINGS.
- FENCE POSTS TO ADHERE TO MAXIMUM 3000mm CENTERS.
- ENDS OF FENCES ARE TO HAVE STRAINER POSTS PROVIDED.
- FAUNA FENCE POSTS TO BE POSITIONED EITHER SIDE OF UNDERGROUND UTILITIES AND DRAINAGE CULVERTS TO AVOID POTENTIAL CLASHES.
- FAUNA FENCE SHOULD CONTAIN INTERNAL ANGLES GREATER THAN 160°.
- STEEL ITEMS SHALL BE HOT DIP GALVANISED IN ACCORDANCE WITH AS 4680.

**BARRIER NOTES**

- EZY-GUARD HIGH CONTAINMENT STEEL RAIL SAFETY BARRIER SYSTEM TO BE ADOPTED.
- BARRIERS TO BE INSTALLED AS PER TNSW'S ACCEPTANCE CONDITIONS AND MANUFACTURERS SPECIFICATION AND GUIDELINE.
- A CHECK MUST BE PERFORMED TO CONFIRM HAZARD PROTECTION HAS BEEN ACHIEVED USING TABLE 6.10 OF AGRD (PART 6), 2010 FOR RESPECTIVE SIGNPOSTED SPEED LIMIT.
- APPROVED TERMINAL AND CONNECTIONS TO BE ADOPTED AND USED AS PER RMS'S ACCEPTANCE CONDITION.
- EZY-GUARD DELINEATORS TO BE INSTALLED AT 20m INTERVALS, UNLESS NOTED OTHERWISE ON THE DRAWINGS.

**DRAINAGE NOTES**

- NOTES ARE TO BE READ IN CONJUNCTION WITH THE GENERAL NOTES IN GE-00001.
- DO NOT OBTAIN DIMENSIONS BY SCALING FROM THE DRAWINGS.
- DURING CONSTRUCTION, PROVIDE TEMPORARY BRACING/SUPPORT AS REQUIRED TO KEEP THE WORKS AND EXCAVATIONS STABLE AT ALL TIMES.
- PIPE INSTALLATION IS TO USE A TYPE HS3 SUPPORT AS PER TNSW MODEL DWG MD.R11.A01.A.2 U.N.O. IN CASES WHERE THE TRENCH CONDITION IS SATURATED THEN ALTERNATIVE BACKFILL MATERIAL TO BE PROPOSED FOR APPROVAL BY THE PRINCIPAL THAT ADHERE TO TNSW/RTA TECHNICAL DIRECTION 2009/008 QUALITY ALERT No.8 - BACKFILL OF CULVERT IN WET CONDITIONS.
- REFER TO 'SCHEDULE OF TNSW MODEL DRAWINGS' FOR RELEVANT PIT DETAIL REFERENCED ON THE DRAWINGS. ANY EXPOSED REINFORCEMENT TO BE PROTECTED IN ACCORDANCE WITH R53 REQUIREMENTS.
- EXISTING STORMWATER PIPES THAT ARE TO BE DECOMMISSIONED ARE TO BE REMOVED WHERE PRACTICAL OR ELSE GROUT FILLED WITH FLOWABLE GROUT WITH THE APPROVAL OF THE PRINCIPAL.
- FOR DETAILS OF ACCESS TO PITS REFER TO TNSW MODEL DRAWING No. MD.R11.B47.B U.N.O.
- ALL REINFORCEMENT SHALL BE IN ACCORDANCE WITH AUSTRALIAN STANDARD 4671 GRADE D500L (FITMENT) AND D500N (TYPICAL).
- GEOTEXTILES TO CONFORM WITH R63.

**DRAINAGE NOTES - DESIGN INFORMATION**

- PIPE BEDDING ASSUMED TO BE HS3 IN ACCORDANCE WITH AS3725 AND PC R11 U.N.O.
- U.N.O ALL PIPES HAVE BEEN PLACED AS A MINIMUM:  
300mm BELOW THE SELECTED MATERIAL ZONE (SMZ);  
ALL DRAINAGE PIPES SHALL BE MINIMUM CLASS 4 RUBBER RING JOINT RCP, U.N.O.
- TNSW MODEL DRAWINGS TO BE ADOPTED ONLY WHERE REFERENCED/APPROVED.
- STEEL GRATES AND FRAMES ARE TO BE FABRICATED FROM MILD STEEL AND HOT DIP GALVANISED. ALL GRATES ARE TO BE CLASS D (U.N.O.). GRATES WITHIN THE PAVEMENTS SURFACE (INCLUDES ADJOINING SO GUTTER) ARE TO BE BICYCLE SAFE IN ACCORDANCE WITH AS 3996 U.N.O.
- ALL WELDS ARE TO BE CATEGORISED AS GENERAL PURPOSE AND TO COMPLY WITH AUSTRALIAN STANDARD AS IS54 (U.N.O.). FILLET WELDS TO BE NOT LESS THAN 6MM U.N.O.
- ALL REINFORCEMENT SHALL COMPLY WITH AS 4671 GRADE D500L (FITMENTS) AND D500N (TYPICAL).
- PITS MORE THAN 1200mm DEEP TO BE PROVIDED WITH STEP IRONS IN ACCORDANCE WITH TNSW MODEL DRAWING MD.R11.B47.B.

**DRAINAGE NOTS - SERVICES**

- THE LOCATION AND LEVEL OF ALL SERVICES CROSSING NEW STORMWATER LINES MUST BE OBTAINED PRIOR TO CONSTRUCTION. ALL LEVELS MUST BE CHECKED FOR CONFLICT WITH ANY SERVICES AND ANY CONFLICTS TO BE RESOLVED.
- REFER TO UTILITY DESIGN LOT FOR SERVICE DETAILS.

**CHANNELS**

- FOR SETOUT OF CHANNELS REFER TO THE EARTHWORK DIGITAL DESIGN MODEL. ALL CHANNEL SETOUT TO BE CONFIRMED BY CONTRACTOR ON-SITE AFTER REVIEW OF THE LOCATION AND LEVEL AGAINST TOPOGRAPHY AND ENVIRONMENTAL CONSTRAINTS.
- ALL CONCRETE LINING SHALL BE IN ACCORDANCE TO TNSW QA SPECIFICATION R53.
- FOR VEGETATED CHANNELS, JUTE MESH LINING SHALL BE LAID AND PINNED IN ACCORDANCE WITH MANUFACTURER'S SPECIFICATIONS AND SATISFY THE REQUIREMENTS OF TNSW D&C SPECIFICATION R178.

**CONCRETE**

- CONCRETE SHALL CONFORM TO AS 1379. CHEMICAL ADMIXTURES, INCLUDING CORROSION INHIBITORS, AND THEIR USE MUST CONFORM TO AS 1478.1.
- CONCRETE EXPOSURE CLASSIFICATION = B1.
- MINIMUM 28 DAY COMPRESSIVE STRENGTH OF CAST-IN-PLACE CONCRETE SHALL BE 40MPa.
- MINIMUM 28 DAY COMPRESSIVE STRENGTH OF MASS CONCRETE BLINDING SHALL BE 20MPa.
- MINIMUM 28 DAY COMPRESSIVE STRENGTH OF NON-SHRINK GENERAL PURPOSE GROUT SHALL BE 40MPa.
- SURFACE FINISHES SHALL BE IN ACCORDANCE WITH TNSW QA SPECIFICATION B80.
- CONSTRUCTION JOINTS (CJ) SHALL BE WELL SCABBLED, CLEANED AND MOISTENED BEFORE POURING NEXT CONCRETE SECTION.
- CONTRACTOR TO SEEK DESIGN APPROVAL FOR ANY ADDITIONAL CONSTRUCTION JOINTS (CJ). EDGES SHALL BE CHAMFERED 20 x 20 AND RE-ENTRANT ANGLES FILLETED 20 x 20 (UNLESS NOTED OTHERWISE).
- CROWN UNITS TO BE PLACED ON A BED OF FRESH CEMENT MORTAR TO ENSURE UNIFORM BEARING IN ACCORDANCE WITH AS 1597.2.

**REINFORCEMENT NOTES**

- ALL REINFORCEMENT TO BE GRADE D500N IN ACCORDANCE WITH AS/NZS. 4671, UNLESS SPECIFIED OTHERWISE.
- NOMINAL COVER TO REINFORCEMENT NEAREST TO THE CONCRETE SURFACE SHALL BE:  
CAST AGAINST GROUND OR BLINDING CONCRETE=75mm,  
CONCRETE BUND = 30mm,  
ELSEWHERE = 45mm.
- LAPS NOT SHOWN ON THE DRAWINGS SHALL BE STAGGERED SO THAT NOT MORE THAN 50% OF THE BARS ARE LAPPED IN ANY CROSS SECTION.
- THE DEVELOP LENGTH SHALL BE 80% OF THE VALUES TABULATED ABOVE. REINFORCEMENT MAY BE DISPLACED SLIGHTLY WHERE NECESSARY TO CLEAR DOWELS AND GENERAL FITMENTS.  
ABBREVIATIONS:  
NF - NEAR FACE, EW - EACH WAY  
FF - FAR FACE, EF - EACH FACE  
UNO - UNLESS NOTED OTHERWISE  
\* VARIABLE LENGTH BAR  
# LAP LONGITUDINAL REINFORCING BARS AS REQUIRED

**CONSTRUCTION STAGING**


- ALL WORK TO BE IN ACCORDANCE WITH TNSW TRAFFIC CONTROL AT WORKSITES (TCAWS) MANUAL VERSION 6.1, TNSW QA G10 SPECIFICAION AND APPROVED ROAD OCCUPENCY LICENCES.
- THE CONTRACTOR SHALL PREPARE AND OBTAIN APPROVAL FROM RMS/TMC FOR TRAFFIC CONTROL PLANS FOR EACH CONSTRUCTION STAGE BEFORE COMMENCEMENT AT SITE.
- THE CONTRACTOR SHALL MONITOR AREAS UNDER TRAFFIC TO BE EFFECTIVELY DRAINED AT ALL TIMES. J-J HOOKS OR APPROVE EQUIVALENT CONCRETE SAFETY BARRIERS WITH SLOTS TO BE USED TO PREVENT RUN-OFF WATER PONDING ALONG THE BARRIER LINE.
- ALL REDUNDANT PAVEMENT MARKINGS TO BE REMOVED BEFORE TRAFFIC SWITCH.
- ACCESS TO FIRE AND EMERGENCY SERVICES TO BE MAINTAINED AT ALL TIME.
- ACCESS TO PROPERTIES AND LOCAL ROADS SHALL BE RETAINED THROUGHOUT CONSTRUCTION.
- LANE AND SHOULDER WIDTHS AS SHOWN ON DRAWINGS. IF DETAIL IS OMITTED, REFER TCAWS 6.1 FOR RELEVANT DIMENSIONS.
- UTILITY RELOCATIONS TO BE COMPLETED BEFORE COMMENCEMENT OF EACH STAGE. FOR UTILITIES RELOCATIONS AND CONSTRUCTION REFER TO CERTIFIED UTILITIES DRAWINGS FOR RELEVANT AUTHORITIES. OPERATIONAL REQUIREMENTS OF THE SERVICE PROVIDERS WILL BE CONSIDERED WHEN CONFIRMING CONSTRUCTION STAGING AND COMMISSIONING OF UTILITIES.
- CONTRACTOR SHALL CONFIRM THE LOCATION OF ALL SERVICES PRIOR TO COMMENCING WORK.
- CONSTRUCTION WORKS TIE-INS TO BE CONSTRUCTED UNDER LIVE TRAFFIC DURING THE OFF-PEAK HOURS.
- TEMPORARY CONCRETE BARRIERS AND SIGNAGE TO BE INSTALLED DURING NIGHT WORKS.
- TEMPORARY BARRIER SYSTEM, TERMINAL OR TEMPORARY CRASH CUSHION SHOULD BE ADOPTED FROM THE CURRENT TNSW APPROVED SAFETY BARRIER PRODUCTS (WORKZONE - TEMPORARY). 6M JJ HOOKS SYSTEM WITH SLOTS HAS BEEN USED FOR SPACE PROOFING AND TO BE USED TO PREVENT RUN-OFF WATER PONDING ALONG THE BARRIER LINE.
- TEMPORARY LINE MARKING SHALL BE DEFINED AND INSTALLED BY THE CONTRACTOR IN ACCORDANCE WITH RMS SPECIFICATION R141 AND RMS DELINEATION GUIDELINES.

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150mm ON A3 SIZE ORIGINAL

DOCUMENT NUMBER / NAME <b>PS107784-1B-GE-DRG-00010</b>				DESIGN LOT CODE		DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING				PLOT DATE / TIME 29 September 2022 - 4:38:12 PM			PLOT BY Zhang, Cathy			CLIENT			CAMPBELLTOWN CITY COUNCIL MR177 APPIN ROAD GLEN LORNE AND BROWNS BUSH FAUNA UNDERPASS			A3														
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				01	11.03.22	ISSUED FOR CONCEPT DESIGN						NOT TO SCALE   Level 27, 680 George Street, Sydney GPO Box 5394, NSW 2001, Australia Tel: +61 2 9272 5100 Fax: +61 2 9272 5101 wsp.com				DRAWN			CATHY ZHANG			30.09.22			DRG CHECK			CLAUDIO BIDART			30.09.22					
				02	30.09.22	UPDATED CONCEPT DESIGN				DESIGN						MARTIN HENEGHAN			30.09.22			DESIGN CHECK			STEVE MCKENNA			30.09.22								
								CO-ORDINATE SYSTEM MGA ZONE 56				HEIGHT DATUM A.H.D.				DESIGN MNGR			DANIEL PARK			30.09.22			PROJECT MNGR			JONATHAN EPSELIS			30.09.22					
																PREPARED FOR			TBC			RMS REGISTRATION No.			DS2019/000540			PART								
																ISSUE STATUS			CONCEPT DESIGN			EDMS No.			SHEET No.			GE-00010			ISSUE			02		

**RIP RAP (SCOUR ROCK)**

- RR1. GEOTEXTILE SHALL BE IN ACCORDANCE WITH PC SPECIFICATION R63 AND THE MANUFACTURER SPECIFICATIONS.
- RR2. ROCK FOR RIP RAP SHALL HAVE A MINIMUM SPECIFIC GRAVITY OF 2.65, A MINIMUM POINT LOAD STRENGTH INDEX (ISSO) OF 1MPa AND WET STRENGTH VARIATION OF NO MORE THAN 35%.
- RR3. THE GRADATION OF ROCK USED FOR RIP RAP SHALL BE:

ROCK GRADATION
D <sub>30</sub> = VARIES
D <sub>15</sub> = 0.75 D <sub>50</sub>
D <sub>85</sub> = 1.5 D <sub>50</sub>
D <sub>100</sub> = 2.0 D <sub>50</sub>

ACTUAL D50 SHALL BE WITHIN 10% OF THE SPECIFIED NOMINAL DIAMETER. D85/D15 SHALL FALL BETWEEN THE RANGE OF 1.5 MIN AND 2.5 MAX

- RR6. RIP RAP SHALL BE PLACED IN A MANNER THAT PREVENTS DAMAGE TO THE GEOTEXTILE.

**CULVERT**

- CU1. FOUNDATION AND TRENCH BASES MUST COMPLY WITH TNSW R11 STORMWATER DRAINAGE SPECIFICATION.
- CU2. A QUALIFIED GEOTECHNICAL ENGINEER SHALL VERIFY THE CONDITIONS OF THE FOUNDATION PRIOR TO CONSTRUCTION. A MINIMUM ALLOWABLE BEARING PRESSURE OF 150kPa (TO BE CONFIRMED WITH DCP TESTING) IS REQUIRED.

**SEDIMENT AND EROSION CONTROL**

- SE1. CONTRACTOR TO DEVELOP EROSION AND SEDIMENT CONTROL PLAN IN ACCORDANCE WITH TNSW GUIDELINE G38 PRIOR TO CONSTRUCTION WORK.



**UTILITIES**

- UT1. THE UTILITIES / SERVICES SHOWN IN THESE PLANS HAVE BEEN COMPILED FROM MULTIPLE SOURCES OF INFORMATION. ADDITIONAL SURVEY PROVIDED HAS BEEN CAPTURED AND INCORPORATED. THE LOCATIONS ARE APPROXIMATE ONLY.
- UT2. ALL UTILITIES SHOWN ON THE DRAWINGS HAVE BEEN DETERMINED BASED ON A COLLATION OF DATA OF VARIOUS QUALITY LEVELS. A COMBINATION OF LEVEL A TO LEVEL D DATA IN ACCORDANCE WITH AS5488 (2019), HAVE BEEN UTILISED TO DETERMINE AND IN SOME INSTANCES INTERPOLATE THE SERVICES LOCATIONS.
- UT3. ALL UTILITIES AND SURVEY SHOWN ARE TO SETOUT TO THE AUSTRALIAN HEIGHT DATUM (AHD) 1994 ZONE 56.
- UT4. NO GUARANTEE IS GIVEN THAT ALL EXISTING SERVICES ARE SHOWN. NOT ALL EXISTING UTILITIES / SERVICES ARE PROVIDED IN DIAL BEFORE YOU DIG REQUESTS.
- UT5. THE CONTRACTOR IS TO ENSURE THE LOCATION OF ALL UNDERGROUND SERVICES HAVE BEEN LOCATED AND VERIFIED PRIOR TO THE COMMENCEMENT OF CONSTRUCTION ACTIVITIES.
- UT6. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO ENSURE THAT ALL SERVICES ARE LOCATED/MARKED BY THE APPROPRIATE SERVICE AUTHORITY PRIOR TO ANY SITE WORK COMMENCING, AND FOR PROTECTING THESE SERVICES FOR THE DURATION OF THE SITE CONTRACT.
- UT7. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO ARRANGE PROTECTION OFFICERS FROM ASSET OWNERS TO SUPERVISE THE WORKS.
- UT8. THIS ITEM IS ESPECIALLY RELEVANT FOR THE SYDNEY WATER RISING SEWER MAIN.
- UT9. WSP SHALL NOT BE LIABLE FOR ANY LOSS OR DAMAGE CAUSED USING THE UTILITIES/SERVICES INFORMATION SHOWN ON THESE DRAWINGS.
- UT10. RESIDENTS SHALL BE ADEQUATELY NOTIFIED PRIOR TO WORKS COMMENCING, AND PRIOR TO DISRUPTION OF SERVICE.
- UT11. ALL WORKS ARE TO BE CONSTRUCTED USING BEST TRADE PRACTICES AND TO THE UTILITY OWNERS SPECIFICATION AND REQUIREMENTS.
- UT12. CONTRACTOR TO REMOVE ALL ABANDONED SURFACE FITTINGS FROM DISUSED UTILITIES.
- UT13. DISUSED UTILITIES TO BE EITHER ABANDONED OR GROUT FILLED AND CONCRETE CAPPED. TO BE CONFIRMED BY EACH UTILITY OWNER.
- UT14. ALL BACKFILL MATERIAL SHOULD BE PLACED AND COMPACTED IN LAYERS NOT EXCEEDING 300mm IN LOOSE DEPTH.
- UT15. PROVISION TO BE MADE FOR MANHOLES, PITS, MARKERS, HYDRANTS, VALVES ETC FOR RELOCATION WORKS.
- UT16. FENCING FOOTINGS ARE TO AVOID EXISTING AND PROPOSED UTILITIES.

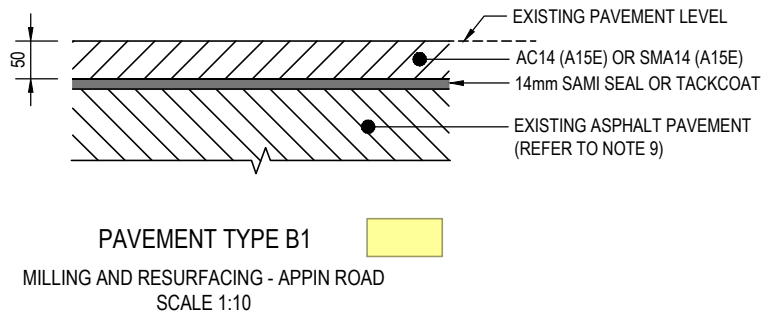
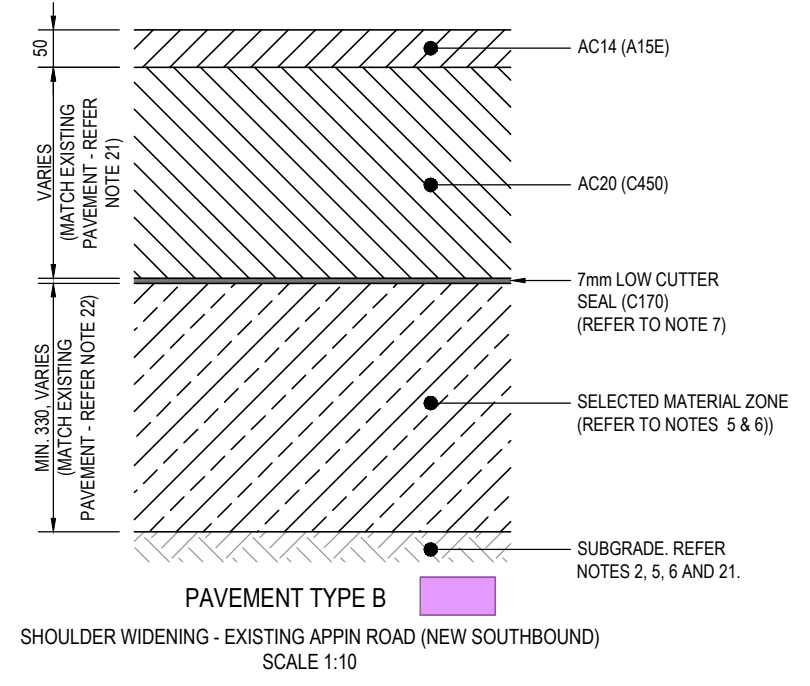
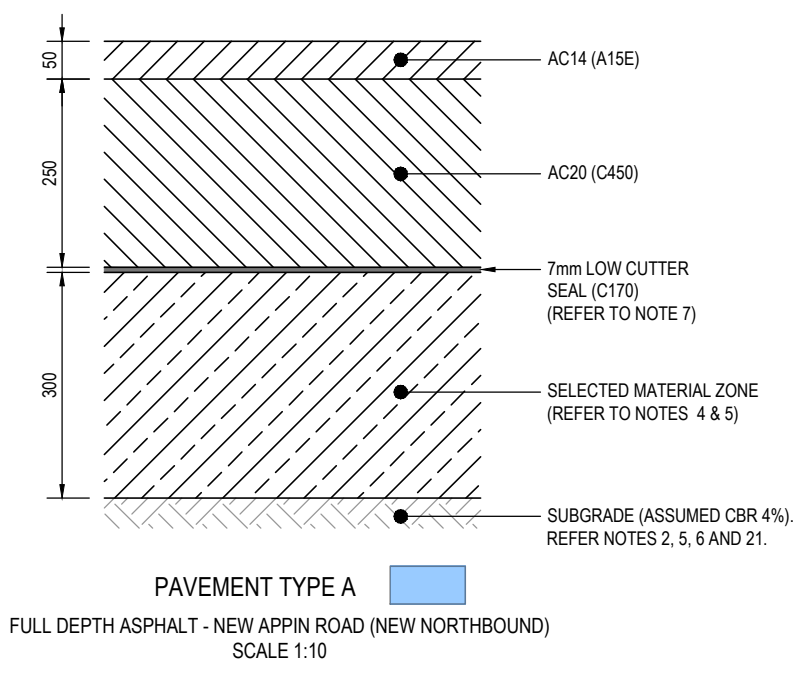
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DOCUMENT NUMBER / NAME <b>PS107784-1B-GE-DRG-00011</b>		DESIGN LOT CODE	DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING		PLOT DATE / TIME 29 September 2022 - 4:38:31 PM		PLOT BY Zhang, Cathy		CLIENT 		CAMPBELLTOWN CITY COUNCIL MR177 APPIN ROAD GLEN LORNE AND BROWNS BUSH FAUNA UNDERPASS		A3
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		02	30.09.22	UPDATED CONCEPT DESIGN						DRG CHECK	CLAUDIO BIDART	30.09.22	
							DESIGN	MARTIN HENEGHAN	30.09.22				
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												RMS REGISTRATION No. <b>DS2019/000540</b>	PART
												ISSUE STATUS CONCEPT DESIGN	EDMS No.
												SHEET No. GE-00011	ISSUE 02

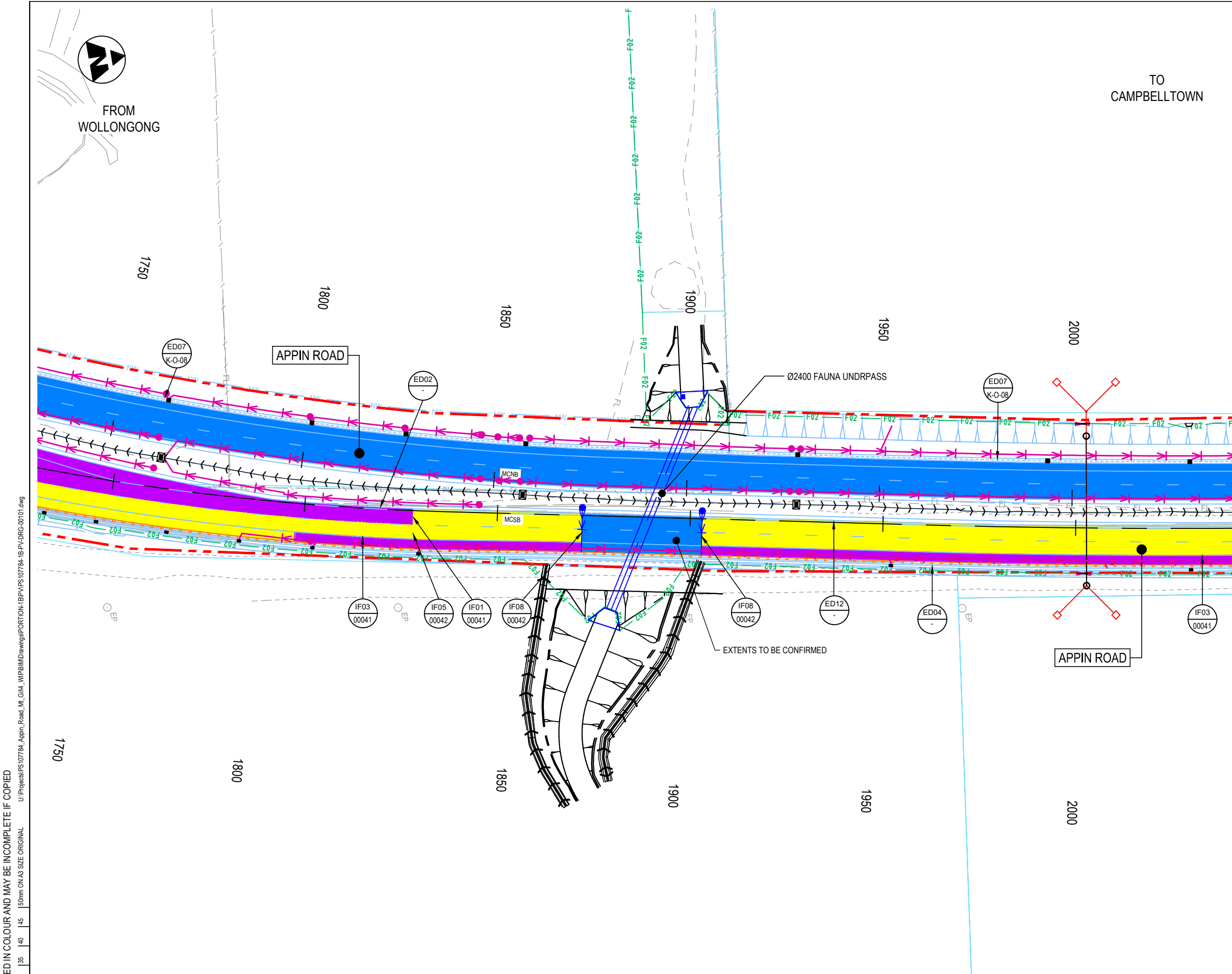
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						 SCALE 1:20mm	 Level 27, 680 George Street, Sydney GPO Box 5394, NSW 2001, Australia Tel: +61 2 9272 5100 Fax: +61 2 9272 5101 wsp.com			RMS REGISTRATION No. <b>DS2019/000540</b>		PART	
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- NOTES**
- FOR GENERAL NOTES REFER TO DRAWING PS107784-1B-GE-DRG-00010 AND 00011.
  - EXTENTS OF PAVEMENT OVER CULVERT TO BE CONFIRMED.

- GENERAL LEGEND**
- PROPOSED BOUNDARY
  - EXISTING CADASTRAL BOUNDARY
  - EASEMENT BOUNDARY
  - PROPOSED ROAD DESIGN
  - PEDESTRIAN FENCE
  - TYPE F BARRIER
  - W BEAM BARRIER
  - FAUNA FENCE (F02)
  - EXISTING FENCE (FL)

- PAVEMENT LEGEND**
- PAVEMENT TYPE A
  - PAVEMENT TYPE B
  - PAVEMENT TYPE B1
  - PAVEMENT TYPE B2
  - PAVEMENT TYPE C
  - PAVEMENT TYPE D
  - PAVEMENT TYPE E
  - PAVEMENT TYPE G (FOR LOCATION REFER TO CS DESIGN LOT)
  - EXISTING PAVEMENT

- SUBSURFACE DRAINAGE LEGEND**
- TRENCH DRAIN
  - INTERFACE DRAIN
  - JUTE MESH CHANNEL
  - START OF SUBSURFACE DRAIN
  - STORMWATER DRAINAGE PIT AND PIPE. (REFER TO DESIGN LOT SM-01 AND SM-1B)

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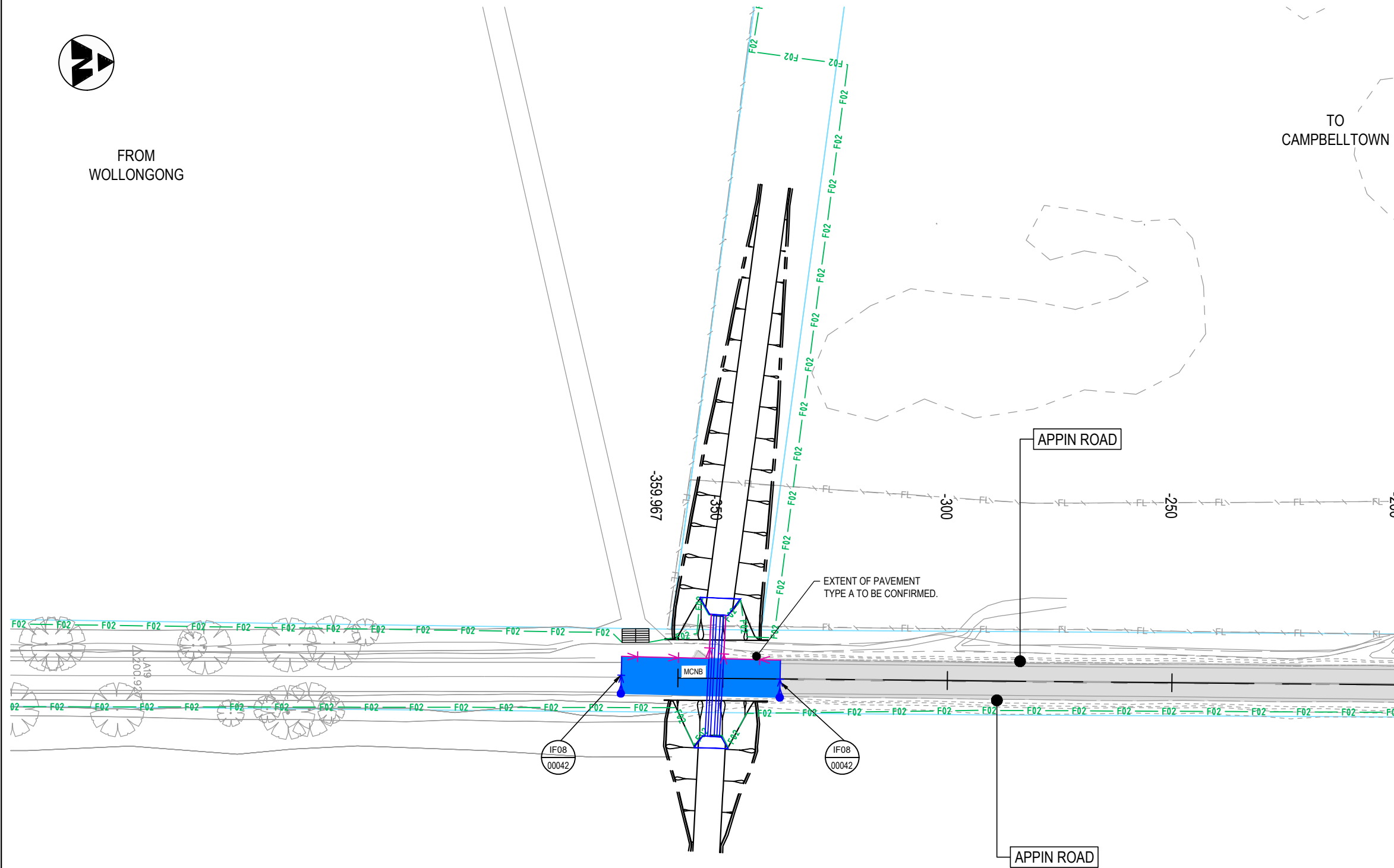
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FROM  
WOLLONGONG

TO  
CAMPBELLTOWN



NOTES

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GENERAL LEGEND

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150mm ON A3 SIZE ORIGINAL

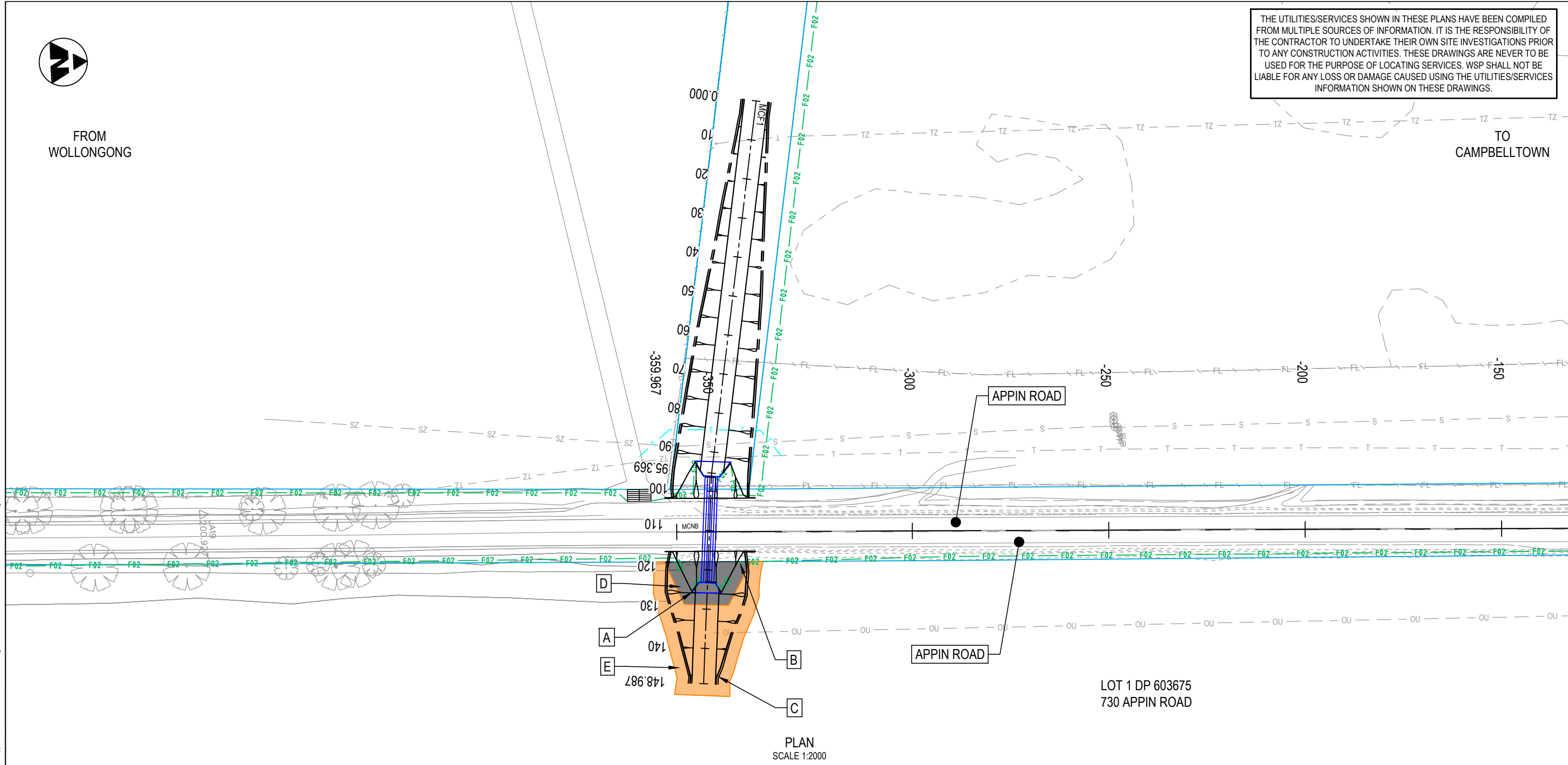
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PLAN  
SCALE 1:2000

PROPERTY ADJUSTMENT SCHEDULE

LOT 1 DP 603675

ID	ITEM	DESCRIPTION	LENGTH (m) AREA (Sq.m) UNIT (ea.)	COMMENT
A	HEADWALL	NEW	1	
B	FAUNA FENCE	NEW	VARIES	
C	FAUNA UNDERPASS PASSAGE	NEW	VARIES	
D	AQUISITION AREA	NEW	182	
E	ADJUSTMENT AREA	NEW	537	

GENERAL LEGEND

- PROJECT BOUNDARY
- EXISTING CADASTRAL BOUNDARY
- PROPOSED ROAD DESIGN
- FAUNA (KOALA) FENCE
- HEADWALL
- AQUISITION
- ADJUSTMENT
- CATTLE GRID

NOTES

1. PROPERTY OWNER APPROVAL AND SIGN OFF REQUIRED PRIOR TO COMMENCEMENT OF PROPERTY ADJUSTMENT OR ACQUISITION WORKS.
2. UTILITY DATA AT THE TIME OF OSSUE IS SUBJECT FOR FURTHER REVIEW. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO ENSURE THAT DBYD PLANS ARE OBTAINED AND UPDATED AND ALL UTILITIES ARE CORRECTLY IDENTIFIED ON SITE PRIOR TO EXCAVATION.
3. CONTRACTOR SHALL ENGAGE SURVEYOR TO CONFIRM EXISTING GROUND LEVEL INFORMATION PRIOR TO UNDERTAKING ADJUSTMENT WORK.
4. REINSTATE EXISTING LANDSCAPING AFTER CONSTRUCTION UNLESS AGREED OTHERWISE WITH PROPERTY OWNER.

**NOT FOR CONSTRUCTION**

The Layout of the proposed adjustments to the improvements in the form shown herein are acceptable to me and I authorise the RMS to enter onto the land and carry out the works.  
The future maintenance of all the adjustments within the property completed by the Authority or it's agent will be the owners responsibility.

Authority's Representative : .....

Date : .....

Property Owner : .....

Date : .....

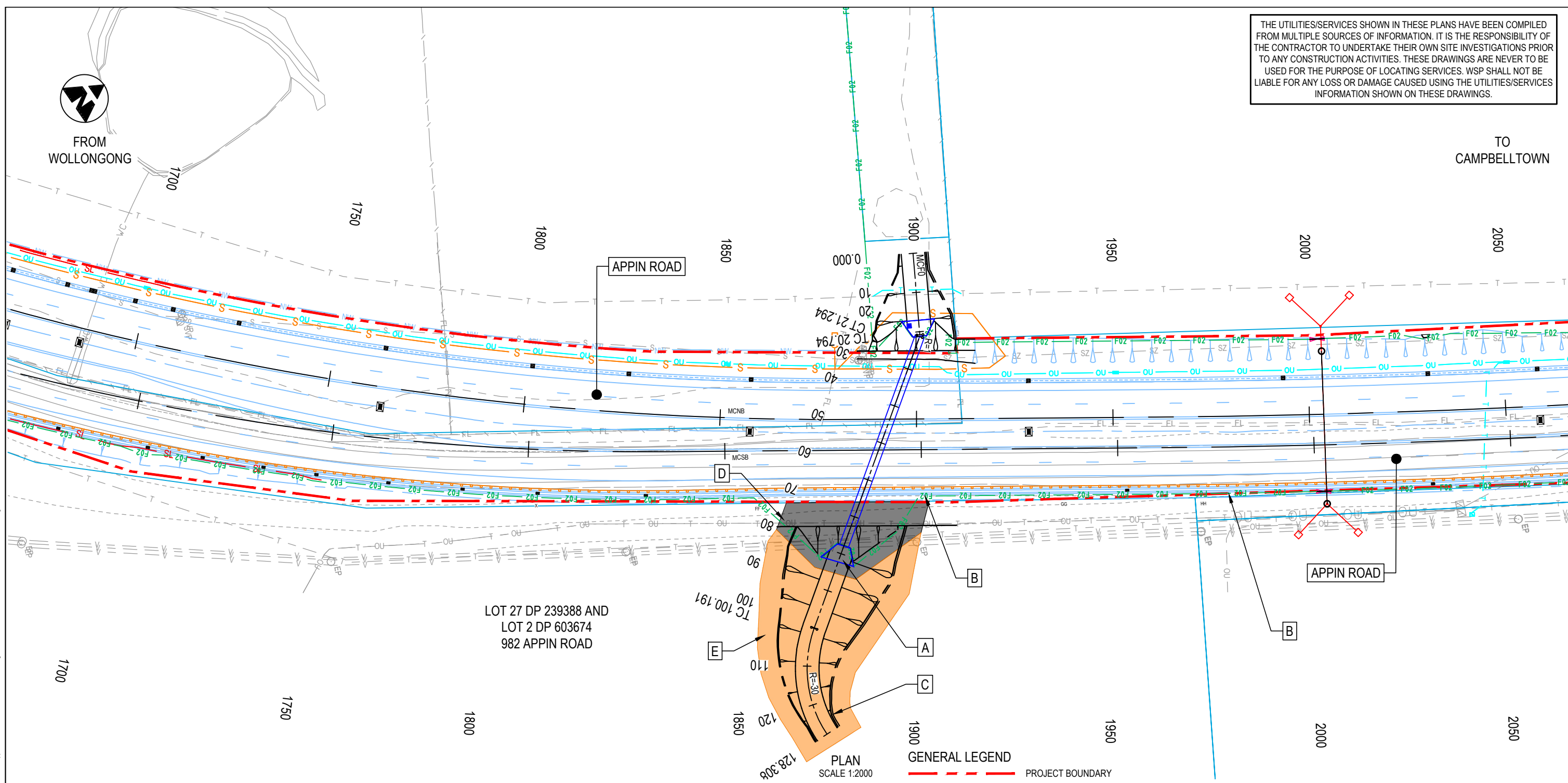
DOCUMENT NUMBER / NAME <b>PS107784-1B-PW-DRG-01081</b>		DESIGN LOT CODE	DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING	PLOT DATE / TIME 30 September 2022 - 10:47:17 AM	PLOT BY Zhang,	CLIENT CAMPBELLTOWN CITY COUNCIL MR177 APPIN ROAD GLEN LORNE AND BROWNS BUSH FAUNA UNDERPASS
EXTERNAL REFERENCE FILES	REV 01 02	DATE 11.03.22 30.09.22	AMENDMENT / REVISION DESCRIPTION ISSUED FOR CONCEPT DESIGN UPDATED CONCEPT DESIGN	WVR No.	APPROVAL	SCALE(S) ON A3 SIZE DRAWING 0 20 40 60 80 100 SCALE 1:2000m
DRAWINGS / DESIGN PREPARED BY 			DRAWN CATHY ZHANG 30.09.22		CLIENT 	
CO-ORDINATE SYSTEM MGA ZONE 56			DESIGN CHECK CLAUDIO BIDART 30.09.22		PREPARED FOR TBC	
HEIGHT DATUM A.H.D.			DESIGN ABID HUSSAIN 30.09.22		RMS REGISTRATION No. <b>DS2019/000540</b>	
			DESIGN CHECK MARTIN HENEGHAN 30.09.22		SHEET No. 1 OF 1	
			DESIGN MNGR DANIEL PARK 30.09.22		ISSUE STATUS CONCEPT DESIGN	
			PROJECT MNGR JONATHAN EPSSELIS 30.09.22		EDMS No. SHEET No. <b>PW-01081</b> ISSUE <b>02</b>	

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THE UTILITIES/SERVICES SHOWN IN THESE PLANS HAVE BEEN COMPILED FROM MULTIPLE SOURCES OF INFORMATION. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO UNDERTAKE THEIR OWN SITE INVESTIGATIONS PRIOR TO ANY CONSTRUCTION ACTIVITIES. THESE DRAWINGS ARE NEVER TO BE USED FOR THE PURPOSE OF LOCATING SERVICES. WSP SHALL NOT BE LIABLE FOR ANY LOSS OR DAMAGE CAUSED USING THE UTILITIES/SERVICES INFORMATION SHOWN ON THESE DRAWINGS.



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The future maintenance of all the adjustments within the property completed by the Authority or its agent will be the owners responsibility.

Authority's Representative : .....

Date : .....

Property Owner : .....

Date : .....

PROPERTY ADJUSTMENT SCHEDULE				
LOT 27 DP 239388 LOT 2 DP 603674				
ID	ITEM	DESCRIPTION	LENGTH (m) AREA (Sq.m) UNIT (ea.)	COMMENT
A	HEADWALL	NEW	1	
B	FAUNA FENCE	NEW	VARIES	
C	FAUNA UNDERPASS PASSAGE	NEW	VARIES	
D	AQUISITION AREA	NEW	531	
E	ADJUSTMENT AREA	NEW	1353	

- GENERAL LEGEND**
- PROJECT BOUNDARY
  - EXISTING CADASTRAL BOUNDARY
  - PROPOSED ROAD DESIGN
  - FAUNA (KOALA) FENCE
  - EZY-GUARD HC BARRIER
  - NOISE MITIGATION TREATMENTS (BY OTHERS)
  - HEADWALL
  - PROPOSED DRAINAGE PIT
  - PROPOSED DRAINAGE PIPE
  - FAUNA ROPE CROSSING
  - AQUISITION
  - ADJUSTMENT

- NOTES**
- PROPERTY OWNER APPROVAL AND SIGN OFF REQUIRED PRIOR TO COMMENCEMENT OF PROPERTY ADJUSTMENT OR ACQUISITION WORKS.
  - UTILITY DATA AT THE TIME OF ISSUE IS SUBJECT FOR FURTHER REVIEW. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO ENSURE THAT DBYD PLANS ARE OBTAINED AND UPDATED AND ALL UTILITIES ARE CORRECTLY IDENTIFIED ON SITE PRIOR TO EXCAVATION.
  - CONTRACTOR SHALL ENGAGE SURVEYOR TO CONFIRM EXISTING GROUND LEVEL INFORMATION PRIOR TO UNDERTAKING ADJUSTMENT WORK.
  - REINSTATE EXISTING LANDSCAPING AFTER CONSTRUCTION UNLESS AGREED OTHERWISE WITH PROPERTY OWNER.

NOT FOR CONSTRUCTION

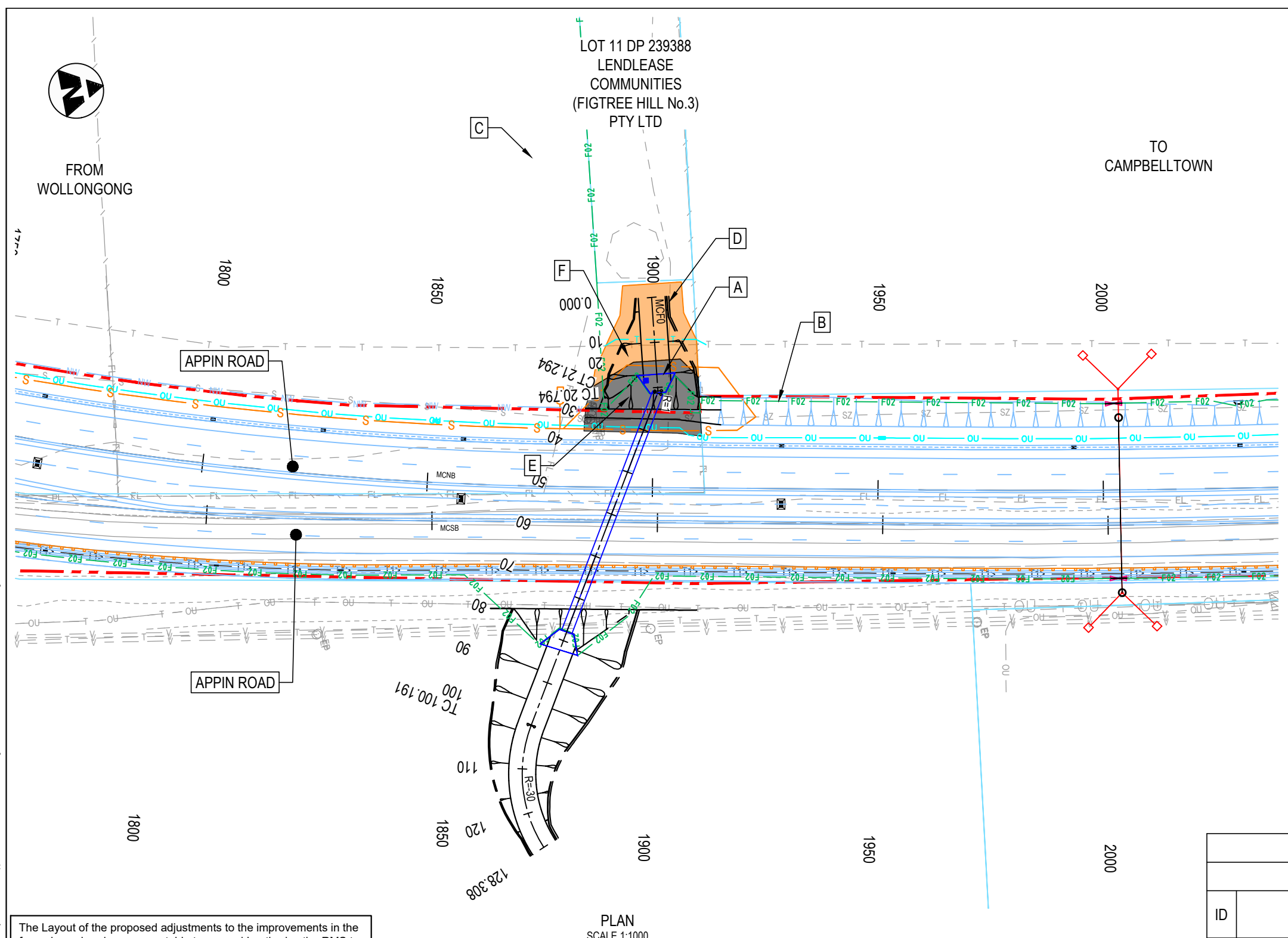
DOCUMENT NUMBER / NAME <b>PS107784-1B-PW-DRG-01091</b>		DESIGN LOT CODE	DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING	PLOT DATE / TIME 30 September 2022 - 10:45:55 AM	PLOT BY Zhang,	CLIENT CAMPBELLTOWN CITY COUNCIL MR177 APPIN ROAD GLEN LORNE AND BROWNS BUSH FAUNA UNDERPASS
EXTERNAL REFERENCE FILES	REV 01 02	DATE 11.03.22 30.09.22	AMENDMENT / REVISION DESCRIPTION ISSUED FOR CONCEPT DESIGN UPDATED CONCEPT DESIGN	WVR No.	APPROVAL	SCALE(S) ON A3 SIZE DRAWING 0 20 40 60 80 100 SCALE 1:2000m
			DRAWINGS / DESIGN PREPARED BY 	NAME CATHY ZHANG CLAUDIO BIDART ABID HUSSAIN MARTIN HENEZHAN DANIEL PARK JONATHAN EPSSELIS	DATE 30.09.22 30.09.22 30.09.22 30.09.22 30.09.22 30.09.22	PREPARED FOR TBC
CO-ORDINATE SYSTEM MGA ZONE 56		HEIGHT DATUM A.H.D.		Level 27, 680 George Street, Sydney GPO Box 5394, NSW 2001, Australia Tel: +61 2 9272 5100 Fax: +61 2 9272 5101 wsp.com		RMS REGISTRATION No. <b>DS2019/000540</b>
ISSUE STATUS CONCEPT DESIGN		EDMS No.	SHEET No. PW-01091	ISSUE 02	PART A3	

THE UTILITIES/SERVICES SHOWN IN THESE PLANS HAVE BEEN COMPILED FROM MULTIPLE SOURCES OF INFORMATION. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO UNDERTAKE THEIR OWN SITE INVESTIGATIONS PRIOR TO ANY CONSTRUCTION ACTIVITIES. THESE DRAWINGS ARE NEVER TO BE USED FOR THE PURPOSE OF LOCATING SERVICES. WSP SHALL NOT BE LIABLE FOR ANY LOSS OR DAMAGE CAUSED USING THE UTILITIES/SERVICES INFORMATION SHOWN ON THESE DRAWINGS.

- NOTES**
1. PROPERTY OWNER APPROVAL AND SIGN OFF REQUIRED PRIOR TO COMMENCEMENT OF PROPERTY ADJUSTMENT OR ACQUISITION WORKS.
  2. UTILITY DATA AT THE TIME OF ISSUE IS SUBJECT FOR FURTHER REVIEW. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO ENSURE THAT DBYD PLANS ARE OBTAINED AND UPDATED AND ALL UTILITIES ARE CORRECTLY IDENTIFIED ON SITE PRIOR TO EXCAVATION.
  3. CONTRACTOR SHALL ENGAGE SURVEYOR TO CONFIRM EXISTING GROUND LEVEL INFORMATION PRIOR TO UNDERTAKING ADJUSTMENT WORK.
  4. REINSTATE EXISTING LANDSCAPING AFTER CONSTRUCTION UNLESS AGREED OTHERWISE WITH PROPERTY OWNER.

**GENERAL LEGEND**

	PROJECT BOUNDARY
	EXISTING CADASTRAL BOUNDARY
	PROPOSED ROAD DESIGN
	FAUNA (KOALA) FENCE
	EZY-GUARD HC BARRIER
	HEADWALL
	PROPOSED DRAINAGE PIT
	PROPOSED DRAINAGE PIPE
	AQUISITION
	ADJUSTMENT



PLAN  
SCALE 1:1000

The Layout of the proposed adjustments to the improvements in the form shown herein are acceptable to me and I authorise the RMS to enter onto the land and carry out the works.  
The future maintenance of all the adjustments within the property completed by the Authority or its agent will be the owners responsibility.

Authority's Representative : .....

Date : .....

Property Owner : .....

Date : .....

PROPERTY ADJUSTMENT SCHEDULE				
LOT 11 DP 239388				
ID	ITEM	DESCRIPTION	LENGTH (m) AREA (Sq.m) UNIT (ea.)	COMMENT
A	HEADWALL	NEW	1	
B	FAUNA FENCE	NEW	VARIES	
C	DRAINAGE PIPE	NEW	VARIES	
D	FAUNA UNDERPASS PASSAGE	NEW	VARIES	
E	AQUISITION AREA	NEW	358	
F	ADJUSTMENT AREA	NEW	313	

**NOT FOR CONSTRUCTION**

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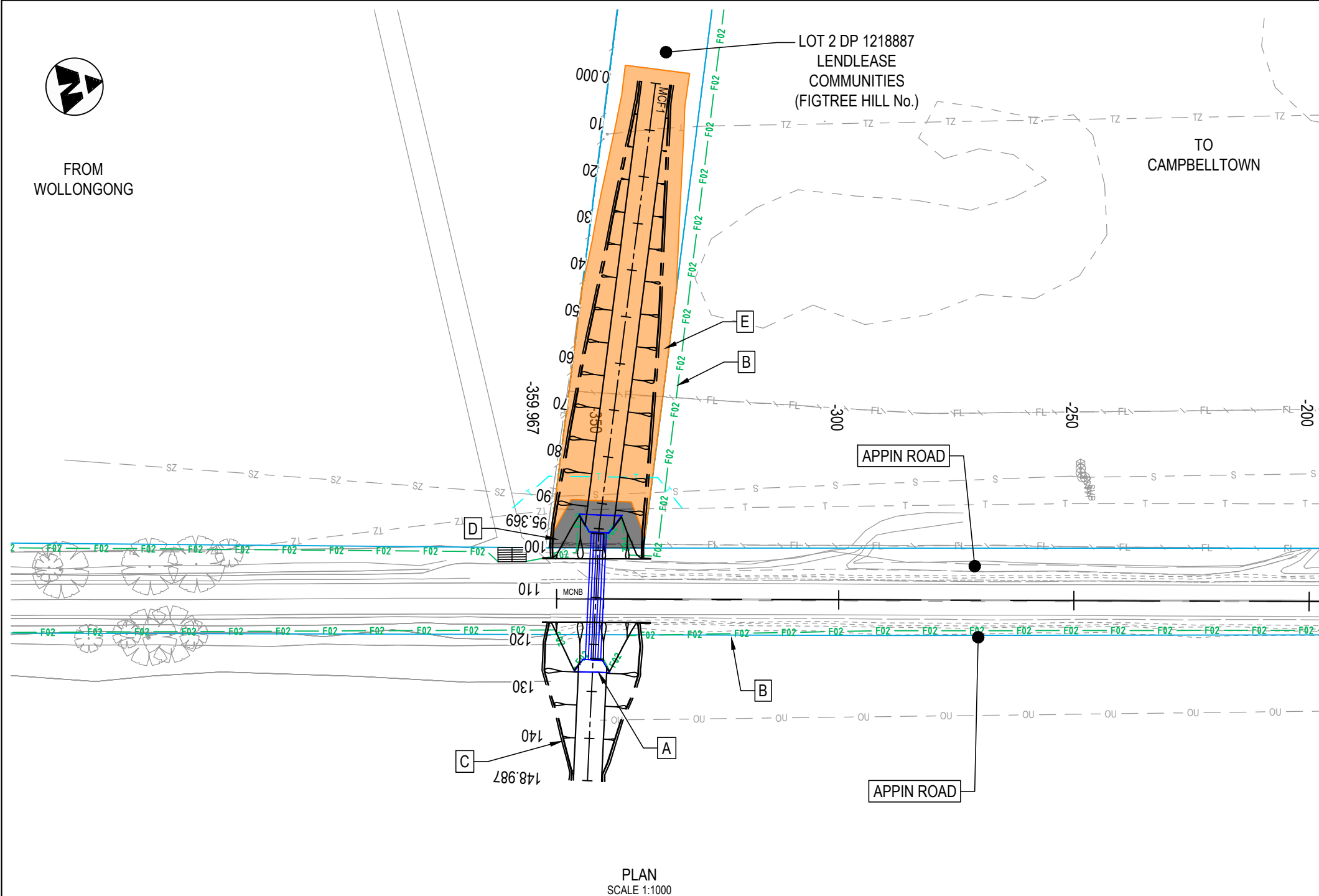
DOCUMENT NUMBER / NAME <b>PS107784-1B-PW-DRG-01201</b>		DESIGN LOT CODE	DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING	PLOT DATE / TIME 30 September 2022 - 10:44:22 AM	PLOT BY Zhang,	CLIENT CAMPBELLTOWN CITY COUNCIL MR177 APPIN ROAD GLEN LORNE AND BROWNS BUSH FAUNA UNDERPASS SHEET No. 1 OF 1		
EXTERNAL REFERENCE FILES	REV 01 02	DATE 11.03.22 30.09.22	AMENDMENT / REVISION DESCRIPTION ISSUED FOR CONCEPT DESIGN UPDATED CONCEPT DESIGN	WVR No.	APPROVAL	SCALE(S) ON A3 SIZE DRAWING 0 10 20 30 40 50 SCALE 1:1000m		
			DRAWINGS / DESIGN PREPARED BY 	NAME CATHY ZHANG CLAUDIO BIDART ABID HUSSAIN MARTIN HENEGHAN DANIEL PARK JONATHAN EPSELIS	DATE 30.09.22 30.09.22 30.09.22 30.09.22 30.09.22 30.09.22	PREPARED FOR TBC		
			CO-ORDINATE SYSTEM MGA ZONE 56	HEIGHT DATUM A.H.D.	RMS REGISTRATION No. <b>DS2019/000540</b>			
			Level 27, 680 George Street, Sydney GPO Box 5394, NSW 2001, Australia Tel: +61 2 9272 5100 Fax: +61 2 9272 5101 wsp.com		ISSUE STATUS CONCEPT DESIGN	EDMS No.	SHEET No. PW-01201	ISSUE 02



FROM  
WOLLONGONG

LOT 2 DP 1218887  
LENLEASE  
COMMUNITIES  
(FIGTREE HILL No.)

TO  
CAMPBELLTOWN



PLAN  
SCALE 1:1000

THE UTILITIES/SERVICES SHOWN IN THESE PLANS HAVE BEEN COMPILED FROM MULTIPLE SOURCES OF INFORMATION. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO UNDERTAKE THEIR OWN SITE INVESTIGATIONS PRIOR TO ANY CONSTRUCTION ACTIVITIES. THESE DRAWINGS ARE NEVER TO BE USED FOR THE PURPOSE OF LOCATING SERVICES. WSP SHALL NOT BE LIABLE FOR ANY LOSS OR DAMAGE CAUSED USING THE UTILITIES/SERVICES INFORMATION SHOWN ON THESE DRAWINGS.

NOTES

1. PROPERTY OWNER APPROVAL AND SIGN OFF REQUIRED PRIOR TO COMMENCEMENT OF PROPERTY ADJUSTMENT OR ACQUISITION WORKS.
2. UTILITY DATA AT THE TIME OF ISSUE IS SUBJECT FOR FURTHER REVIEW. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO ENSURE THAT DBYD PLANS ARE OBTAINED AND UPDATED AND ALL UTILITIES ARE CORRECTLY IDENTIFIED ON SITE PRIOR TO EXCAVATION.
3. CONTRACTOR SHALL ENGAGE SURVEYOR TO CONFIRM EXISTING GROUND LEVEL INFORMATION PRIOR TO UNDERTAKING ADJUSTMENT WORK.
4. REINSTATE EXISTING LANDSCAPING AFTER CONSTRUCTION UNLESS AGREED OTHERWISE WITH PROPERTY OWNER.

GENERAL LEGEND

- PROJECT BOUNDARY
- EXISTING CADASTRAL BOUNDARY
- PROPOSED ROAD DESIGN
- FAUNA (KOALA) FENCE
- EZY-GUARD HC BARRIER
- HEADWALL
- AQUISITION
- ADJUSTMENT
- CATTLE GRID

The Layout of the proposed adjustments to the improvements in the form shown herein are acceptable to me and I authorise the RMS to enter onto the land and carry out the works.  
The future maintenance of all the adjustments within the property completed by the Authority or its agent will be the owners responsibility.

Authority's Representative : .....

Date : .....

Property Owner : .....

Date : .....

PROPERTY ADJUSTMENT SCHEDULE				
LOT 2 DP 1218887				
ID	ITEM	DESCRIPTION	LENGTH (m) AREA (Sq.m) UNIT (ea.)	COMMENT
A	HEADWALL	NEW	1	
B	FAUNA FENCE	NEW	VARIES	
C	FAUNA UNDERPASS PASSAGE	NEW	VARIES	
D	AQUISITION AREA	NEW	173	
E	ADJUSTMENT AREA	NEW	1701	

**NOT FOR CONSTRUCTION**

DOCUMENT NUMBER / NAME PS107784-1B-PW-DRG-01211		DESIGN LOT CODE	DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING	PLOT DATE / TIME 30 September 2022 - 10:53:43 AM	PLOT BY Zhang,	CLIENT CAMPBELLTOWN CITY COUNCIL MR177 APPIN ROAD GLEN LORNE AND BROWNS BUSH FAUNA UNDERPASS	A3
EXTERNAL REFERENCE FILES	REV 01 02	DATE 11.03.22 30.09.22	AMENDMENT / REVISION DESCRIPTION ISSUED FOR CONCEPT DESIGN UPDATED CONCEPT DESIGN	WVR No.	APPROVAL	SCALES ON A3 SIZE DRAWING	DRAWINGS / DESIGN PREPARED BY wsp
SCALE 1:1000m				CO-ORDINATE SYSTEM MGA ZONE 56		HEIGHT DATUM A.H.D.	
DRAWN CATHY ZHANG 30.09.22		DRG CHECK CLAUDIO BIDART 30.09.22		DESIGN ABID HUSSAIN 30.09.22		DESIGN CHECK MARTIN HENEGHAN 30.09.22	
DESIGN MNGR DANIEL PARK 30.09.22		PROJECT MNGR JONATHAN EPSELIS 30.09.22		PREPARED FOR TBC		RMS REGISTRATION No. DS2019/000540	
ISSUE STATUS CONCEPT DESIGN		EDMS No.		SHEET No. PW-01211		ISSUE 02	

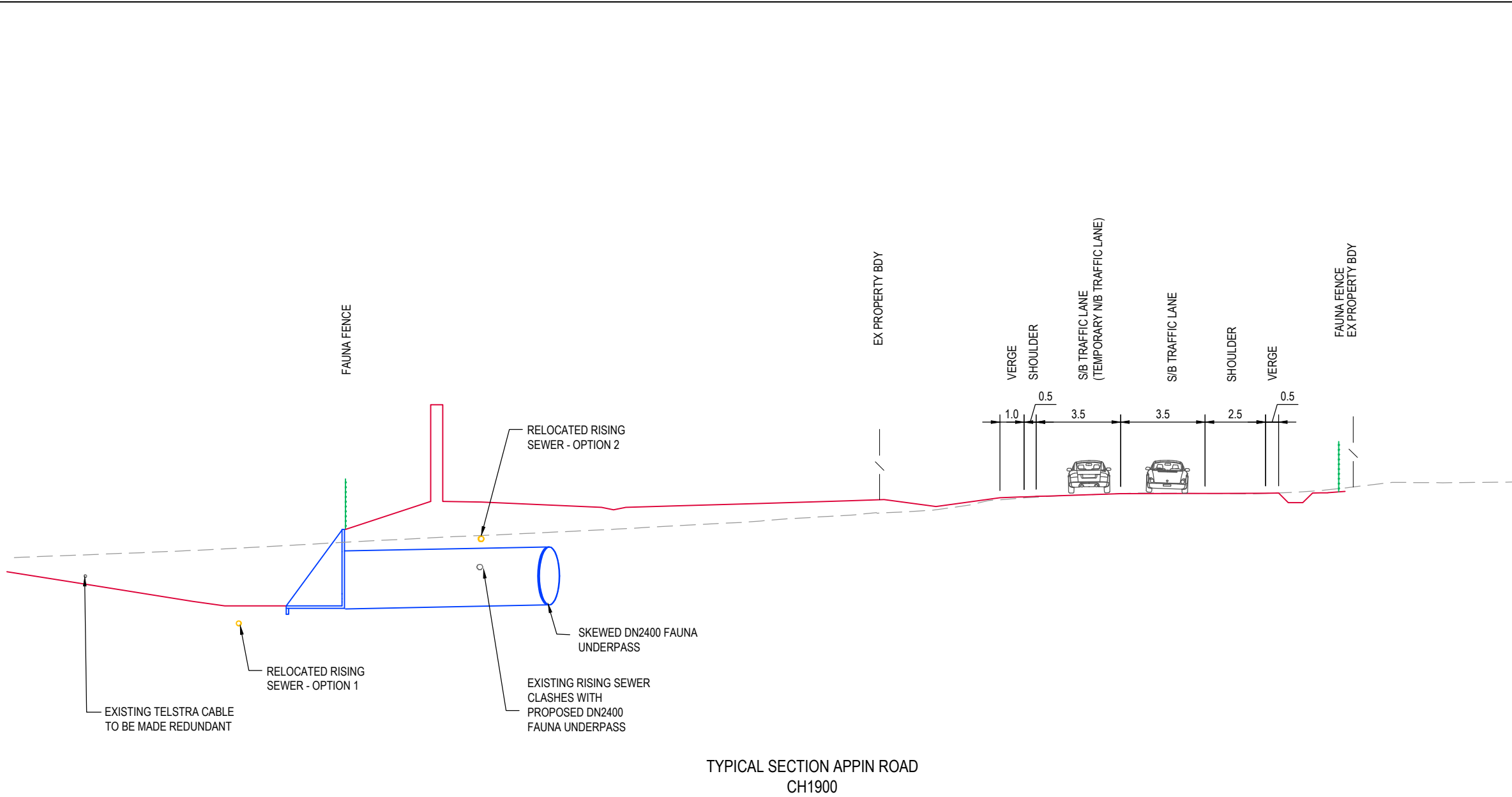
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TYPICAL SECTION APPIN ROAD  
CH1900

- NOTES**
1. ALL DIMENSIONS IN METRES UNLESS SPECIFIED OTHERWISE.
  2. NO PROVISIONS FOR LIGHTING INCLUDED AT MID BLOCK LOCATIONS.
  3. PROPERTY BOUNDARY ONLY SHOWN INDICATIVELY - LOCATION VARIES ALONG APPIN ROAD.
  4. NO PROVISIONS FOR OPEN CHANNELS AND ASSOCIATED EARTHWORKS INCLUDED.
  5. FOR DETAILS OF UTILITIES REFER TO TYPICAL SECTION DRAWING SET FOR UTILITIES. (CHAINAGE INFORMATION DOESN'T APPLY)
  6. CHAINAGE REFERS TO THE NORTHBOUND CONTROL LINE
  7. DIMENSIONS ON SB CARRIAGEWAY MATCHES EXISTING
  8. TYPICAL DRAINAGE ARRANGEMENTS ARE NOT SHOWN AT THIS STAGE.

**LEGEND**

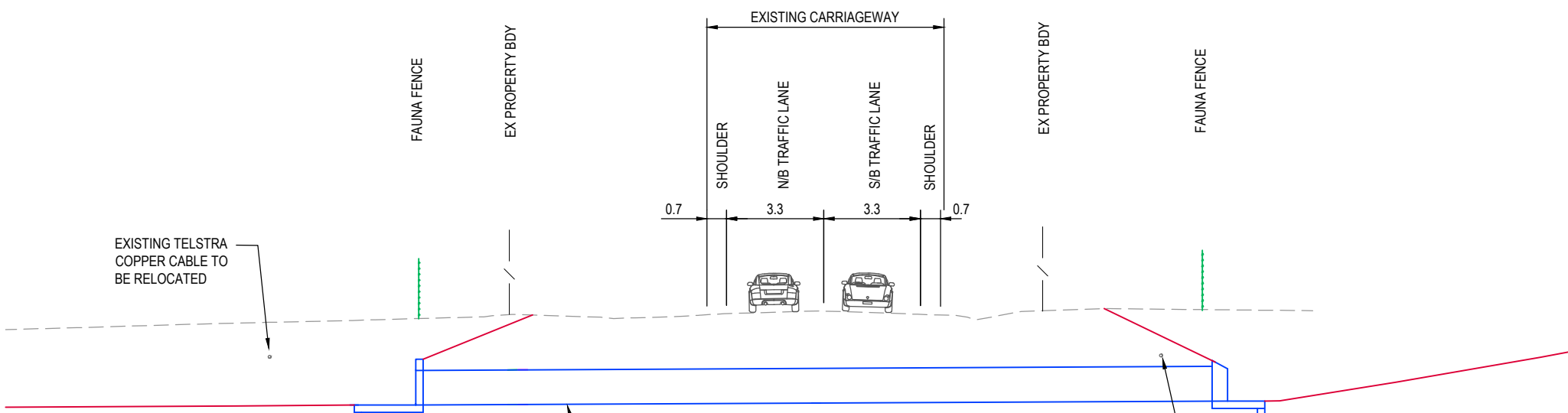
- FUTURE SUB-DIVISION BOUNDARY @ 20m OFFSET FROM EX BOUNDARY
- EXISTING PROPERTY BOUNDARY
- PROPOSED WIRE ROPE SAFETY BARRIER
- EXISTING PAVEMENT
- EXISTING SURFACE
- PROPOSED WIDENING

NOT FOR CONSTRUCTION

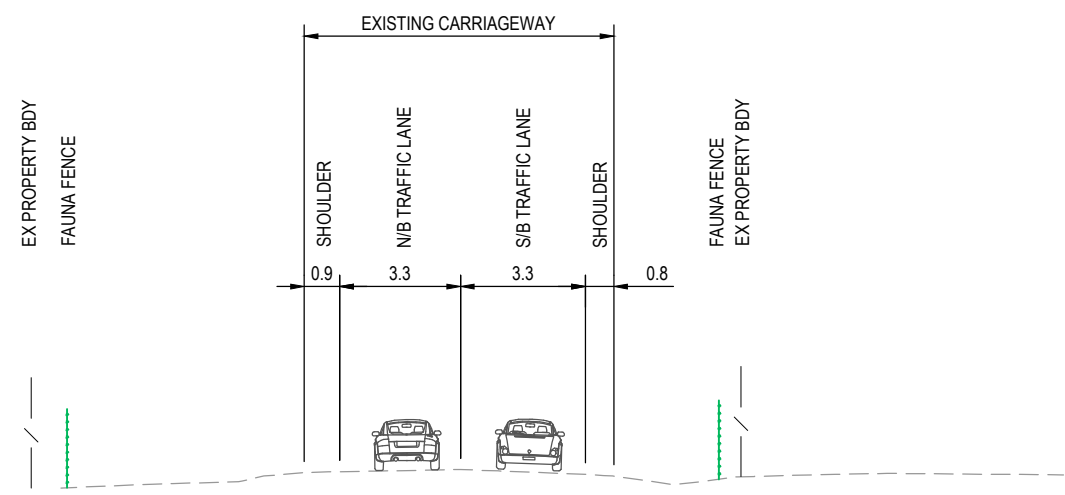
DOCUMENT NUMBER / NAME <b>PS107784-1B-RD-DRG-00021</b>			DESIGN LOT CODE	DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING			PLOT DATE / TIME 29 September 2022 - 4:55:31 PM		PLOT BY Zhang, Cathy		CLIENT	CAMPBELLTOWN CITY COUNCIL MR177 APPIN ROAD GLEN LORNE AND BROWNS BUSH FAUNA UNDERPASS	A3		
EXTERNAL REFERENCE FILES	REV	DATE	AMENDMENT / REVISION DESCRIPTION	WVR No.	APPROVAL	SCALES ON A3 SIZE DRAWING	DRAWINGS / DESIGN PREPARED BY		TITLE	NAME	DATE	 PREPARED FOR TBC	RMS REGISTRATION No. <b>DS2019/000540</b> SHEET No. 1 OF 2 PART		
	01	30.09.22	UPDATED CONCEPT DESIGN			 SCALE 1:200m	 Level 27, 680 George Street, Sydney GPO Box 5394, NSW 2001, Australia Tel: +61 2 9272 5100 Fax: +61 2 9272 5101 wsp.com		DRAWN	CATHY ZHANG	30.09.22				
								DRG CHECK	MARCO HOFFMANN	30.09.22					
								DESIGN	MARTIN HENEGHAN	30.09.22					
								DESIGN CHECK	STEVE MCKENNA	30.09.22					
								DESIGN MNGR	DANIEL PARK	30.09.22					
								PROJECT MNGR	JONATHAN EPSSELIS	30.09.22					
CO-ORDINATE SYSTEM MGA ZONE 56			HEIGHT DATUM A.H.D.									ISSUE STATUS CONCEPT DESIGN	EDMS No.	SHEET No. RD-00021	ISSUE 01

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TYPICAL SECTION ON APPIN ROAD  
BROWNS BUSH UNDERPASS



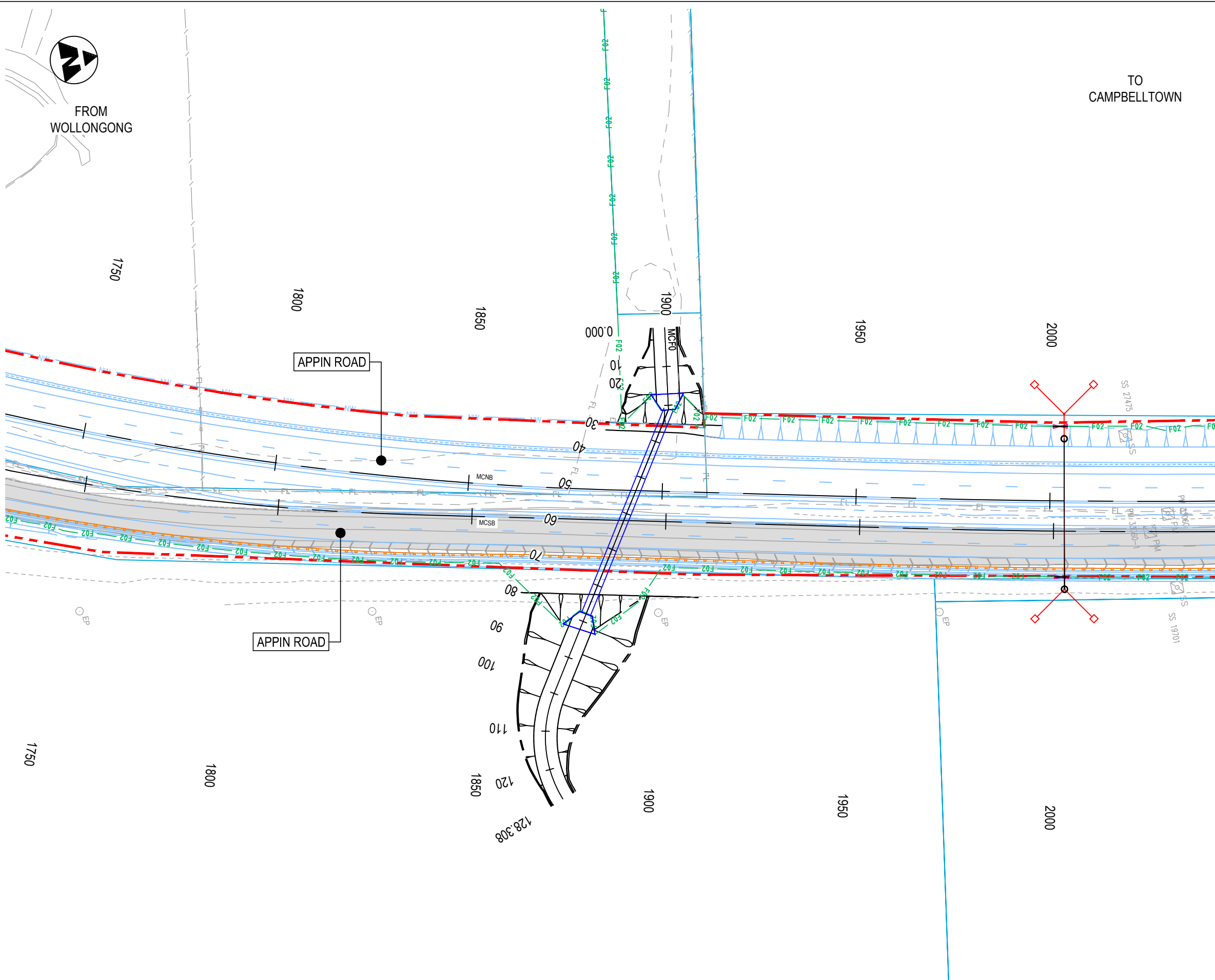
TYPICAL SECTION ON APPIN ROAD  
IN FRONT OF BEULAH RESERVE

- NOTES**
1. ALL DIMENSIONS IN METRES UNLESS SPECIFIED OTHERWISE.
  2. NO PROVISIONS FOR LIGHTING INCLUDED AT MID BLOCK LOCATIONS.
  3. PROPERTY BOUNDARY ONLY SHOWN INDICATIVELY - LOCATION VARIES ALONG APPIN ROAD.
  4. NO PROVISIONS FOR OPEN CHANNELS AND ASSOCIATED EARTHWORKS INCLUDED.
  5. FOR DETAILS OF UTILITIES REFER TO TYPICAL SECTION DRAWING SET FOR UTILITIES. (CHAINAGE INFORMATION DOESN'T APPLY)
  6. CHAINAGE REFERS TO THE NORTHBOUND CONTROL LINE
  7. DIMENSIONS ON SB CARRIAGEWAY MATCHES EXISTING
  8. TYPICAL DRAINAGE ARRANGEMENTS ARE NOT SHOWN AT THIS STAGE.

- LEGEND**
- FUTURE SUB-DIVISION BOUNDARY @ 20m OFFSET FROM EX BOUNDARY
  - EXISTING PROPERTY BOUNDARY
  - PROPOSED WIRE ROPE SAFETY BARRIER
  - EXISTING PAVEMENT
  - EXISTING SURFACE
  - PROPOSED WIDENING

**NOT FOR CONSTRUCTION**

DOCUMENT NUMBER / NAME <b>PS107784-1B-RD-DRG-00022</b>		DESIGN LOT CODE	DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING		PLOT DATE / TIME 29 September 2022 - 4:55:54 PM	PLOT BY Zhang, Cathy	CLIENT CAMPBELLTOWN CITY COUNCIL MR177 APPIN ROAD GLEN LORNE AND BROWNS BUSH FAUNA UNDERPASS	<b>A3</b>																					
EXTERNAL REFERENCE FILES	REV 01	DATE 30.09.22	AMENDMENT / REVISION DESCRIPTION UPDATED CONCEPT DESIGN	WVR No.	APPROVAL	SCALES ON A3 SIZE DRAWING	DRAWINGS / DESIGN PREPARED BY	TITLE																					
						 SCALE 1:200m	 Level 27, 680 George Street, Sydney GPO Box 5394, NSW 2001, Australia Tel: +61 2 9272 5100 Fax: +61 2 9272 5101 wsp.com	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr><th>TITLE</th><th>NAME</th><th>DATE</th></tr> <tr><td>DRAWN</td><td>CATHY ZHANG</td><td>30.09.22</td></tr> <tr><td>DRG CHECK</td><td>MARCO HOFFMANN</td><td>30.09.22</td></tr> <tr><td>DESIGN</td><td>MARTIN HENEGHAN</td><td>30.09.22</td></tr> <tr><td>DESIGN CHECK</td><td>STEVE MCKENNA</td><td>30.09.22</td></tr> <tr><td>DESIGN MNGR</td><td>DANIEL PARK</td><td>30.09.22</td></tr> <tr><td>PROJECT MNGR</td><td>JONATHAN EPSELIS</td><td>30.09.22</td></tr> </table>	TITLE	NAME	DATE	DRAWN	CATHY ZHANG	30.09.22	DRG CHECK	MARCO HOFFMANN	30.09.22	DESIGN	MARTIN HENEGHAN	30.09.22	DESIGN CHECK	STEVE MCKENNA	30.09.22	DESIGN MNGR	DANIEL PARK	30.09.22	PROJECT MNGR	JONATHAN EPSELIS	30.09.22
TITLE	NAME	DATE																											
DRAWN	CATHY ZHANG	30.09.22																											
DRG CHECK	MARCO HOFFMANN	30.09.22																											
DESIGN	MARTIN HENEGHAN	30.09.22																											
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DESIGN MNGR	DANIEL PARK	30.09.22																											
PROJECT MNGR	JONATHAN EPSELIS	30.09.22																											
				CO-ORDINATE SYSTEM MGA ZONE 56		HEIGHT DATUM A.H.D.																							
				RMS REGISTRATION No. <b>DS2019/000540</b>		PREPARED FOR TBC		SHEET No. 2 OF 2 SHEET No. <b>RD-00022</b> ISSUE No. <b>01</b>																					
				ISSUE STATUS CONCEPT DESIGN		EDMS No.		© Roads and Maritime Services																					



THE UTILITIES/SERVICES SHOWN IN THESE PLANS HAVE BEEN COMPILED FROM MULTIPLE SOURCES OF INFORMATION. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO UNDERTAKE THEIR OWN SITE INVESTIGATIONS PRIOR TO ANY CONSTRUCTION ACTIVITIES. THESE DRAWINGS ARE NEVER TO BE USED FOR THE PURPOSE OF LOCATING SERVICES. WSP SHALL NOT BE LIABLE FOR ANY LOSS OR DAMAGE CAUSED USING THE UTILITIES/SERVICES INFORMATION SHOWN ON THESE DRAWINGS.

- NOTES**
1. ALL DIMENSIONS IN METRES UNLESS SPECIFIED OTHERWISE.
  2. FOR GENERAL NOTES REFER TO DRAWING PS107784-1B-GE-DRG-00010 AND 00011.
  3. NOISE WALL/RETAINING WALL TO THE MT. GILEAD SIDE IS DETAILED BY OTHERS.
  4. REFER TO PROPERTY WORKS SET PW-0001 FOR ANY PROPERTY ADJUSTMENT.

- GENERAL LEGEND**
- NEW ROAD RESERVE BOUNDARY
  - EXISTING CADASTRAL BOUNDARY
  - EASEMENT BOUNDARY
  - PROPOSED ROAD DESIGN
  - EZY-GUARD HC BARRIER
  - TYPE F BARRIER
  - NOISE MITIGATION TREATMENTS (BY OTHERS)
  - EXISTING PAVEMENT
  - FAUNA UNDERPASS
  - FAUNA (KOALA) FENCE
  - MAINTENANCE ACCESS GATE
  - CATTLE GRID
  - FAUNA ROPE CROSSING

**NOT FOR CONSTRUCTION**

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U:\Projects\PS107784-1B-RD-DRG-00101.dwg 150mm ON A3 SIZE ORIGINAL

DOCUMENT NUMBER / NAME <b>PS107784-1B-RD-DRG-00101</b>		DESIGN LOT CODE	DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING	PLOT DATE / TIME 29 September 2022 - 4:57:09 PM	PLOT BY Zhang, Cathy	CLIENT 	CAMPBELLTOWN CITY COUNCIL MR177 APPIN ROAD GLEN LORNE AND BROWNS BUSH FAUNA UNDERPASS	<b>A3</b>
EXTERNAL REFERENCE FILES	REV 01 02	DATE 11.03.22 30.09.22	AMENDMENT / REVISION DESCRIPTION ISSUED FOR CONCEPT DESIGN UPDATED CONCEPT DESIGN	WVR No.	APPROVAL	SCALES ON A3 SIZE DRAWING	DRAWINGS / DESIGN PREPARED BY 	TITLE DRAWN DRG CHECK DESIGN DESIGN CHECK DESIGN MNGR PROJECT MNGR
		SCALE 1:1000m 0 10 20 30 40 50		Level 27, 680 George Street, Sydney GPO Box 5394, NSW 2001, Australia Tel: +61 2 9272 5100 Fax: +61 2 9272 5101 wsp.com		CAMPBELLTOWN CITY COUNCIL MR177 APPIN ROAD GLEN LORNE AND BROWNS BUSH FAUNA UNDERPASS		PREPARED FOR TBC
		CO-ORDINATE SYSTEM MGA ZONE 56		HEIGHT DATUM A.H.D.		GENERAL ARRANGEMENT PLAN RMS REGISTRATION No. <b>DS2019/000540</b>		SHEET No. 1 OF 1 PART
						ISSUE STATUS CONCEPT DESIGN		EDMS No. SHEET No. RD-00101 ISSUE 02



FROM  
WOLLONGONG

TO  
CAMPBELLTOWN

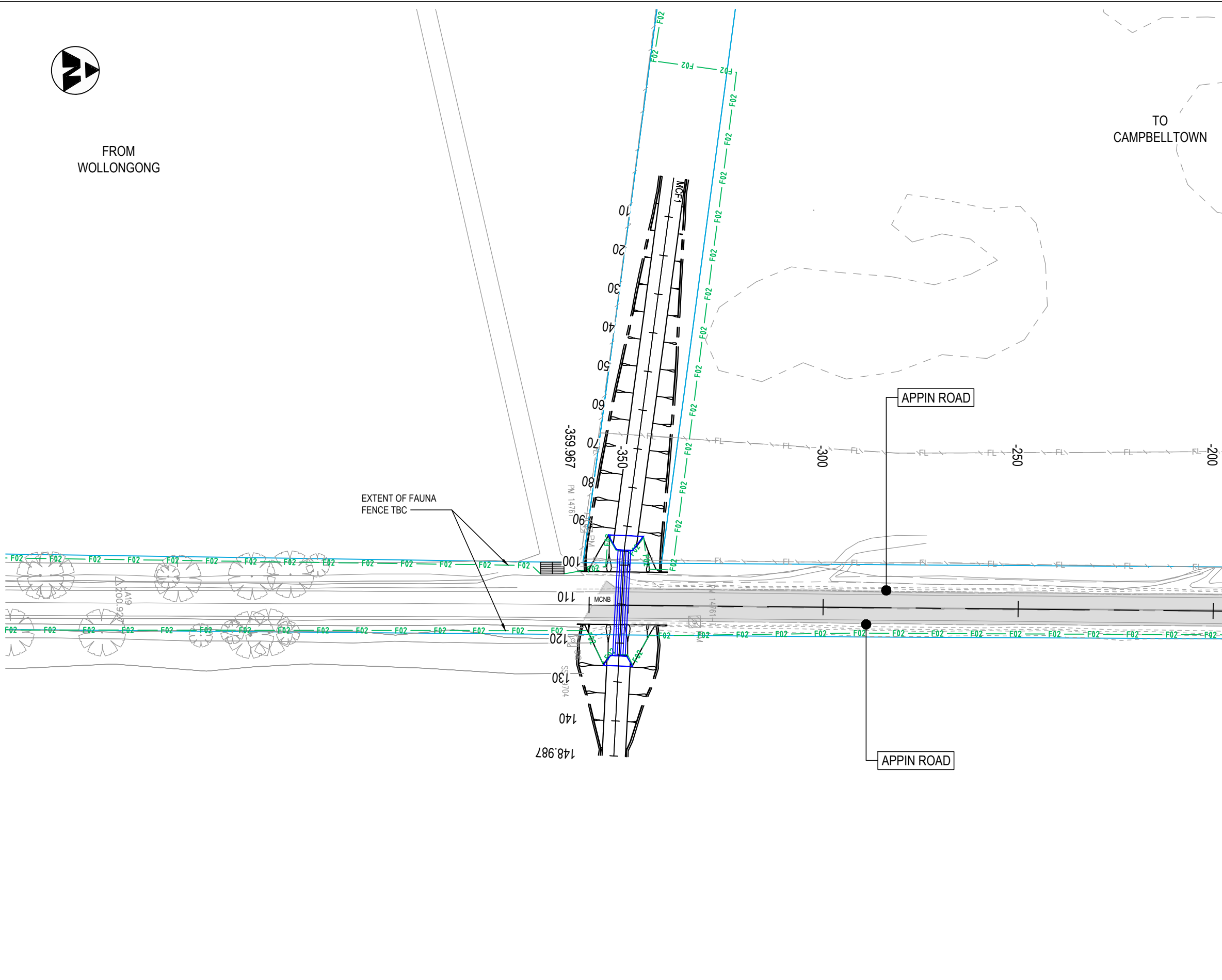
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**NOTES**

1. ALL DIMENSIONS IN METRES UNLESS SPECIFIED OTHERWISE.
2. FOR GENERAL NOTES REFER TO DRAWING PS107784-1B-GE-DRG-00010 AND 00011.
3. NOISE WALL/RETAINING WALL TO THE MT. GILEAD SIDE IS DETAILED BY OTHERS.
4. REFER TO PROPERTY WORKS SET PW-0001 FOR ANY PROPERTY ADJUSTMENT.

**GENERAL LEGEND**

- NEW ROAD RESERVE BOUNDARY
- EXISTING CADASTRAL BOUNDARY
- EASEMENT BOUNDARY
- PROPOSED ROAD DESIGN
- EZY-GUARD HC BARRIER
- TYPE F BARRIER
- NOISE MITIGATION TREATMENTS (BY OTHERS)
- EXISTING PAVEMENT
- FAUNA UNDERPASS
- FAUNA (KOALA) FENCE
- MAINTENANCE ACCESS GATE
- CATTLE GRID
- FAUNA ROPE CROSSING



EXTENT OF FAUNA FENCE TBC

APPIN ROAD

APPIN ROAD

**NOT FOR CONSTRUCTION**

THIS DRAWING MAY BE PREPARED IN COLOUR AND MAY BE INCOMPLETE IF COPIED

U:\Projects\PS107784-1B-RD-DRG-00102.dwg

DOCUMENT NUMBER / NAME <b>PS107784-1B-RD-DRG-00102</b>		DESIGN LOT CODE	DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING	PLOT DATE / TIME 29 September 2022 - 4:58:06 PM	PLOT BY Zhang, Cathy	CLIENT 	CAMPBELLTOWN CITY COUNCIL MR177 APPIN ROAD GLEN LORNE AND BROWNS BUSH FAUNA UNDERPASS	A3
EXTERNAL REFERENCE FILES	REV 01	DATE 30.09.22	AMENDMENT / REVISION DESCRIPTION UPDATED CONCEPT DESIGN	WVR No.	APPROVAL	TITLE	NAME	DATE
SCALES ON A3 SIZE DRAWING  SCALE 1:1000m				DRAWINGS / DESIGN PREPARED BY 		DRAWN	CATHY ZHANG	30.09.22
CO-ORDINATE SYSTEM MGA ZONE 56				HEIGHT DATUM A.H.D.		DRG CHECK	MARCO HOFFMANN	30.09.22
				Level 27, 680 George Street, Sydney GPO Box 5394, NSW 2001, Australia Tel: +61 2 9272 5100 Fax: +61 2 9272 5101 wsp.com		DESIGN	MARTIN HENEGHAN	30.09.22
						DESIGN CHECK	STEVE MCKENNA	30.09.22
						DESIGN MNGR	DANIEL PARK	30.09.22
						PROJECT MNGR	JONATHAN EPSELIS	30.09.22
PREPARED FOR TBC						RMS REGISTRATION No. <b>DS2019/000540</b>		PART
ISSUE STATUS CONCEPT DESIGN						EDMS No.	SHEET No. RD-00102	ISSUE 01

**NOTES**

1. ALL DIMENSIONS IN METERS UNLESS SPECIFIED OTHERWISE.
2. DRAWINGS TO BE IN CONJUNCTION WITH ROAD GENERAL ARRANGEMENT PLANS.

THIS DRAWING MAY BE PREPARED IN COLOUR AND MAY BE INCOMPLETE IF COPIED  
U:\Projects\PS107784\_Appin\_Road\_Mc\_Mf\WIP\Drawings\PORTION-1\RD\PS107784-1B-RD-DRG-00201.dwg  
150mm ON A3 SIZE ORIGINAL

DATUM R.L. 138.00

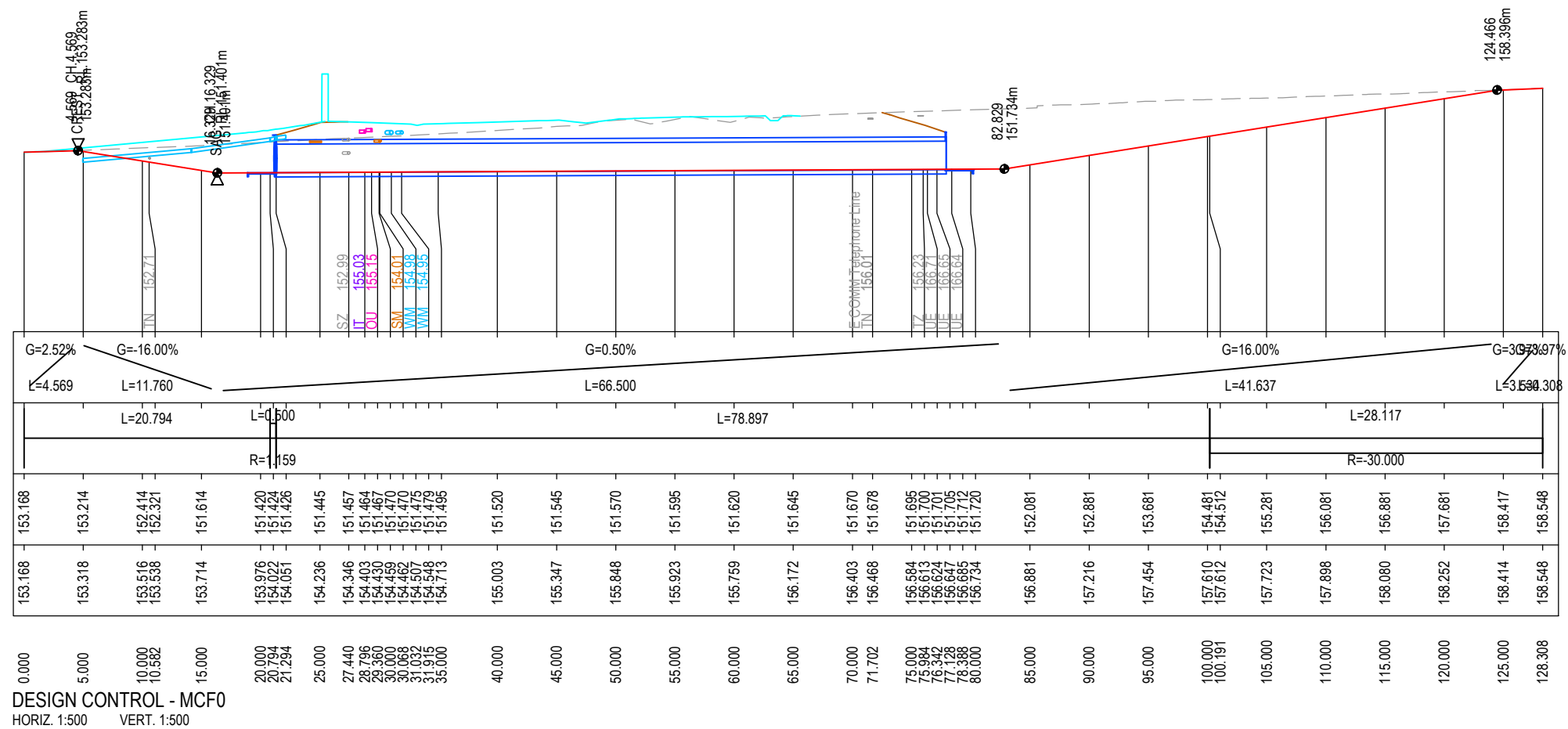
VERTICAL ALIGNMENT

HORIZONTAL ALIGNMENT

DESIGN LEVELS



EXISTING LEVELS

CHAINAGE



DESIGN CONTROL - MCF0  
HORIZ. 1:500 VERT. 1:500

NOT FOR CONSTRUCTION

DOCUMENT NUMBER / NAME <b>PS107784-1B-RD-DRG-00201</b>		DESIGN LOT CODE	DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING	PLOT DATE / TIME 29 September 2022 - 4:58:31 PM	PLOT BY Zhang, Cathy	CLIENT CAMPBELLTOWN CITY COUNCIL MR177 APPIN ROAD GLEN LORNE AND BROWNS BUSH FAUNA UNDERPASS	
EXTERNAL REFERENCE FILES	REV 01	DATE 29.09.22	AMENDMENT / REVISION DESCRIPTION UPDATED CONCEPT DESIGN	WVR No.	APPROVAL	 PREPARED FOR TBC	
SCALES ON A3 SIZE DRAWING 0 2 4 6 8 10 VERTICAL SCALE 1:200m 0 10 20 30 40 50 HORIZONTAL SCALE 1:1000m		DRAWINGS / DESIGN PREPARED BY		TITLE	NAME		DATE
CO-ORDINATE SYSTEM MGA ZONE 56		HEIGHT DATUM A.H.D.		 Level 27, 680 George Street, Sydney GPO Box 5394, NSW 2001, Australia Tel: +61 2 9272 5100 Fax: +61 2 9272 5101 wsp.com		DRAWN CATHY ZHANG 30.09.22 DRG CHECK MARCO HOFFMANN 30.09.22 DESIGN MARTIN HENEGHAN 30.09.22 DESIGN CHECK STEVE MCKENNA 30.09.22 DESIGN MNGR DANIEL PARK 30.09.22 PROJECT MNGR JONATHAN EPSELIS 30.09.22	SHEET No. 1 OF 1 RMS REGISTRATION No. <b>DS2019/000540</b> ISSUE STATUS CONCEPT DESIGN EDMS No. SHEET No. <b>RD-00201</b> ISSUE <b>01</b>

**NOTES**

1. ALL DIMENSIONS IN METERS UNLESS SPECIFIED OTHERWISE.
2. DRAWINGS TO BE IN CONJUNCTION WITH ROAD GENERAL ARRANGEMENT PLANS.

DATUM R.L. 184.00

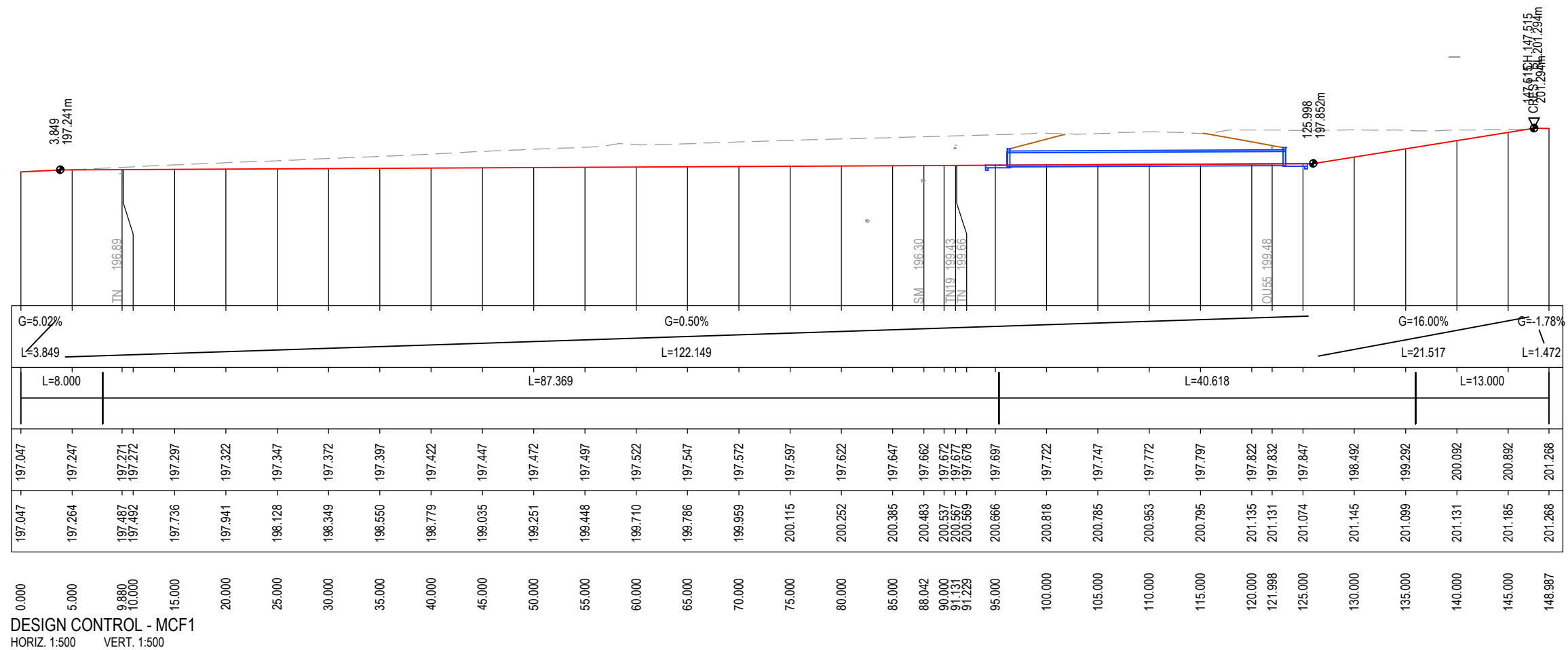
VERTICAL ALIGNMENT

HORIZONTAL ALIGNMENT

DESIGN LEVELS

EXISTING LEVELS

CHAINAGE



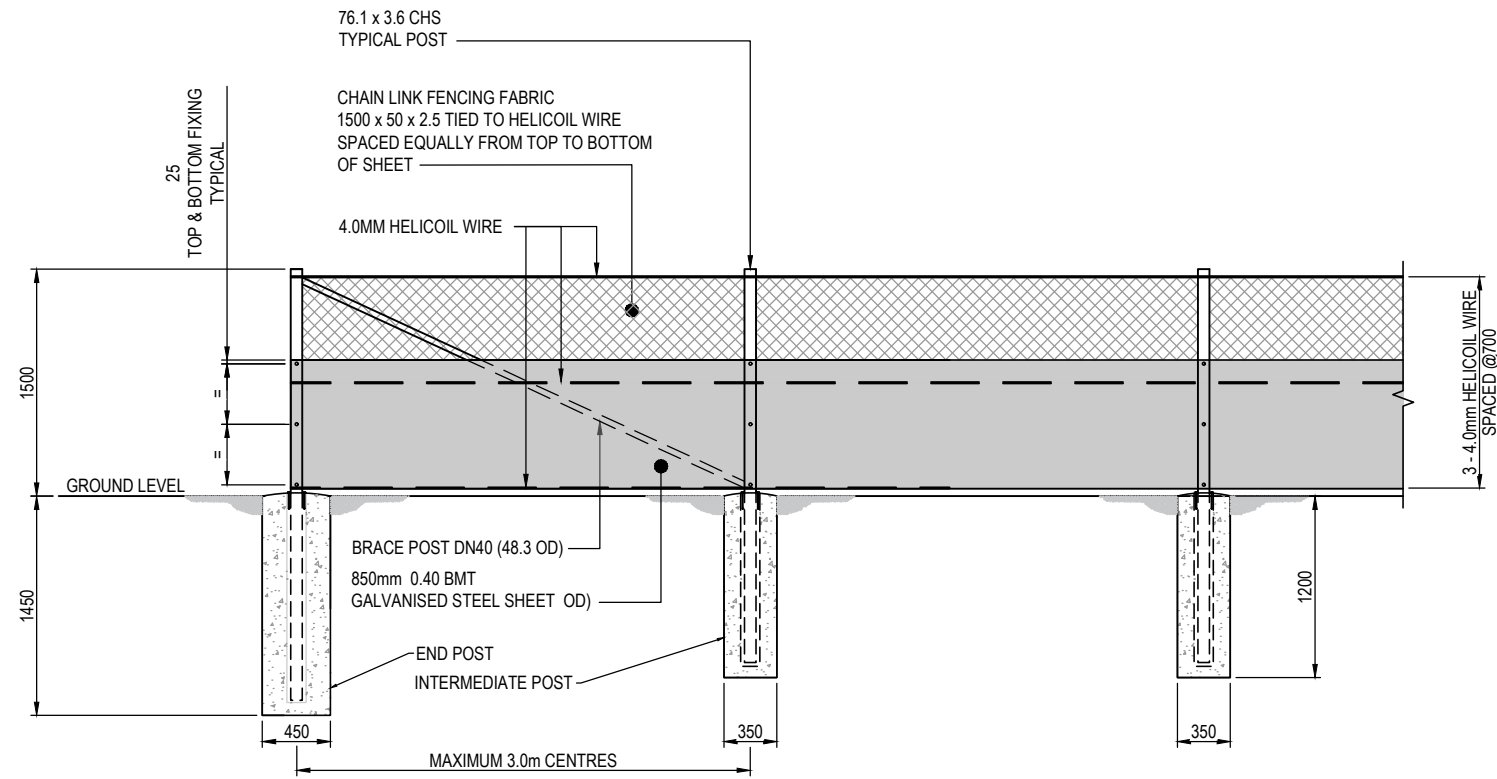
DESIGN CONTROL - MCF1  
HORIZ. 1:500 VERT. 1:500

NOT FOR CONSTRUCTION

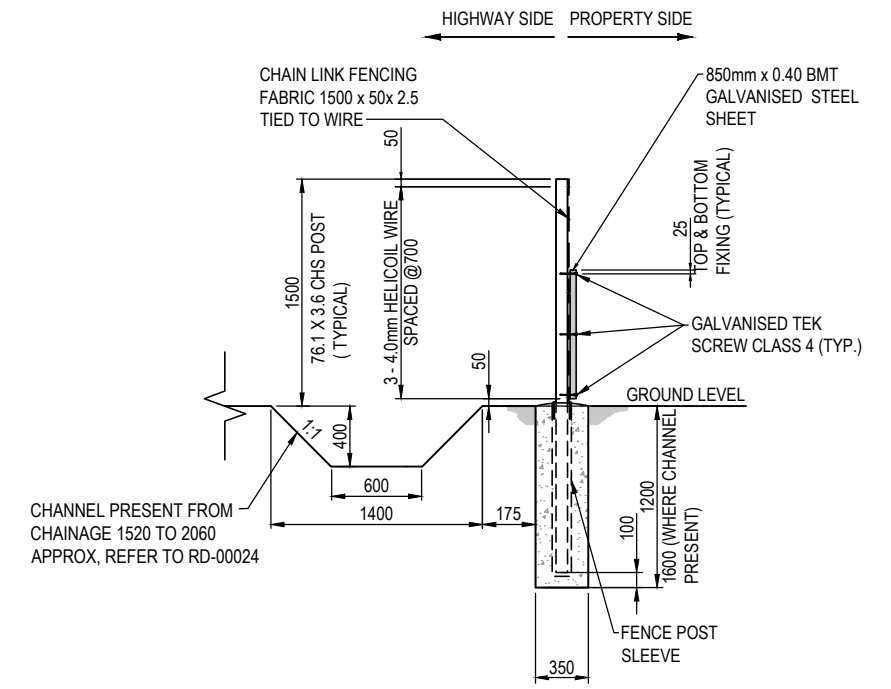
THIS DRAWING MAY BE PREPARED IN COLOUR AND MAY BE INCOMPLETE IF COPIED  
U:\Projects\PS107784\_Appin\_Road\_Mc\_Coll\_MIP\BIM\Drawings\PORTION-1\BROD\PS107784-1B-RD-DRG-00202.dwg  
150mm ON A3 SIZE ORIGINAL

DOCUMENT NUMBER / NAME <b>PS107784-1B-RD-DRG-00202</b>			DESIGN LOT CODE		DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING			PLOT DATE / TIME 29 September 2022 - 4:58:59 PM		PLOT BY Zhang, Cathy		CLIENT CAMPBELLTOWN CITY COUNCIL MR177 APPIN ROAD GLEN LORNE AND BROWNS BUSH FAUNA UNDERPASS		A3			
EXTERNAL REFERENCE FILES			REV	DATE	AMENDMENT / REVISION DESCRIPTION			WVR No.		APPROVAL		PREPARED FOR TBC		PART			
			01	29.09.22	UPDATED CONCEPT DESIGN							RMS REGISTRATION No. <b>DS2019/000540</b>		SHEET No. 1 OF 1			
						SCALES ON A3 SIZE DRAWING 0 2 4 6 8 10 VERTICAL SCALE 1:200m 0 10 20 30 40 50 HORIZONTAL SCALE 1:1000m			DRAWINGS / DESIGN PREPARED BY		TITLE NAME DATE DRAWN CATHY ZHANG 30.09.22 DRG CHECK MARCO HOFFMANN 30.09.22 DESIGN MARTIN HENEGHAN 30.09.22 DESIGN CHECK STEVE MCKENNA 30.09.22 DESIGN MNGR DANIEL PARK 30.09.22 PROJECT MNGR JONATHAN EPSELIS 30.09.22		ISSUE STATUS CONCEPT DESIGN		EDMS No.	SHEET No. RD-00202	ISSUE 01
						CO-ORDINATE SYSTEM MGA ZONE 56											
						HEIGHT DATUM A.H.D.			Level 27, 680 George Street, Sydney GPO Box 5394, NSW 2001, Australia Tel: +61 2 9272 5100 Fax: +61 2 9272 5101 wsp.com		lendlease						





FAUNA FENCE DETAIL  
ELEVATION FROM PROPERTY SIDE  
SCALE 1:50



SIDE ELEVATION  
SCALE 1:50

NOTES

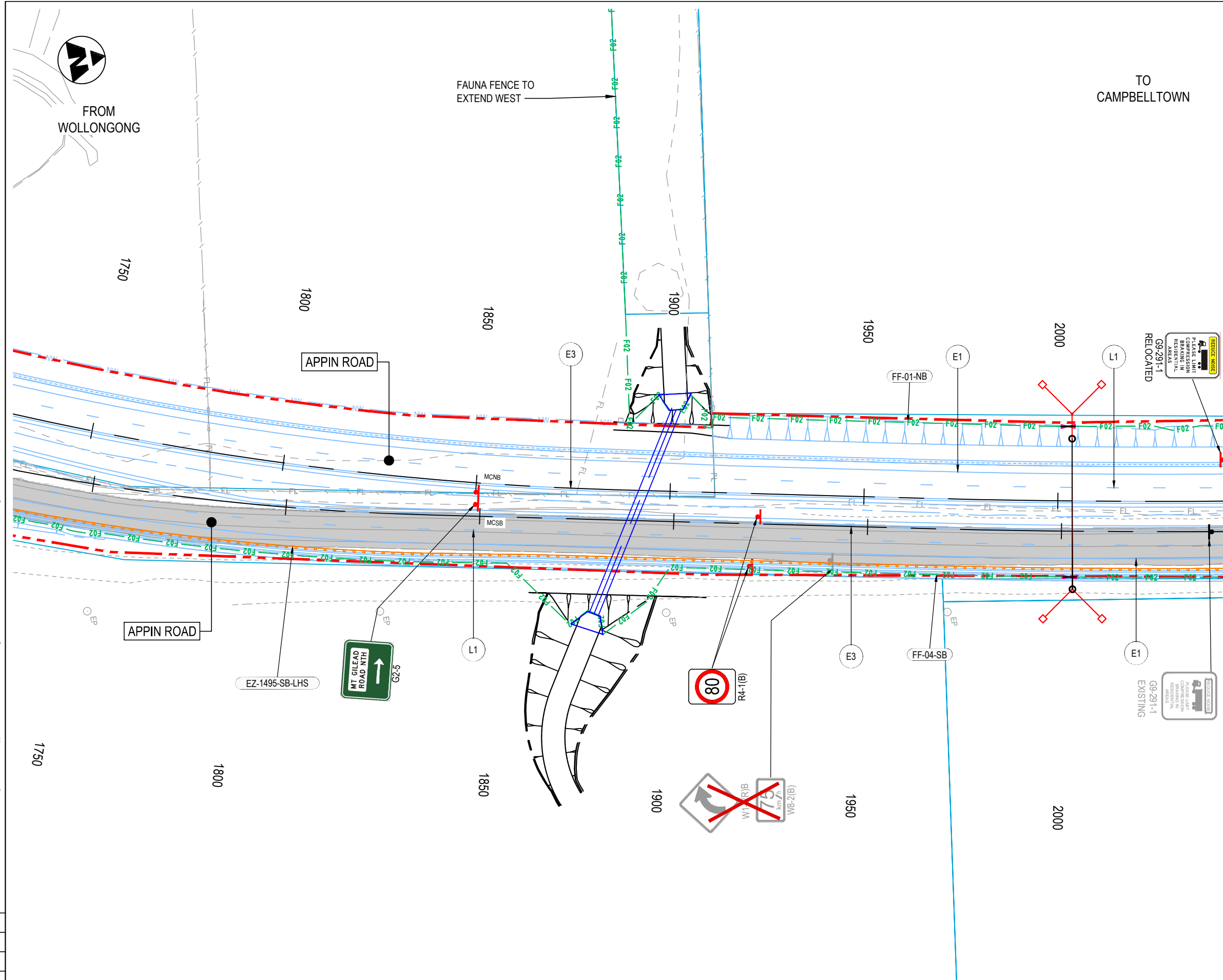
1. CIRCULAR HOLLOW SECTION (CHS) TO BE GRADE C250 TO AS 1163.
2. CONCRETE GRADE SHALL BE N32/20.
3. GALVANIZED CHAINWIRE SHALL CONFORM TO AS 2423 WITH A MESH SIZE OF 50mm AND Ø2.5mm WIRE, AND COATED WITH GREEN PVC.
4. CHAIN WIRE AND PREPAINTED GALVANIZED SHEET SHALL BE LOCATED ON THE OPPOSITE SIDE OF THE POSTS TO THE ROAD CORRIDOR TO PREVENT KOALA CLIMBING THE CHS POST AND STAYS.
5. GALVANIZED SHEET TO BE FIXED TO POST WITH 12-24x68 HEX WASHER SUPER TEK 500 C3 SELF DRILLING SCREWS.
6. BRACE POSTS TO BE ADOPTED WHERE CHANGE IN HORIZONTAL ALIGNMENT EXCEEDS 20 DEGREES, GATE POSTS AND END POSTS.
7. BOLTS, NUTS AND WASHERS TO BE HOT DIPPED GALVANIZED TO AS 1214.
8. WELDING SHALL BE TO AS/NZS 1554.1.
9. ALL STEELWORK AND FITTINGS SHALL BE HOT-DIPPED GALVANIZED TO AS/NZS 4680.
10. GALVANIZED FENCING WIRE TO AS 2423.
11. BRACE POSTS TO BE FIXED WITH CLAMPS.
12. ALL POSTS TO BE FITTED WITH GALVANIZED POST CAPS.
13. PILES TO BE FOUNDED IN STIFF RESIDUAL CLAY OR BETTER HAVING A MINIMUM UNDRAINED SHEAR STRENGTH GREATER THAN OR EQUAL TO 50KPa. NOT TO BE FOUNDED IN FILL MATERIAL. VISUAL INSPECTION OF EMBEDMENT MATERIAL SHALL BE UNDERTAKEN BY A SUITABLY QUALIFIED ENGINEER NOMINATED BY THE PRINCIPAL.

NOT FOR CONSTRUCTION

THIS DRAWING MAY BE PREPARED IN COLOUR AND MAY BE INCOMPLETE IF COPIED

U:\Projects\PS107784\_Appin\_Road\_Mc\_Coll\_MIP\BIM\Drawings\PORTION-1\BRRP\PS107784-1B-RF-DRG-00021.dwg

DOCUMENT NUMBER / NAME <b>PS107784-1B-RF-DRG-00021</b>		DESIGN LOT CODE	DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING		PLOT DATE / TIME 29 September 2022 - 5:08:34 PM	PLOT BY Zhang, Cathy	CLIENT <b>CAMPBELLTOWN CITY COUNCIL</b>	<b>A3</b>
EXTERNAL REFERENCE FILES	REV 01 02	DATE 11.03.22 30.09.22	AMENDMENT / REVISION DESCRIPTION ISSUED FOR CONCEPT DESIGN UPDATED CONCEPT DESIGN	WVR No.	APPROVAL	SCALES ON A3 SIZE DRAWING	DRAWINGS / DESIGN PREPARED BY	TITLE
						0 500 1000 1500 2000 2500 SCALE 1:50mm	<b>wsp</b> Level 27, 680 George Street, Sydney GPO Box 5394, NSW 2001, Australia Tel: +61 2 9272 5100 Fax: +61 2 9272 5101 wsp.com	DRAWN CATHY ZHANG 30.09.22
						CO-ORDINATE SYSTEM MGA ZONE 56	HEIGHT DATUM A.H.D.	NAME CATHY ZHANG CLAUDIO BIDART ABID HUSSAIN MARTIN HENEGHAN DANIEL PARK JONATHAN EPSELIS
								DATE 30.09.22 30.09.22 30.09.22 30.09.22 30.09.22
								PREPARED FOR TBC
								RMS REGISTRATION No. <b>DS2019/000540</b>
								SHEET No. 1 OF 1
								ISSUE STATUS CONCEPT DESIGN
								EDMS No.
								SHEET No. RF-00021
								ISSUE 02



**NOTES**  
 1. FOR ROAD FURNITURE GENERAL NOTES AND LEGEND REFER TO DRAWING PS107784-1B-RF-DRG-00010.  
 2. FOR FAUNA FENCE TYPICAL DETAILS REFER DRAWING PS107784-1B-RF-DRG-00021.

**SIGNPOSTING STATUS**

- NEW SINGLE SIGNPOST
- NEW DOUBLE SIGNPOST
- NEW DOUBLE FACE SINGLE SIGNPOST
- EXISTING SIGNPOST (RETAIN / RELOCATE)
- EXISTING SIGNPOST (REMOVE)

**SIGN FACE**

- NEW SIGN
- R4-1 ← RMS / AS1742 CODE FOR STANDARD SIGNAGE
- RETAIN / RELOCATE EXISTING SIGN
- REMOVE EXISTING SIGN

**LINEMARKING**

- NEW LINEMARKING
- S1/L1 LINETYPE
- C1 LINETYPE
- TB LINETYPE
- TB1 LINETYPE
- EDGE LINETYPE (E1,E2,E3,E4,E5)
- BB LINETYPE
- TRAFFIC FLOW DIRECTION

**BARRIERS**

- BARRIER TAG (TYPE - APPROX. START CHAINAGE - CARRIAGEWAY DIRECTION - SIDE)
- EZY-GUARD HC BARRIER

**FENCING**

- FAUNA (KOALA) FENCE
- MAINTENANCE ACCESS GATE
- CATTLE GRID
- FAUNA ROPE CROSSING

**NOT FOR CONSTRUCTION**

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DOCUMENT NUMBER / NAME <b>PS107784-1B-RF-DRG-00101</b>		DESIGN LOT CODE	DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING	PLOT DATE / TIME 29 September 2022 - 5:09:40 PM	PLOT BY Zhang, Cathy	CLIENT <b>lendlease</b>	CAMPBELLTOWN CITY COUNCIL MR177 APPIN ROAD GLEN LORNE AND BROWNS BUSH FAUNA UNDERPASS A3																					
EXTERNAL REFERENCE FILES	REV 01 02	DATE 11.03.22 30.09.22	AMENDMENT / REVISION DESCRIPTION ISSUED FOR CONCEPT DESIGN UPDATED CONCEPT DESIGN	WVR No.	APPROVAL	SCALES ON A3 SIZE DRAWING	DRAWINGS / DESIGN PREPARED BY																					
<p>SCALE 1:1000m</p>				<p>Level 27, 680 George Street, Sydney GPO Box 5394, NSW 2001, Australia Tel: +61 2 9272 5100 Fax: +61 2 9272 5101 wsp.com</p>		<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>TITLE</th> <th>NAME</th> <th>DATE</th> </tr> </thead> <tbody> <tr> <td>DRAWN</td> <td>CATHY ZHANG</td> <td>30.09.22</td> </tr> <tr> <td>DRG CHECK</td> <td>CLAUDIO BIDART</td> <td>30.09.22</td> </tr> <tr> <td>DESIGN</td> <td>ABID HUSSAIN</td> <td>30.09.22</td> </tr> <tr> <td>DESIGN CHECK</td> <td>MARTIN HENEGHAN</td> <td>30.09.22</td> </tr> <tr> <td>DESIGN MNGR</td> <td>DANIEL PARK</td> <td>30.09.22</td> </tr> <tr> <td>PROJECT MNGR</td> <td>JONATHAN EPSELIS</td> <td>30.09.22</td> </tr> </tbody> </table>		TITLE	NAME	DATE	DRAWN	CATHY ZHANG	30.09.22	DRG CHECK	CLAUDIO BIDART	30.09.22	DESIGN	ABID HUSSAIN	30.09.22	DESIGN CHECK	MARTIN HENEGHAN	30.09.22	DESIGN MNGR	DANIEL PARK	30.09.22	PROJECT MNGR	JONATHAN EPSELIS	30.09.22
TITLE	NAME	DATE																										
DRAWN	CATHY ZHANG	30.09.22																										
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DESIGN CHECK	MARTIN HENEGHAN	30.09.22																										
DESIGN MNGR	DANIEL PARK	30.09.22																										
PROJECT MNGR	JONATHAN EPSELIS	30.09.22																										
CO-ORDINATE SYSTEM MGA ZONE 56				HEIGHT DATUM A.H.D.		PREPARED FOR TBC																						
GENERAL ARRANGEMENT PLAN				RMS REGISTRATION No. <b>DS2019/000540</b>		SHEET No. 1 OF 4																						
ISSUE STATUS CONCEPT DESIGN				EDMS No.		SHEET No. <b>RF-00101</b>																						
						ISSUE No. <b>02</b>																						



FROM  
WOLLONGONG






TO  
CAMPBELLTOWN

FAUNA FENCE TO  
EXTEND WEST




### NOTES

- FOR ROAD FURNITURE GENERAL NOTES AND LEGEND REFER TO DRAWING PS107784-1B-RF-DRG-00010.
- FOR FAUNA FENCE TYPICAL DETAILS REFER DRAWING PS107784-1B-RF-DRG-00021.




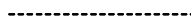
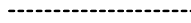

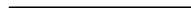

### SIGNPOSTING STATUS

-  NEW SINGLE SIGNPOST
-  NEW DOUBLE SIGNPOST
-  NEW DOUBLE FACE SINGLE SIGNPOST
-  EXISTING SIGNPOST (RETAIN / RELOCATE)
-  EXISTING SIGNPOST (REMOVE)

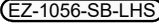

### SIGN FACE

-  NEW SIGN
- R4-1 ← RMS / AS1742 CODE FOR STANDARD SIGNAGE
-  RETAIN / RELOCATE EXISTING SIGN
- R4-1
-  REMOVE EXISTING SIGN
- R4-1





### LINEMARKING

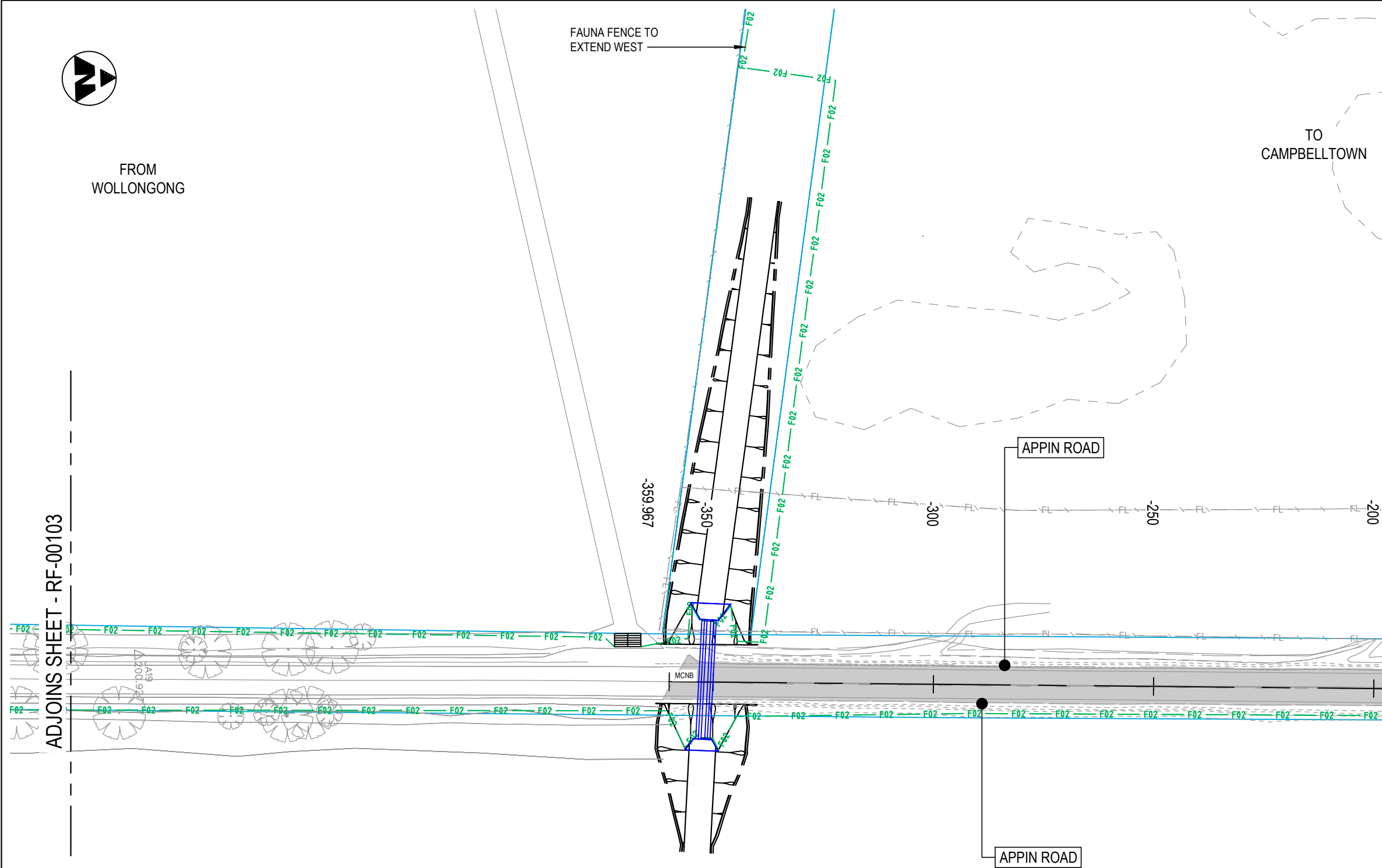
-  NEW LINEMARKING
-  S1/L1 LINETYPE
-  C1 LINETYPE
-  TB LINETYPE
-  TB1 LINETYPE
-  EDGE LINETYPE (E1,E2,E3,E4,E5)
-  BB LINETYPE
-  TRAFFIC FLOW DIRECTION

### BARRIERS

-  BARRIER TAG  
(TYPE - APPROX. START CHAINAGE - CARRIAGEWAY DIRECTION - SIDE)
-  EZY-GUARD HC BARRIER

### FENCING

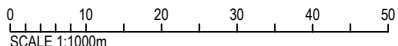


-  FAUNA (KOALA) FENCE
-  MAINTENANCE ACCESS GATE
-  CATTLE GRID
-  FAUNA ROPE CROSSING



**NOT FOR CONSTRUCTION**

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U:\Projects\PS107784-1B-RF-DRG-00102.dwg

DOCUMENT NUMBER / NAME PS107784-1B-RF-DRG-00102		DESIGN LOT CODE	DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING		PLOT DATE / TIME 29 September 2022 - 5:10:45 PM	PLOT BY Zhang, Cathy	CLIENT CAMPBELLTOWN CITY COUNCIL	A3
EXTERNAL REFERENCE FILES	REV 01	DATE 30.09.22	AMENDMENT / REVISION DESCRIPTION UPDATED CONCEPT DESIGN	WVR No.	APPROVAL	SCALES ON A3 SIZE DRAWING	DRAWINGS / DESIGN PREPARED BY	TITLE
						 SCALE 1:1000m		DRAWN CATHY ZHANG 30.09.22 DRG CHECK CLAUDIO BIDART 30.09.22 DESIGN ABID HUSSAIN 30.09.22 DESIGN CHECK MARTIN HENEGHAN 30.09.22 DESIGN MNGR DANIEL PARK 30.09.22 PROJECT MNGR JONATHAN EPSELIS 30.09.22
						 Level 27, 680 George Street, Sydney GPO Box 5394, NSW 2001, Australia Tel: +61 2 9272 5100 Fax: +61 2 9272 5101 wsp.com		PREPARED FOR TBC
								MR177 APPIN ROAD GLEN LORNE AND BROWNS BUSH FAUNA UNDERPASS GENERAL ARRANGEMENT PLAN SHEET No. 2 OF 4
							RMS REGISTRATION No.	DS2019/000540
							ISSUE STATUS	CONCEPT DESIGN
							EDMS No.	
							SHEET No.	RF-00102
							ISSUE	01



FROM  
WOLLONGONG

TO  
CAMPBELLTOWN

NOTES

- FOR ROAD FURNITURE GENERAL NOTES AND LEGEND REFER TO DRAWING PS107784-1B-RF-DRG-00010.
- FOR FAUNA FENCE TYPICAL DETAILS REFER DRAWING PS107784-1B-RF-DRG-00021.

SIGNPOSTING STATUS

- NEW SINGLE SIGNPOST
- NEW DOUBLE SIGNPOST
- NEW DOUBLE FACE SINGLE SIGNPOST
- EXISTING SIGNPOST (RETAIN / RELOCATE)
- EXISTING SIGNPOST (REMOVE)

SIGN FACE

- NEW SIGN  
R4-1 ← RMS / AS1742 CODE FOR STANDARD SIGNAGE
- RETAIN / RELOCATE EXISTING SIGN  
R4-1
- REMOVE EXISTING SIGN  
R4-1

LINEMARKING

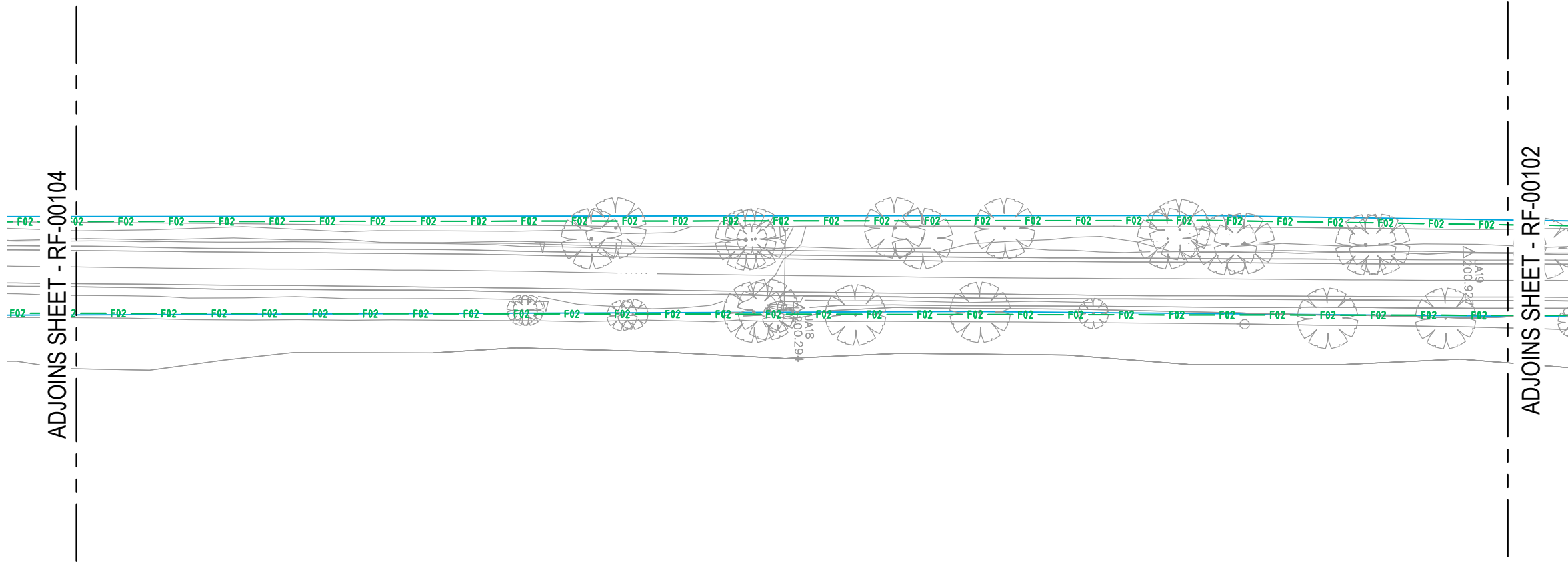
- NEW LINEMARKING  
L1 →
- S1/L1 LINETYPE
- C1 LINETYPE
- TB LINETYPE
- TB1 LINETYPE
- EDGE LINETYPE (E1,E2,E3,E4,E5)
- BB LINETYPE
- TRAFFIC FLOW DIRECTION

BARRIERS

- BARRIER TAG  
(TYPE - APPROX. START CHAINAGE - CARRIAGEWAY DIRECTION - SIDE)
- EZY-GUARD HC BARRIER

FENCING

- FAUNA (KOALA) FENCE
- MAINTENANCE ACCESS GATE
- CATTLE GRID
- FAUNA ROPE CROSSING



**NOT FOR CONSTRUCTION**

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U:\Projects\PS107784-1B-RF-DRG-00103.dwg

DOCUMENT NUMBER / NAME <b>PS107784-1B-RF-DRG-00103</b>		DESIGN LOT CODE	DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING		PLOT DATE / TIME 29 September 2022 - 5:11:45 PM	PLOT BY Zhang, Cathy	CLIENT 	CAMPBELLTOWN CITY COUNCIL MR177 APPIN ROAD GLEN LORNE AND BROWNS BUSH FAUNA UNDERPASS	A3
EXTERNAL REFERENCE FILES	REV 01	DATE 30.09.22	AMENDMENT / REVISION DESCRIPTION UPDATED CONCEPT DESIGN	WVR No.	APPROVAL	SCALES ON A3 SIZE DRAWING 0 10 20 30 40 50 SCALE 1:1000m	DRAWINGS / DESIGN PREPARED BY 	TITLE DRAWN DRG CHECK DESIGN DESIGN CHECK DESIGN MNGR PROJECT MNGR	NAME CATHY ZHANG CLAUDIO BIDART ABID HUSSAIN MARTIN HENEGHAN DANIEL PARK JONATHAN EPSELIS
CO-ORDINATE SYSTEM MGA ZONE 56		HEIGHT DATUM A.H.D.		Level 27, 680 George Street, Sydney GPO Box 5394, NSW 2001, Australia Tel: +61 2 9272 5100 Fax: +61 2 9272 5101 wsp.com		PREPARED FOR TBC		GENERAL ARRANGEMENT PLAN SHEET No. 3 OF 4	
ISSUE STATUS CONCEPT DESIGN		EDMS No.	SHEET No. RF-00103	RMS REGISTRATION No. DS2019/000540		PART		ISSUE 01	








FROM  
WOLLONGONG

TO  
CAMPBELLTOWN




### NOTES

- FOR ROAD FURNITURE GENERAL NOTES AND LEGEND REFER TO DRAWING PS107784-1B-RF-DRG-00010.
- FOR FAUNA FENCE TYPICAL DETAILS REFER DRAWING PS107784-1B-RF-DRG-00021.




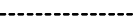
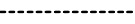

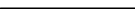

### SIGNPOSTING STATUS

-  NEW SINGLE SIGNPOST
-  NEW DOUBLE SIGNPOST
-  NEW DOUBLE FACE SINGLE SIGNPOST
-  EXISTING SIGNPOST (RETAIN / RELOCATE)
-  EXISTING SIGNPOST (REMOVE)

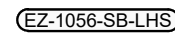

### SIGN FACE

-  NEW SIGN  
R4-1 ← RMS / AS1742 CODE FOR STANDARD SIGNAGE
-  RETAIN / RELOCATE EXISTING SIGN  
R4-1
-  REMOVE EXISTING SIGN  
R4-1





### LINEMARKING

-  NEW LINEMARKING
-  S1/L1 LINETYPE
-  C1 LINETYPE
-  TB LINETYPE
-  TB1 LINETYPE
-  EDGE LINETYPE (E1,E2,E3,E4,E5)
-  BB LINETYPE
-  TRAFFIC FLOW DIRECTION

### BARRIERS

-  BARRIER TAG  
(TYPE - APPROX. START CHAINAGE - CARRIAGEWAY DIRECTION - SIDE)
-  EZY-GUARD HC BARRIER



### FENCING

-  FAUNA (KOALA) FENCE
-  MAINTENANCE ACCESS GATE
-  CATTLE GRID
-  FAUNA ROPE CROSSING

ADJOINS SHEET - RF-00103

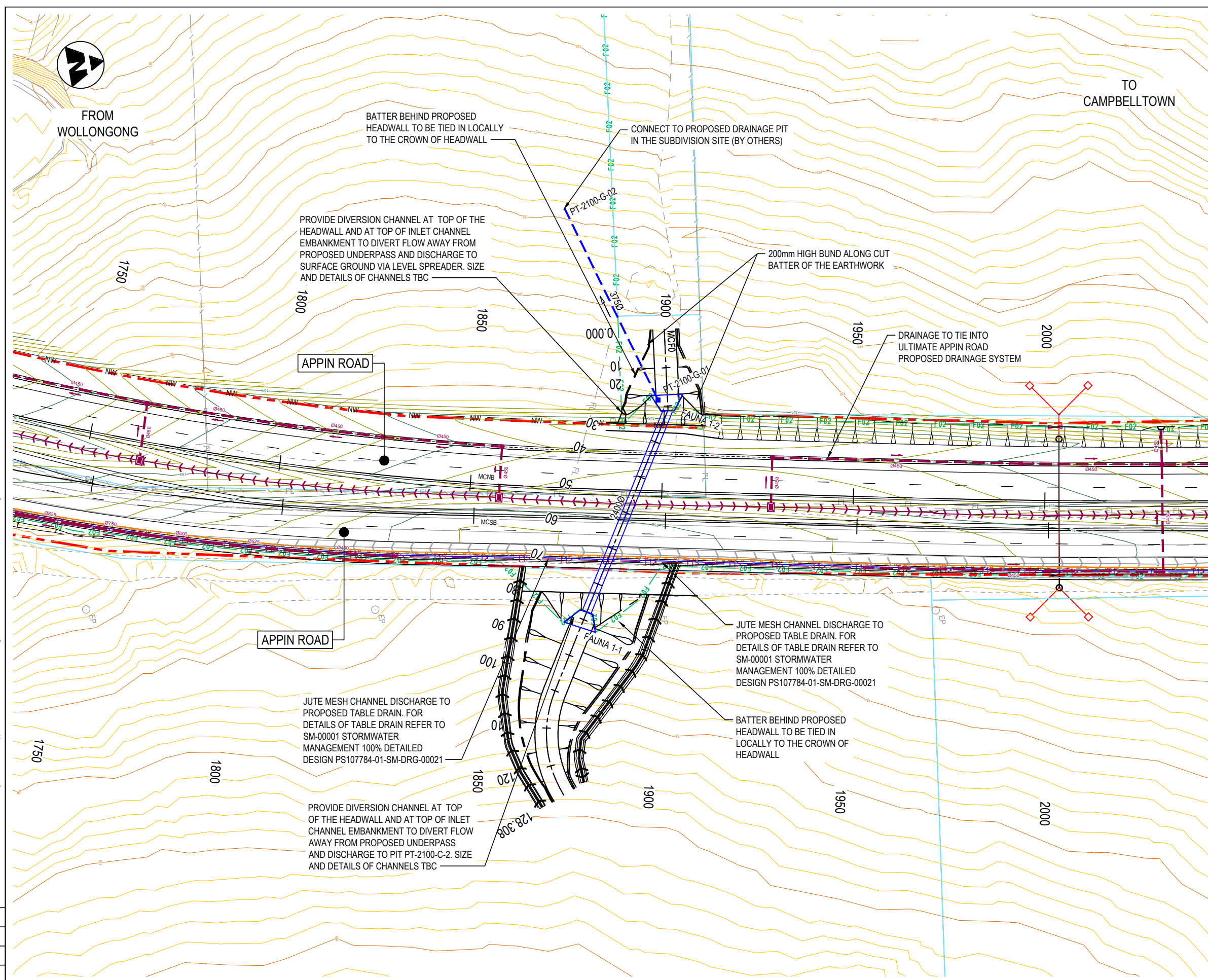
THIS DRAWING MAY BE PREPARED IN COLOUR AND MAY BE INCOMPLETE IF COPIED  
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NOT FOR CONSTRUCTION

DOCUMENT NUMBER / NAME <b>PS107784-1B-RF-DRG-00104</b>		DESIGN LOT CODE	DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING		PLOT DATE / TIME 29 September 2022 - 5:12:46 PM	PLOT BY Zhang, Cathy	CLIENT 	CAMPBELLTOWN CITY COUNCIL MR177 APPIN ROAD GLEN LORNE AND BROWNS BUSH FAUNA UNDERPASS	A3								
EXTERNAL REFERENCE FILES	REV 01	DATE 30.09.22	AMENDMENT / REVISION DESCRIPTION UPDATED CONCEPT DESIGN	WVR No.	APPROVAL	SCALES ON A3 SIZE DRAWING 0 10 20 30 40 50 SCALE 1:1000m	DRAWINGS / DESIGN PREPARED BY 	TITLE	NAME	DATE	PREPARED FOR TBC	GENERAL ARRANGEMENT PLAN SHEET No. 4 OF 4	RMS REGISTRATION No. <b>DS2019/000540</b>	ISSUE STATUS CONCEPT DESIGN	EDMS No.	SHEET No. RF-00104	ISSUE 01
CO-ORDINATE SYSTEM MGA ZONE 56		HEIGHT DATUM A.H.D.		Level 27, 680 George Street, Sydney GPO Box 5394, NSW 2001, Australia Tel: +61 2 9272 5100 Fax: +61 2 9272 5101 wsp.com		DRAWN CATHY ZHANG 30.09.22		DRG CHECK CLAUDIO BIDART 30.09.22		DESIGN ABID HUSSAIN 30.09.22		DESIGN CHECK MARTIN HENEGHAN 30.09.22		DESIGN MNGR DANIEL PARK 30.09.22		PROJECT MNGR JONATHAN EPSELIS 30.09.22	



THE UTILITIES/SERVICES SHOWN IN THESE PLANS HAVE BEEN COMPILED FROM MULTIPLE SOURCES OF INFORMATION. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO UNDERTAKE THEIR OWN SITE INVESTIGATIONS PRIOR TO ANY CONSTRUCTION ACTIVITIES. THESE DRAWINGS ARE NEVER TO BE USED FOR THE PURPOSE OF LOCATING SERVICES. WSP SHALL NOT BE LIABLE FOR ANY LOSS OR DAMAGE CAUSED USING THE UTILITIES/SERVICES INFORMATION SHOWN ON THESE DRAWINGS.



- NOTES**
- LOCATIONS OF EXISTING DRAINAGE IS BASED ON SURVEY INFORMATION RECEIVED TO DATE. SEVERAL ASSUMPTIONS HAVE BEEN MADE WHERE SURVEY DATA IS INCOMPLETE.
  - DESIGN CONTOURS SHOWN AT 1.0m INTERVALS (MAJOR).
  - FOR LEGEND REFER TO DRAWING PS107784-1B-GE-DRG-00010.
  - DRAWING TO BE READ IN CONJUNCTION WITH UTILITIES DESIGN LOT UT-00001, ASSOCIATED DETAILED DESIGN DRAWINGS AND REPORTS.
  - DEMOLISH EXISTING PIPES, PITS AND HEADWALL.
  - ABANDON THE EXISTING DRAIN ON THE EASTERN SIDE FROM CH:0 TO CH:2100.
  - THE EXISTING SURFACE LEVEL CONTOURS HAVE BEEN DEVELOPED USING DIFFERENT SOURCES OF TOPOGRAPHY INFORMATION. AT SOME LOCATIONS EXISTING SURFACE LEVEL CONTOURS SHOWS DISCONTINUITY DUE TO INTERFACE BETWEEN A DETAILED DESIGN TOPOGRAPHY SURVEY AND LIDAR SURVEY INFORMATION.
  - FOR DOWNSTREAM DRAINAGE DESIGN AND TREATMENT DETAILS, REFER TO MT GLEAD DEVELOPMENT DRAINAGE DETAILED DESIGN 80216021-10-CI SERIES.

**DRAINAGE LEGEND - NEW**

- DRAINAGE PIPE
- CROSS DRAINAGE
- DRAINAGE NETWORK REFER TO SM-01 PACKAGE FOR DETAILS
- HEADWALL
- DRAINAGE PIT TYPE MGDG
- DRAINAGE PIT TYPE MGSG
- DRAINAGE PIT TYPE SA
- DRAINAGE PIT TYPE SA1
- DRAINAGE PIT TYPE SA2
- DRAINAGE PIT TYPE SO1
- DRAINAGE PIT TYPE SO2
- DRAINAGE JUNCTION PIT
- DRAINAGE PIT TYPE RSG (600x900)
- DRAINAGE PIT TYPE SL1
- JUTE MESH CHANNEL
- DESIGN CONTOURS
- PAVEMENT DRAINAGE TAG ID
- PIT NUMBER
- LINE IDENTIFIER
- CHAINAGE
- COMPONENT CODE

**DRAINAGE LEGEND - EXISTING**

- DRAINAGE PIPE
- CROSS DRAINAGE
- DRAINAGE PIT
- EXISTING CHANNEL

**NOT FOR CONSTRUCTION**

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DOCUMENT NUMBER / NAME <b>PS107784-1B-SM-DRG-00101</b>		DESIGN LOT CODE	DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING		PLOT DATE / TIME 30 September 2022 - 10:29:36 AM	PLOT BY Zhang,	CLIENT CAMPBELLTOWN CITY COUNCIL MR177 APPIN ROAD GLEN LORNE AND BROWNS BUSH FAUNA UNDERPASS	A3																					
EXTERNAL REFERENCE FILES	REV 01 02	DATE 11.03.22 30.09.22	AMENDMENT / REVISION DESCRIPTION ISSUED FOR CONCEPT DESIGN UPDATED CONCEPT DESIGN	WVR No.	APPROVAL	SCALES ON A3 SIZE DRAWING 0 10 20 30 40 50 SCALE 1:1000m	DRAWINGS / DESIGN PREPARED BY 	PREPARED FOR TBC																					
CO-ORDINATE SYSTEM MGA ZONE 56				HEIGHT DATUM A.H.D.		<table border="1"> <thead> <tr> <th>DATE</th> <th>NAME</th> <th>DATE</th> </tr> </thead> <tbody> <tr> <td>30.09.22</td> <td>CATHY ZHANG</td> <td>30.09.22</td> </tr> <tr> <td>30.09.22</td> <td>CLAUDIO BIDART</td> <td>30.09.22</td> </tr> <tr> <td>30.09.22</td> <td>SHAHIN ALAVI</td> <td>30.09.22</td> </tr> <tr> <td>30.09.22</td> <td>IAN WILCOCK</td> <td>30.09.22</td> </tr> <tr> <td>30.09.22</td> <td>DANIEL PARK</td> <td>30.09.22</td> </tr> <tr> <td>30.09.22</td> <td>JONATHAN EPSELIS</td> <td>30.09.22</td> </tr> </tbody> </table>		DATE	NAME	DATE	30.09.22	CATHY ZHANG	30.09.22	30.09.22	CLAUDIO BIDART	30.09.22	30.09.22	SHAHIN ALAVI	30.09.22	30.09.22	IAN WILCOCK	30.09.22	30.09.22	DANIEL PARK	30.09.22	30.09.22	JONATHAN EPSELIS	30.09.22	 GENERAL ARRANGEMENT PLAN SHEET No. 1 OF 1 RMS REGISTRATION No. <b>DS2019/000540</b> ISSUE STATUS CONCEPT DESIGN EDMS No. SHEET No. <b>SM-00101</b> ISSUE <b>02</b>
DATE	NAME	DATE																											
30.09.22	CATHY ZHANG	30.09.22																											
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FROM WOLLONGONG

TO CAMPBELLTOWN

THE UTILITIES/SERVICES SHOWN IN THESE PLANS HAVE BEEN COMPILED FROM MULTIPLE SOURCES OF INFORMATION. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO UNDERTAKE THEIR OWN SITE INVESTIGATIONS PRIOR TO ANY CONSTRUCTION ACTIVITIES. THESE DRAWINGS ARE NEVER TO BE USED FOR THE PURPOSE OF LOCATING SERVICES. WSP SHALL NOT BE LIABLE FOR ANY LOSS OR DAMAGE CAUSED USING THE UTILITIES/SERVICES INFORMATION SHOWN ON THESE DRAWINGS.

NOTES

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4. DRAWING TO BE READ IN CONJUNCTION WITH UTILITIES DESIGN LOT UT-00001, ASSOCIATED DETAILED DESIGN DRAWINGS AND REPORTS.
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6. ABANDON THE EXISTING DRAIN ON THE EASTERN SIDE FROM CH:0 TO CH:2100.
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8. FOR DOWNSTREAM DRAINAGE DESIGN AND TREATMENT DETAILS, REFER TO MT GILEAD DEVELOPMENT DRAINAGE DETAILED DESIGN 80216021-10-CI SERIES.

DRAINAGE LEGEND - NEW

- DRAINAGE PIPE
  - CROSS DRAINAGE
  - DRAINAGE NETWORK REFER TO SM-01 PACKAGE FOR DETAILS
  - HEADWALL
  - DRAINAGE PIT TYPE MGDG
  - DRAINAGE PIT TYPE MGSG
  - DRAINAGE PIT TYPE SA
  - DRAINAGE PIT TYPE SA1
  - DRAINAGE PIT TYPE SA2
  - DRAINAGE PIT TYPE SO1
  - DRAINAGE PIT TYPE SO2
  - DRAINAGE JUNCTION PIT
  - DRAINAGE PIT TYPE RSG (600x900)
  - DRAINAGE PIT TYPE SL1
  - JUTE MESH CHANNEL
  - DESIGN CONTOURS
  - PAVEMENT DRAINAGE TAG ID
- PIT NUMBER  
 LINE IDENTIFIER  
 CHAINAGE  
 COMPONENT CODE

DRAINAGE LEGEND - EXISTING

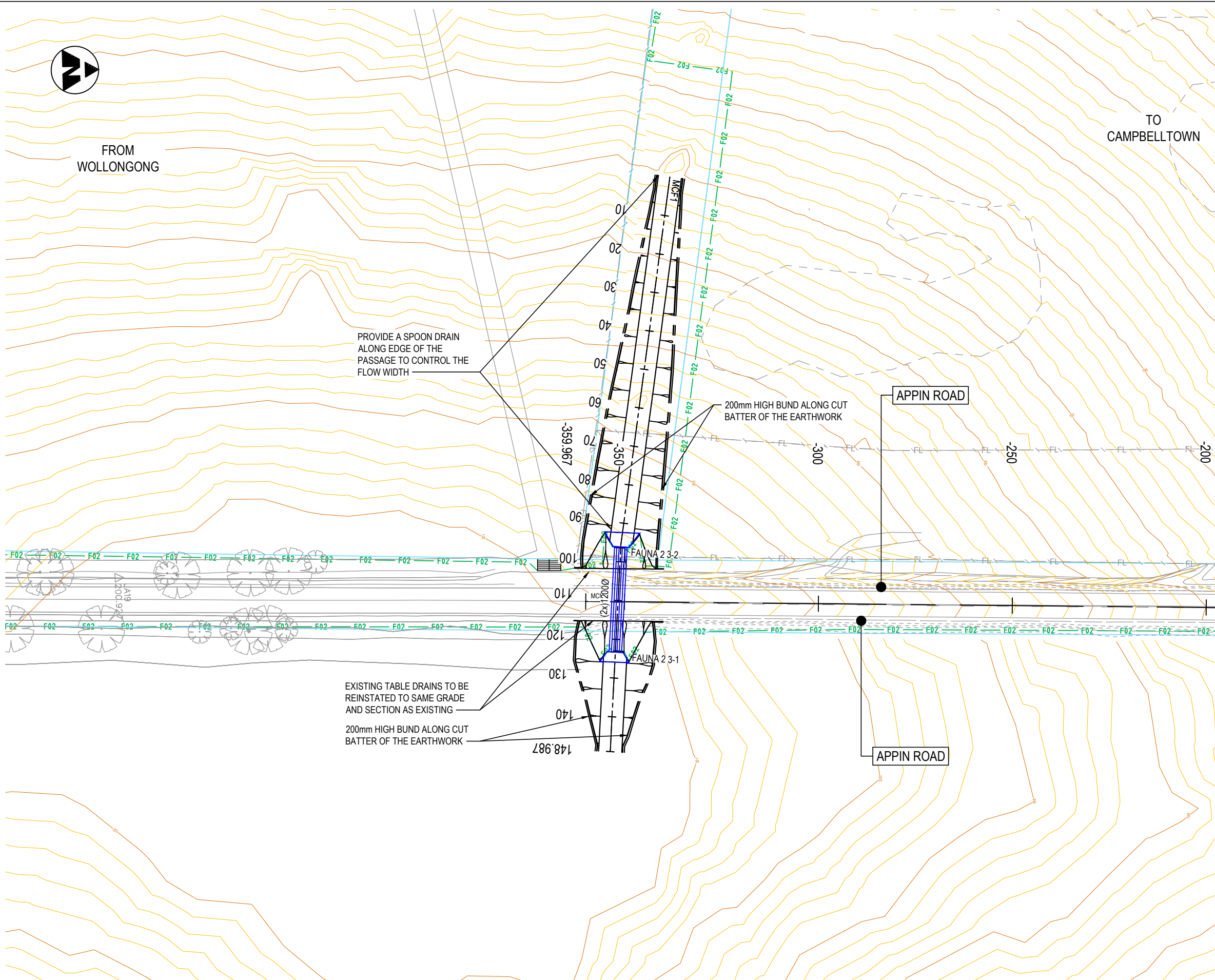
- DRAINAGE PIPE
- CROSS DRAINAGE
- DRAINAGE PIT
- EXISTING CHANNEL

PROVIDE A SPOON DRAIN ALONG EDGE OF THE PASSAGE TO CONTROL THE FLOW WIDTH

200mm HIGH BUND ALONG CUT BATTER OF THE EARTHWORK

EXISTING TABLE DRAINS TO BE REINSTATED TO SAME GRADE AND SECTION AS EXISTING

200mm HIGH BUND ALONG CUT BATTER OF THE EARTHWORK



**NOT FOR CONSTRUCTION**

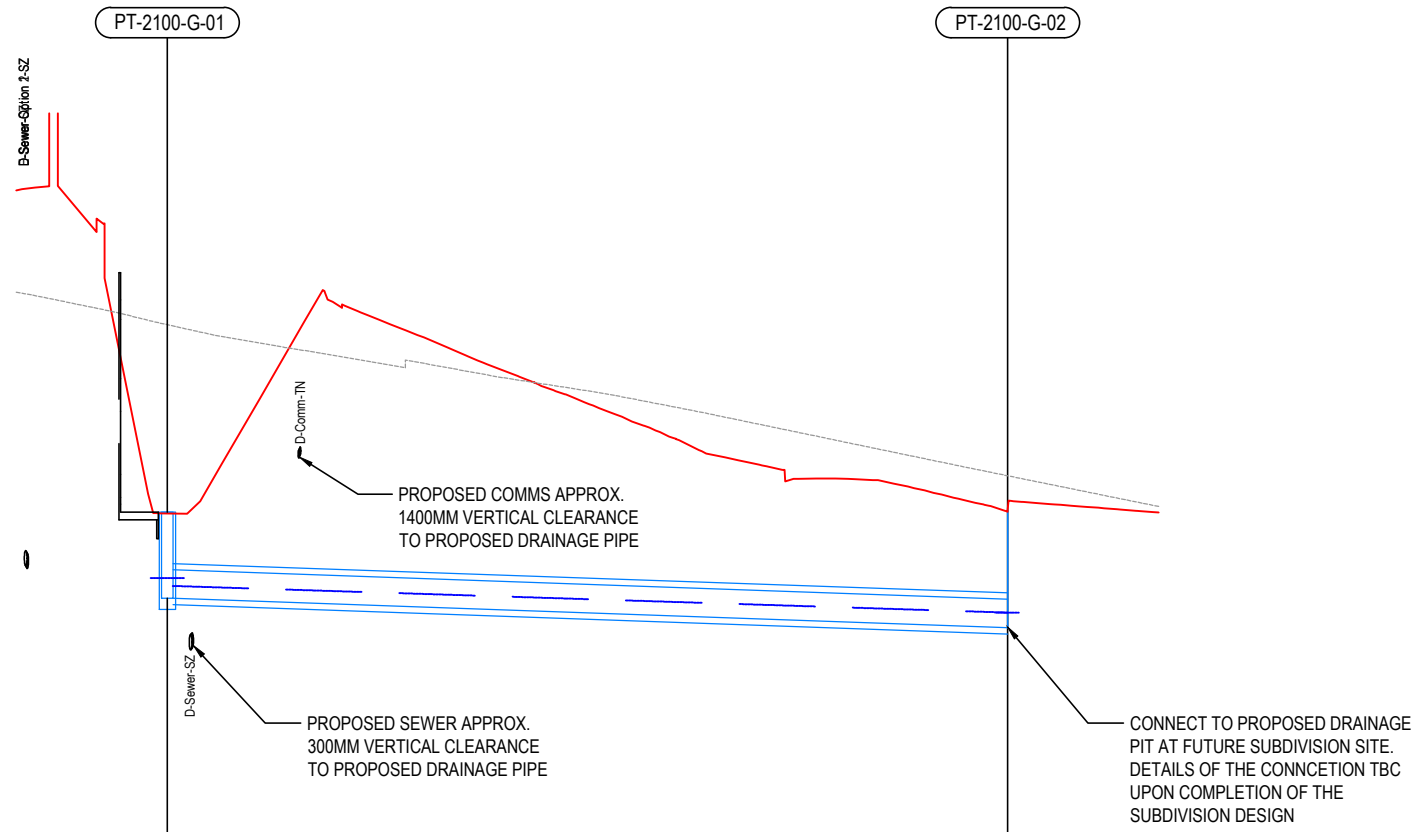
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DOCUMENT NUMBER / NAME <b>PS107784-1B-SM-DRG-00102</b>		DESIGN LOT CODE	DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING		PLOT DATE / TIME 30 September 2022 - 10:30:41 AM	PLOT BY Zhang,	CLIENT <b>lendlease</b>	CAMPBELLTOWN CITY COUNCIL MR177 APPIN ROAD GLEN LORNE AND BROWNS BUSH FAUNA UNDERPASS	A3																								
EXTERNAL REFERENCE FILES	REV 01	DATE 30.09.22	AMENDMENT / REVISION DESCRIPTION UPDATED CONCEPT DESIGN	WVR No.	APPROVAL	SCALES ON A3 SIZE DRAWING 0 10 20 30 40 50 SCALE 1:1000m	DRAWINGS / DESIGN PREPARED BY <b>wsp</b>	PREPARED FOR TBC	GENERAL ARRANGEMENT PLAN SHEET No. 1 OF 1																								
CO-ORDINATE SYSTEM MGA ZONE 56		HEIGHT DATUM A.H.D.		Level 27, 680 George Street, Sydney GPO Box 5394, NSW 2001, Australia Tel: +61 2 9272 5100 Fax: +61 2 9272 5101 wsp.com		<table border="1"> <thead> <tr> <th>DATE</th> <th>NAME</th> <th>DATE</th> </tr> </thead> <tbody> <tr> <td>30.09.22</td> <td>CATHY ZHANG</td> <td>30.09.22</td> </tr> <tr> <td>30.09.22</td> <td>CLAUDIO BIDART</td> <td>30.09.22</td> </tr> <tr> <td>30.09.22</td> <td>SHAHIN ALAVI</td> <td>30.09.22</td> </tr> <tr> <td>30.09.22</td> <td>IAN WILCOCK</td> <td>30.09.22</td> </tr> <tr> <td>30.09.22</td> <td>DANIEL PARK</td> <td>30.09.22</td> </tr> <tr> <td>30.09.22</td> <td>JONATHAN EPSELIS</td> <td>30.09.22</td> </tr> </tbody> </table>		DATE	NAME	DATE	30.09.22	CATHY ZHANG	30.09.22	30.09.22	CLAUDIO BIDART	30.09.22	30.09.22	SHAHIN ALAVI	30.09.22	30.09.22	IAN WILCOCK	30.09.22	30.09.22	DANIEL PARK	30.09.22	30.09.22	JONATHAN EPSELIS	30.09.22	RMS REGISTRATION No. <b>DS2019/000540</b>	ISSUE STATUS CONCEPT DESIGN	EDMS No.	SHEET No. <b>SM-00102</b>	ISSUE <b>01</b>
DATE	NAME	DATE																															
30.09.22	CATHY ZHANG	30.09.22																															
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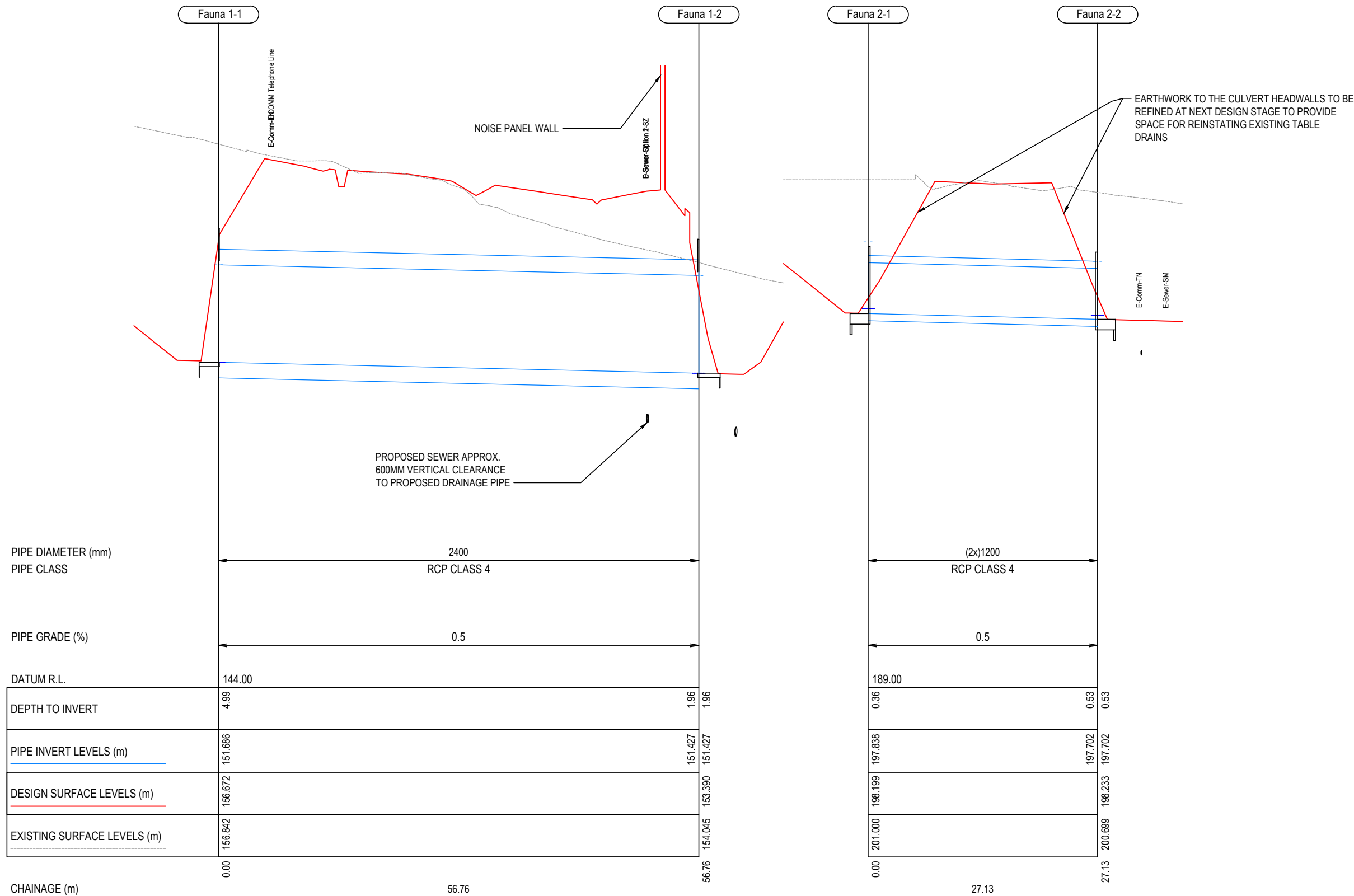
PIPE DIAMETER (mm)	375	
PIPE CLASS	RCP CLASS 4	
10% AEP PIPE VELOCITY (m/s)	0.46	
10% AEP PIPE FLOW (m <sup>3</sup> /s)	0.051	
PIPE GRADE (%)	0.7	
DATUM R.L.	142.00	
DEPTH TO INVERT	1.12	1.53
HYDRAULIC GRADE LINE (m)	150.48	150.20
PIPE INVERT LEVELS (m)	150.290	149.902
DESIGN SURFACE LEVELS (m)	151.411	151.434
EXISTING SURFACE LEVELS (m)	153.907	151.910
CHAINAGE (m)	0.00	55.57

LINE DN375

NOT FOR CONSTRUCTION

DOCUMENT NUMBER / NAME <b>PS107784-1B-SM-DRG-00201</b>			DESIGN LOT CODE	DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING	PLOT DATE / TIME 30 September 2022 - 10:31:36 AM	PLOT BY Zhang,	CLIENT CAMPBELLTOWN CITY COUNCIL MR177 APPIN ROAD GLEN LORNE AND BROWNS BUSH FAUNA UNDERPASS	A3																					
EXTERNAL REFERENCE FILES	REV	DATE	AMENDMENT / REVISION DESCRIPTION	WVR No.	APPROVAL	SCALES ON A3 SIZE DRAWING	DRAWINGS / DESIGN PREPARED BY	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th>TYPE</th> <th>NAME</th> <th>DATE</th> </tr> <tr> <td>DRAWN</td> <td>CATHY ZHANG</td> <td>30.09.22</td> </tr> <tr> <td>DRG CHECK</td> <td>CLAUDIO BIDART</td> <td>30.09.22</td> </tr> <tr> <td>DESIGN</td> <td>SHAHIN ALAVI</td> <td>30.09.22</td> </tr> <tr> <td>DESIGN CHECK</td> <td>IAN WILCOCK</td> <td>30.09.22</td> </tr> <tr> <td>DESIGN MNGR</td> <td>DANIEL PARK</td> <td>30.09.22</td> </tr> <tr> <td>PROJECT MNGR</td> <td>JONATHAN EPSELIS</td> <td>30.09.22</td> </tr> </table>	TYPE	NAME	DATE	DRAWN	CATHY ZHANG	30.09.22	DRG CHECK	CLAUDIO BIDART	30.09.22	DESIGN	SHAHIN ALAVI	30.09.22	DESIGN CHECK	IAN WILCOCK	30.09.22	DESIGN MNGR	DANIEL PARK	30.09.22	PROJECT MNGR	JONATHAN EPSELIS	30.09.22
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PROJECT MNGR	JONATHAN EPSELIS	30.09.22																											
				VERTICAL SCALE 1:100m HORIZONTAL SCALE 1:500m 		Level 27, 680 George Street, Sydney GPO Box 5394, NSW 2001, Australia Tel: +61 2 9272 5100 Fax: +61 2 9272 5101 wsp.com		PREPARED FOR TBC	LONGITUDINAL SECTION SHEET No. 1 OF 1																				
				CO-ORDINATE SYSTEM MGA ZONE 56		HEIGHT DATUM A.H.D.		RMS REGISTRATION No. <b>DS2019/000540</b>																					
						ISSUE STATUS CONCEPT DESIGN		EDMS No. SHEET No. <b>SM-00201</b> ISSUE <b>02</b>																					

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EARTHWORK TO THE CULVERT HEADWALLS TO BE REFINED AT NEXT DESIGN STAGE TO PROVIDE SPACE FOR REINSTATING EXISTING TABLE DRAINS

PROPOSED SEWER APPROX. 600MM VERTICAL CLEARANCE TO PROPOSED DRAINAGE PIPE

NOT FOR CONSTRUCTION

DOCUMENT NUMBER / NAME <b>PS107784-1B-SM-DRG-00202</b>			DESIGN LOT CODE		DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING			PLOT DATE / TIME 30 September 2022 - 10:34:25 AM		PLOT BY Zhang,		CLIENT CAMPBELLTOWN CITY COUNCIL MR177 APPIN ROAD GLEN LORNE AND BROWNS BUSH FAUNA UNDERPASS		A3																										
EXTERNAL REFERENCE FILES			REV	DATE	AMENDMENT / REVISION DESCRIPTION			WVR No.	APPROVAL	SCALES ON A3 SIZE DRAWING		DRAWINGS / DESIGN PREPARED BY																												
			01	30.09.22	UPDATED CONCEPT DESIGN																																			
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TYPE	NAME	DATE																																						
DRAWN	CATHY ZHANG	30.09.22																																						
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FROM  
WOLLONGONG

TO  
CAMPBELLTOWN

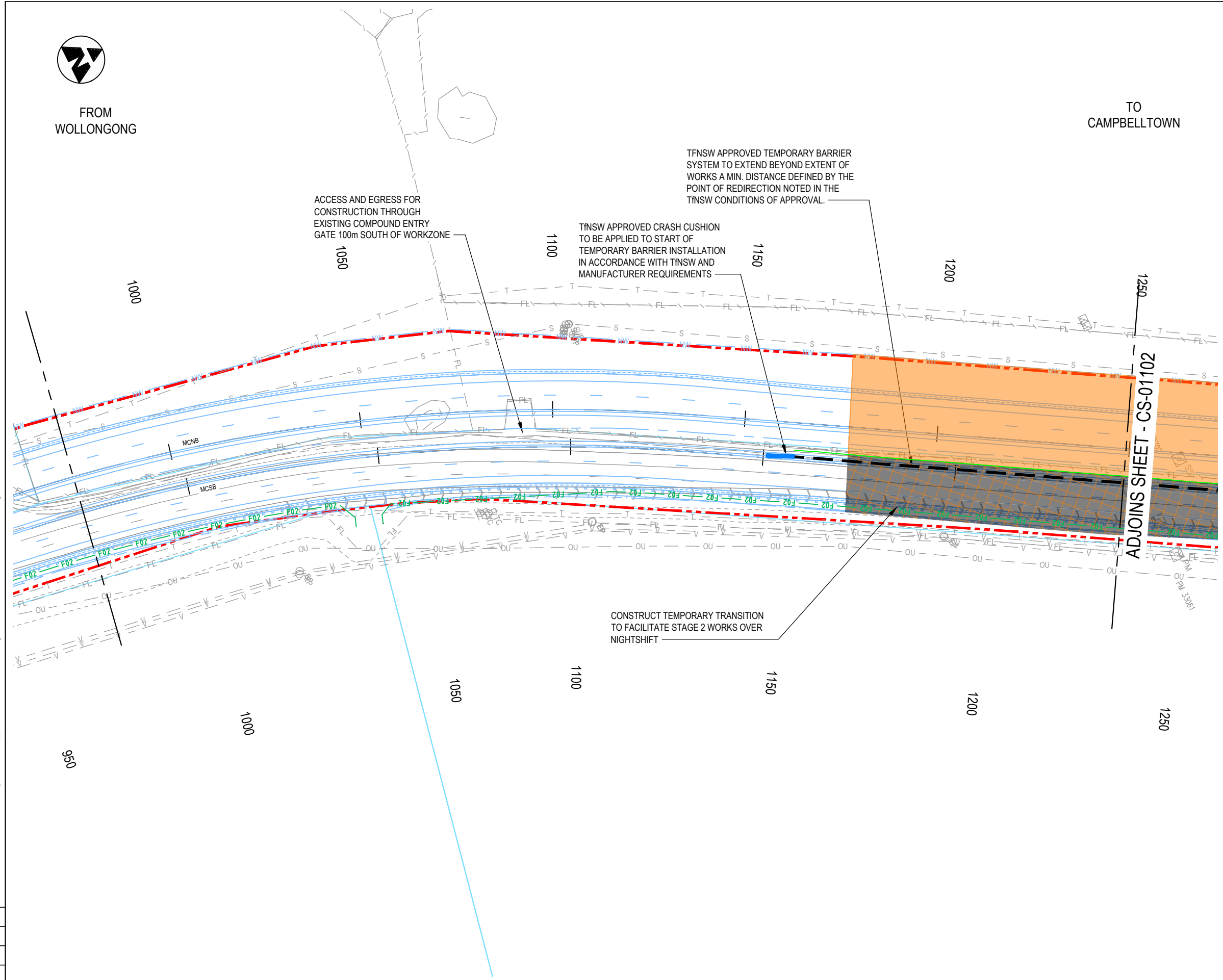
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NOTES

1. ALL DIMENSIONS, LEVELS, CHAINAGES AND CO-ORDINATES ARE EXPRESSED IN METRES UNLESS SPECIFIED OTHERWISE.
2. GENERAL ARRANGEMENT PLAN DRAWINGS TO BE READ IN CONJUNCTION WITH SUPPORTING TYPICAL SECTIONS AND DESIGN REPORT.
3. TW DESIGN PACKAGE IS FOR INFORMATION ONLY. IT IS THE RESPONSIBILITY OF THE CONSTRUCTION CONTRACTOR TO VALIDATE THE STAGING STRATEGY, ACCESS AND TEMPORARY WORKS REQUIRED FOR THE PROJECT.

GENERAL LEGEND

- PROJECT BOUNDARY
- CONSTRUCTION BOUNDARY
- EXISTING CADASTRAL BOUNDARY
- DESIGN (WSP)
- PROPOSED ROAD DESIGN
- DESIGN BY OTHERS
- EXISTING ROAD PAVEMENT
- UNDER CONSTRUCTION
- TEMPORARY PAVEMENT - CONSTRUCTION UNDER TRAFFIC CONTROL
- CONSTRUCTION COMPLETED
- PERMANENT STRUCTURE UNDER CONSTRUCTION
- STRUCTURE COMPLETED
- TNSW APPROVED TEMPORARY WORKZONE BARRIER
- CONSTRUCTION TRAFFIC DIRECTION
- GENERAL TRAFFIC DIRECTION
- TNSW APPROVED TEMPORARY CRASH CUSHION (LEADING) OR TERMINAL (TRAILING)



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150mm ON A3 SIZE ORIGINAL

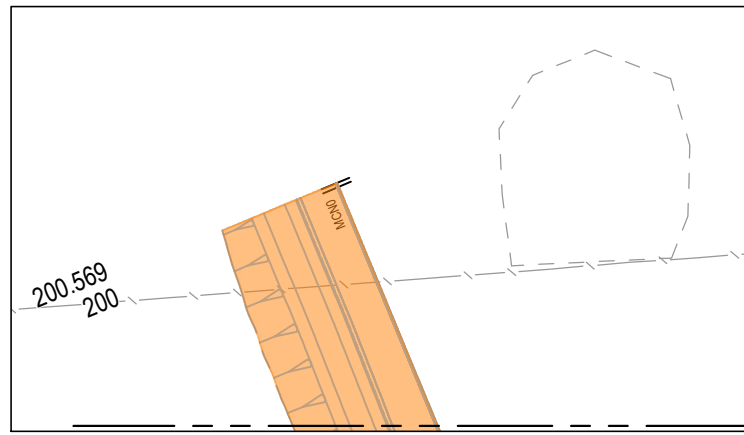
**NOT FOR CONSTRUCTION**

DOCUMENT NUMBER / NAME <b>PS107784-1B-CS-DRG-01101</b>		DESIGN LOT CODE	DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING		PLOT DATE / TIME 29 September 2022 - 5:18:07 PM	PLOT BY Zhang, Cathy	CLIENT 	CAMPBELLTOWN CITY COUNCIL MR177 APPIN ROAD GLEN LORNE AND BROWNS BUSH FAUNA UNDERPASS A3
EXTERNAL REFERENCE FILES	REV 01 02	DATE 11.03.22 30.09.22	AMENDMENT / REVISION DESCRIPTION ISSUED FOR CONCEPT DESIGN UPDATED CONCEPT DESIGN	WVR No.	APPROVAL	SCALES ON A3 SIZE DRAWING 0 10 20 30 40 50 SCALE 1:1000m	DRAWINGS / DESIGN PREPARED BY  Level 27, 680 George Street, Sydney GPO Box 5394, NSW 2001, Australia Tel: +61 2 9272 5100 Fax: +61 2 9272 5101 wsp.com	TITLE DRAWN DRG CHECK DESIGN DESIGN CHECK DESIGN MNGR PROJECT MNGR
								NAME CATHY ZHANG CLAUDIO BIDART CHRIS MUNDY CHRIS CHUN DANIEL PARK JONATHAN EPSELIS
								DATE 30.09.22 30.09.22 30.09.22 30.09.22 30.09.22 30.09.22
								PREPARED FOR TBC
								RMS REGISTRATION No. <b>DS2019/000540</b>
								ISSUE STATUS CONCEPT DESIGN
								EDMS No.
								SHEET No. <b>CS-01101</b>
								ISSUE <b>02</b>





FROM  
WOLLONGONG



INSET PLAN

ADJOINS INSET PLAN

TO  
CAMPBELLTOWN

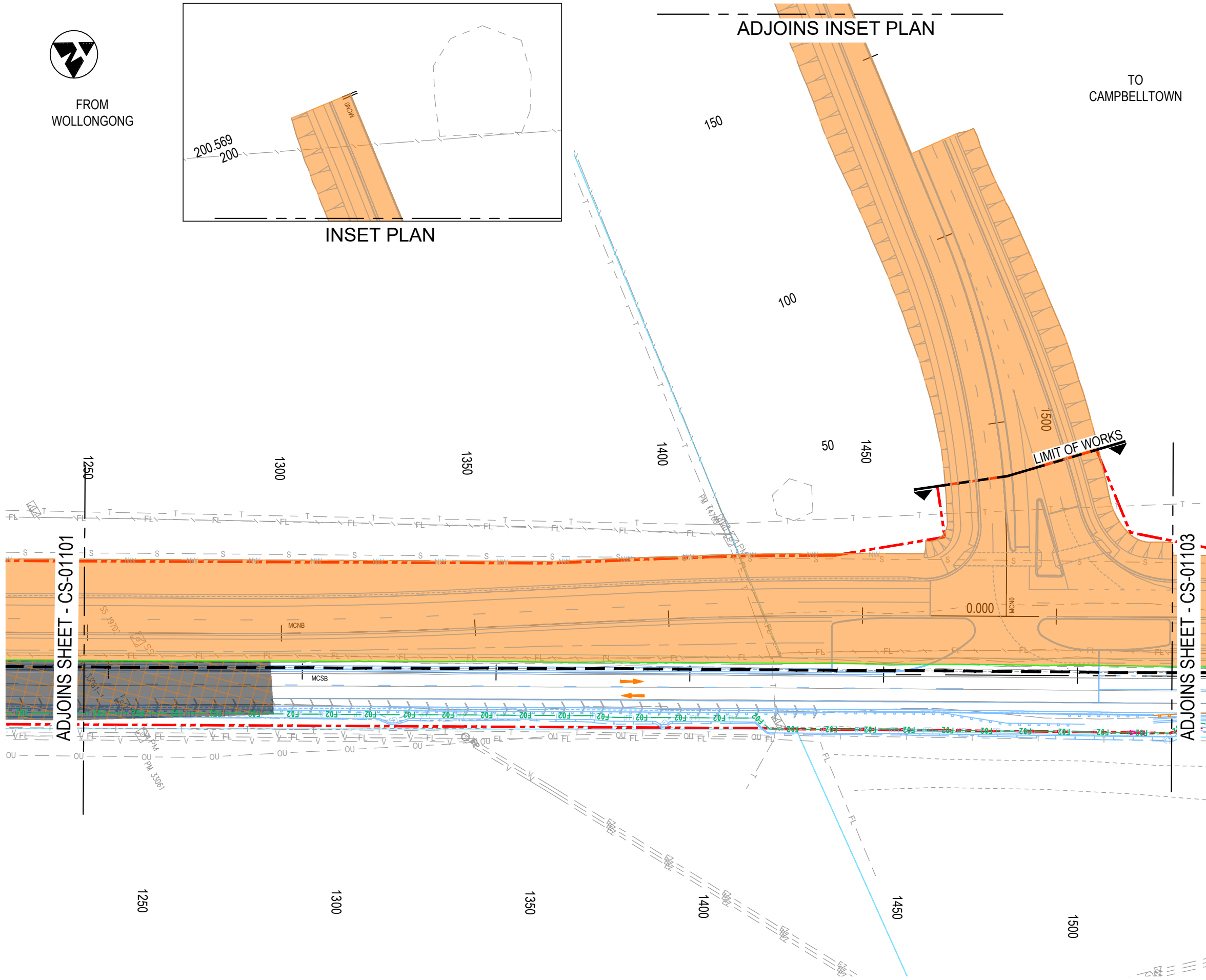
THE UTILITIES/SERVICES SHOWN IN THESE PLANS HAVE BEEN COMPILED FROM MULTIPLE SOURCES OF INFORMATION. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO UNDERTAKE THEIR OWN SITE INVESTIGATIONS PRIOR TO ANY CONSTRUCTION ACTIVITIES. THESE DRAWINGS ARE NEVER TO BE USED FOR THE PURPOSE OF LOCATING SERVICES. WSP SHALL NOT BE LIABLE FOR ANY LOSS OR DAMAGE CAUSED USING THE UTILITIES/SERVICES INFORMATION SHOWN ON THESE DRAWINGS.

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GENERAL LEGEND

- PROJECT BOUNDARY
- CONSTRUCTION BOUNDARY
- EXISTING CADASTRAL BOUNDARY
- DESIGN (WSP)
- PROPOSED ROAD DESIGN
- DESIGN BY OTHERS
- EXISTING ROAD PAVEMENT
- UNDER CONSTRUCTION
- TEMPORARY PAVEMENT - CONSTRUCTION UNDER TRAFFIC CONTROL
- CONSTRUCTION COMPLETED
- PERMANENT STRUCTURE UNDER CONSTRUCTION
- STRUCTURE COMPLETED
- TNSW APPROVED TEMPORARY WORKZONE BARRIER
- CONSTRUCTION TRAFFIC DIRECTION
- GENERAL TRAFFIC DIRECTION
- TNSW APPROVED TEMPORARY CRASH CUSHION (LEADING) OR TERMINAL (TRAILING)





ADJOINS SHEET - CS-01101

ADJOINS SHEET - CS-01103

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DOCUMENT NUMBER / NAME PS107784-1B-CS-DRG-01102		DESIGN LOT CODE	DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING		PLOT DATE / TIME 29 September 2022 - 5:19:19 PM		PLOT BY Zhang, Cathy		CLIENT CAMPBELLTOWN CITY COUNCIL MR177 APPIN ROAD GLEN LORNE AND BROWNS BUSH FAUNA UNDERPASS		A3
EXTERNAL REFERENCE FILES		REV	DATE	AMENDMENT / REVISION DESCRIPTION	WVR No.	APPROVAL	SCALES ON A3 SIZE DRAWING		DRAWINGS / DESIGN PREPARED BY		
		01	11.03.22	ISSUED FOR CONCEPT DESIGN			0 10 20 30 40 50 SCALE 1:1000m		 Level 27, 680 George Street, Sydney GPO Box 5394, NSW 2001, Australia Tel: +61 2 9272 5100 Fax: +61 2 9272 5101 wsp.com		
		02	30.09.22	UPDATED CONCEPT DESIGN			CO-ORDINATE SYSTEM MGA ZONE 56		HEIGHT DATUM A.H.D.		RMS REGISTRATION No. <b>DS2019/000540</b>
									TITLE NAME DATE DRAWN CATHY ZHANG 30.09.22 DRG CHECK CLAUDIO BIDART 30.09.22 DESIGN CHRIS MUNDY 30.09.22 DESIGN CHECK CHRIS CHUN 30.09.22 DESIGN MNGR DANIEL PARK 30.09.22 PROJECT MNGR JONATHAN EPSELIS 30.09.22		SHEET No. 2 OF 4 STAGE 1 GENERAL ARRANGEMENT PLAN ISSUE STATUS CONCEPT DESIGN
									SHEET No. CS-01102		ISSUE 02



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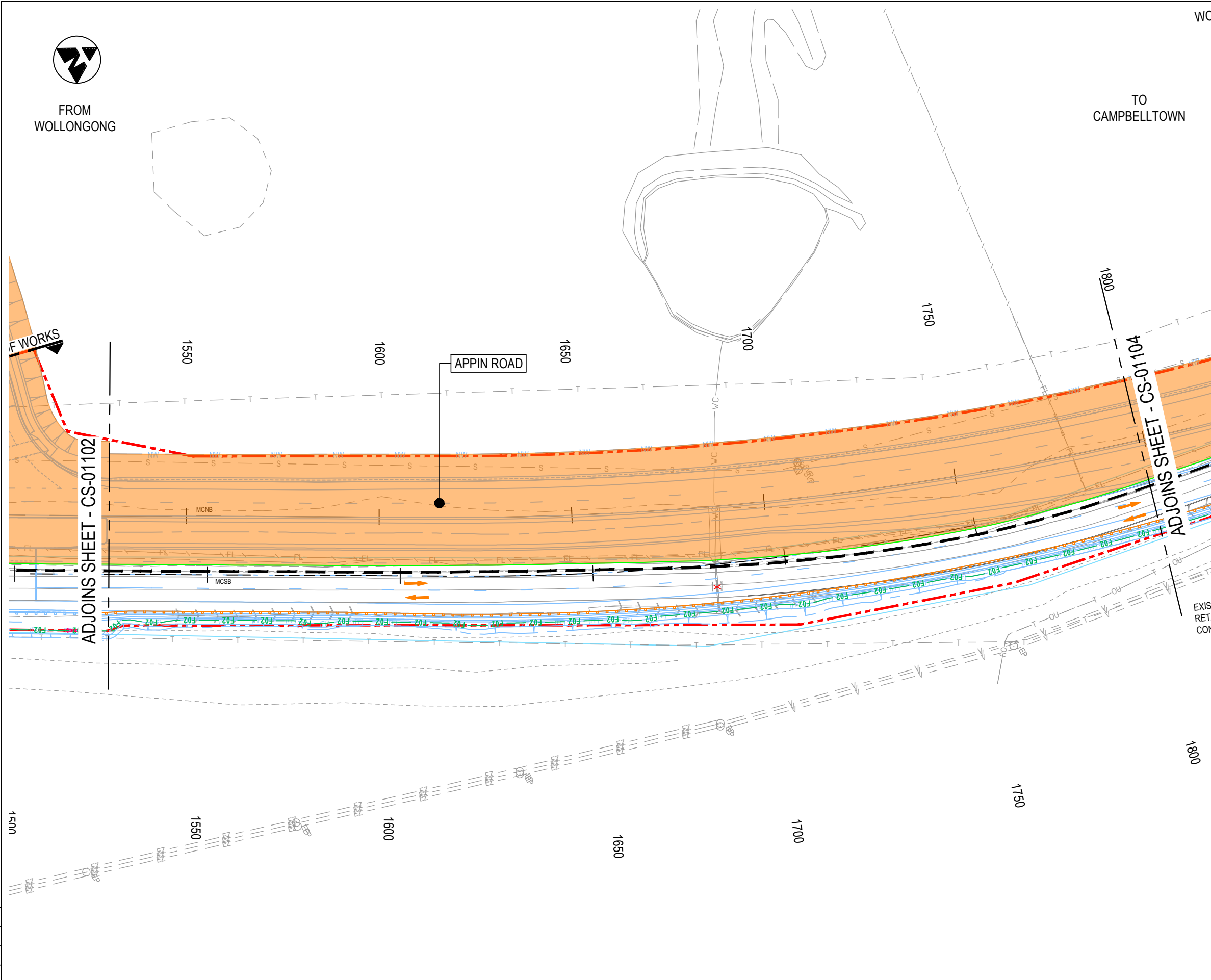
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- CONSTRUCTION TRAFFIC DIRECTION
- GENERAL TRAFFIC DIRECTION
- TNSW APPROVED TEMPORARY CRASH CUSHION (LEADING) OR TERMINAL (TRAILING)



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DOCUMENT NUMBER / NAME <b>PS107784-1B-CS-DRG-01103</b>		DESIGN LOT CODE	DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING		PLOT DATE / TIME 29 September 2022 - 5:20:47 PM	PLOT BY Zhang, Cathy	CLIENT 	CAMPBELLTOWN CITY COUNCIL MR177 APPIN ROAD GLEN LORNE AND BROWNS BUSH FAUNA UNDERPASS	<b>A3</b>					
EXTERNAL REFERENCE FILES	REV 01 02	DATE 11.03.22 30.09.22	AMENDMENT / REVISION DESCRIPTION ISSUED FOR CONCEPT DESIGN UPDATED CONCEPT DESIGN	WVR No.	APPROVAL	SCALES ON A3 SIZE DRAWING	DRAWINGS / DESIGN PREPARED BY 	TITLE	NAME	DATE	PREPARED FOR TBC	RMS REGISTRATION No. <b>DS2019/000540</b>	PART	
				 CO-ORDINATE SYSTEM MGA ZONE 56		HEIGHT DATUM A.H.D.		DRAWN CATHY ZHANG 30.09.22	DRG CHECK CLAUDIO BIDART 30.09.22	DESIGN CHRIS MUNDY 30.09.22	DESIGN CHECK CHRIS CHUN 30.09.22	DESIGN MNGR DANIEL PARK 30.09.22	PROJECT MNGR JONATHAN EPSELIS 30.09.22	SHEET No. CS-01103 ISSUE 02
											STAGE 1 GENERAL ARRANGEMENT PLAN SHEET No. 3 OF 4			
											© Roads and Maritime Services			





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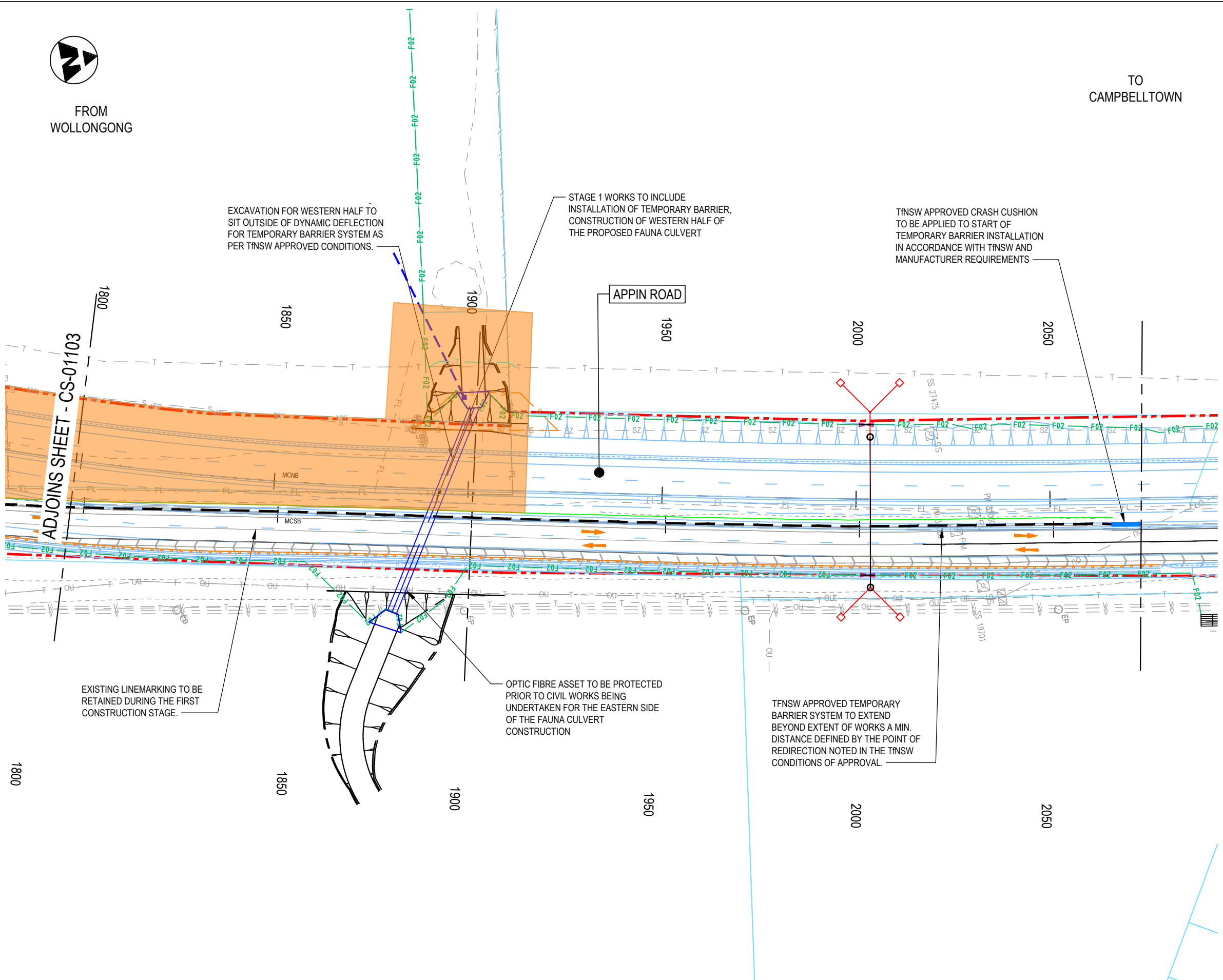
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DOCUMENT NUMBER / NAME PS107784-1B-CS-DRG-01104		DESIGN LOT CODE	DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING		PLOT DATE / TIME 29 September 2022 - 5:22:01 PM	PLOT BY Zhang, Cathy	CLIENT CAMPBELLTOWN CITY COUNCIL MR177 APPIN ROAD GLEN LORNE AND BROWNS BUSH FAUNA UNDERPASS	A3
EXTERNAL REFERENCE FILES	REV 01	DATE 30.09.22	AMENDMENT / REVISION DESCRIPTION UPDATED CONCEPT DESIGN	WVR No. / APPROVAL	SCALES ON A3 SIZE DRAWING 0 10 20 30 40 50 SCALE 1:1000m	DRAWINGS / DESIGN PREPARED BY 	TITLE DRAWN DRG CHECK DESIGN DESIGN CHECK DESIGN MNGR PROJECT MNGR	NAME CATHY ZHANG CLAUDIO BIDART CHRIS MUNDY CHRIS CHUN DANIEL PARK JONATHAN EPSELIS
CO-ORDINATE SYSTEM MGA ZONE 56		HEIGHT DATUM A.H.D.		PREPARED FOR TBC		RMS REGISTRATION No. DS2019/000540		ISSUE STATUS CONCEPT DESIGN
EDMS No.		SHEET No. CS-01104		ISSUE No. 01		PART		STAGE 1 GENERAL ARRANGEMENT PLAN SHEET No. 4 OF 4



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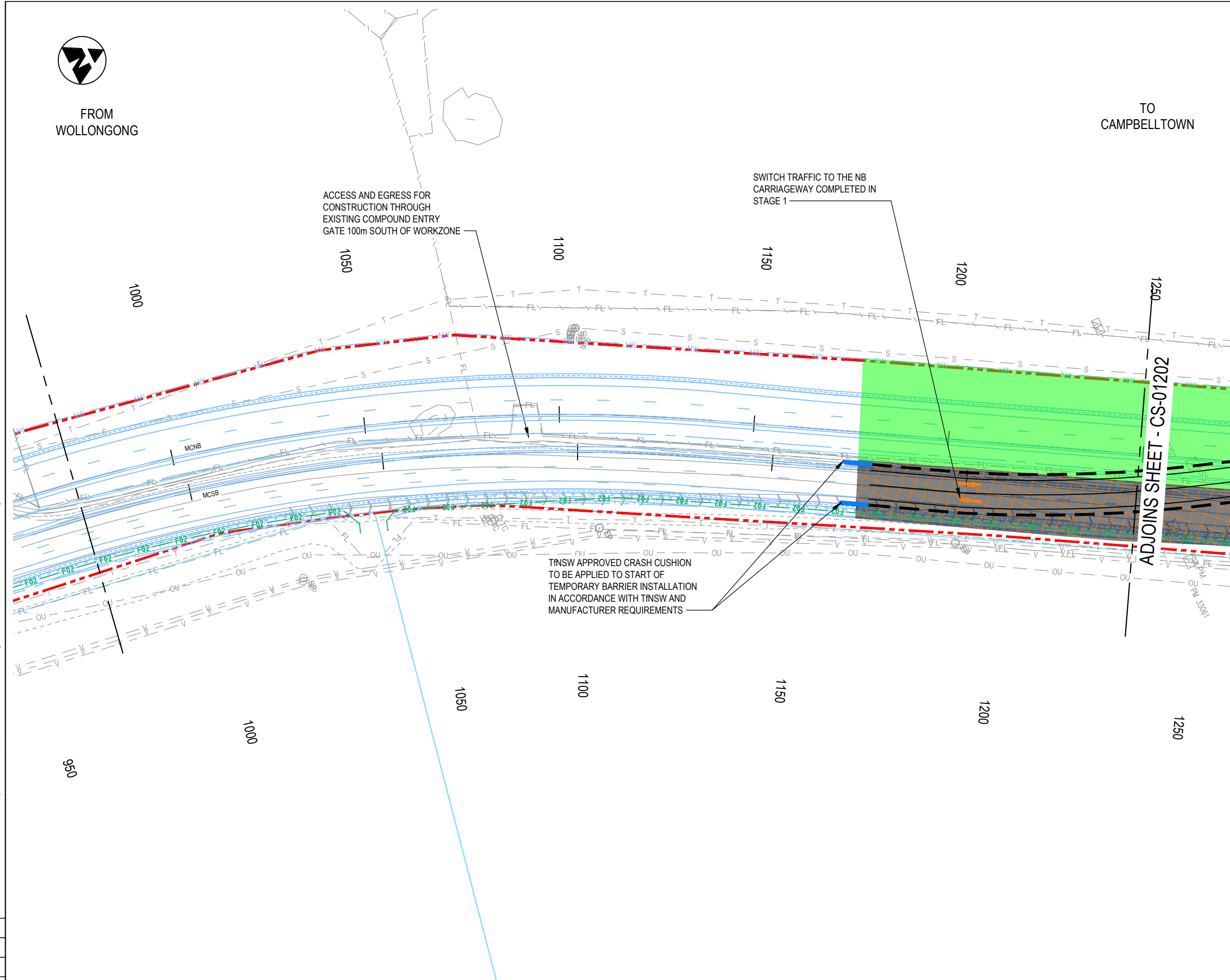
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GENERAL LEGEND

- PROJECT BOUNDARY
- CONSTRUCTION BOUNDARY
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- DESIGN (WSP)
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- UNDER CONSTRUCTION
- TEMPORARY PAVEMENT - CONSTRUCTION UNDER TRAFFIC CONTROL
- CONSTRUCTION COMPLETED
- PERMANENT STRUCTURE UNDER CONSTRUCTION
- STRUCTURE COMPLETED
- TNSW APPROVED TEMPORARY WORKZONE BARRIER
- CONSTRUCTION TRAFFIC DIRECTION
- GENERAL TRAFFIC DIRECTION
- TNSW APPROVED TEMPORARY CRASH CUSHION (LEADING) OR TERMINAL (TRAILING)



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150mm ON A3 SIZE ORIGINAL

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DOCUMENT NUMBER / NAME <b>PS107784-1B-CS-DRG-01201</b>		DESIGN LOT CODE	DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING	PLOT DATE / TIME 29 September 2022 - 5:23:17 PM	PLOT BY Zhang, Cathy	CLIENT 	CAMPBELLTOWN CITY COUNCIL MR177 APPIN ROAD GLEN LORNE AND BROWNS BUSH FAUNA UNDERPASS A3	
EXTERNAL REFERENCE FILES	REV 01 02	DATE 11.03.22 30.09.22	AMENDMENT / REVISION DESCRIPTION ISSUED FOR CONCEPT DESIGN UPDATED CONCEPT DESIGN	WVR No.	APPROVAL	TITLE	NAME	DATE
SCALES ON A3 SIZE DRAWING SCALE 1:1000m CO-ORDINATE SYSTEM MGA ZONE 56 HEIGHT DATUM A.H.D.				DRAWINGS / DESIGN PREPARED BY Level 27, 680 George Street, Sydney GPO Box 5394, NSW 2001, Australia Tel: +61 2 9272 5100 Fax: +61 2 9272 5101 wsp.com		DRG CHECK	CLAUDIO BIDART	30.09.22
						DESIGN	CHRIS MUNDY	30.09.22
				DESIGN CHECK	CHRIS CHUN	30.09.22	PREPARED FOR TBC	RMS REGISTRATION No. <b>DS2019/000540</b>
				DESIGN MNGR	DANIEL PARK	30.09.22	ISSUE STATUS CONCEPT DESIGN	EDMS No.
				PROJECT MNGR	JONATHAN EPSELIS	30.09.22	SHEET No. CS-01201	ISSUE 02







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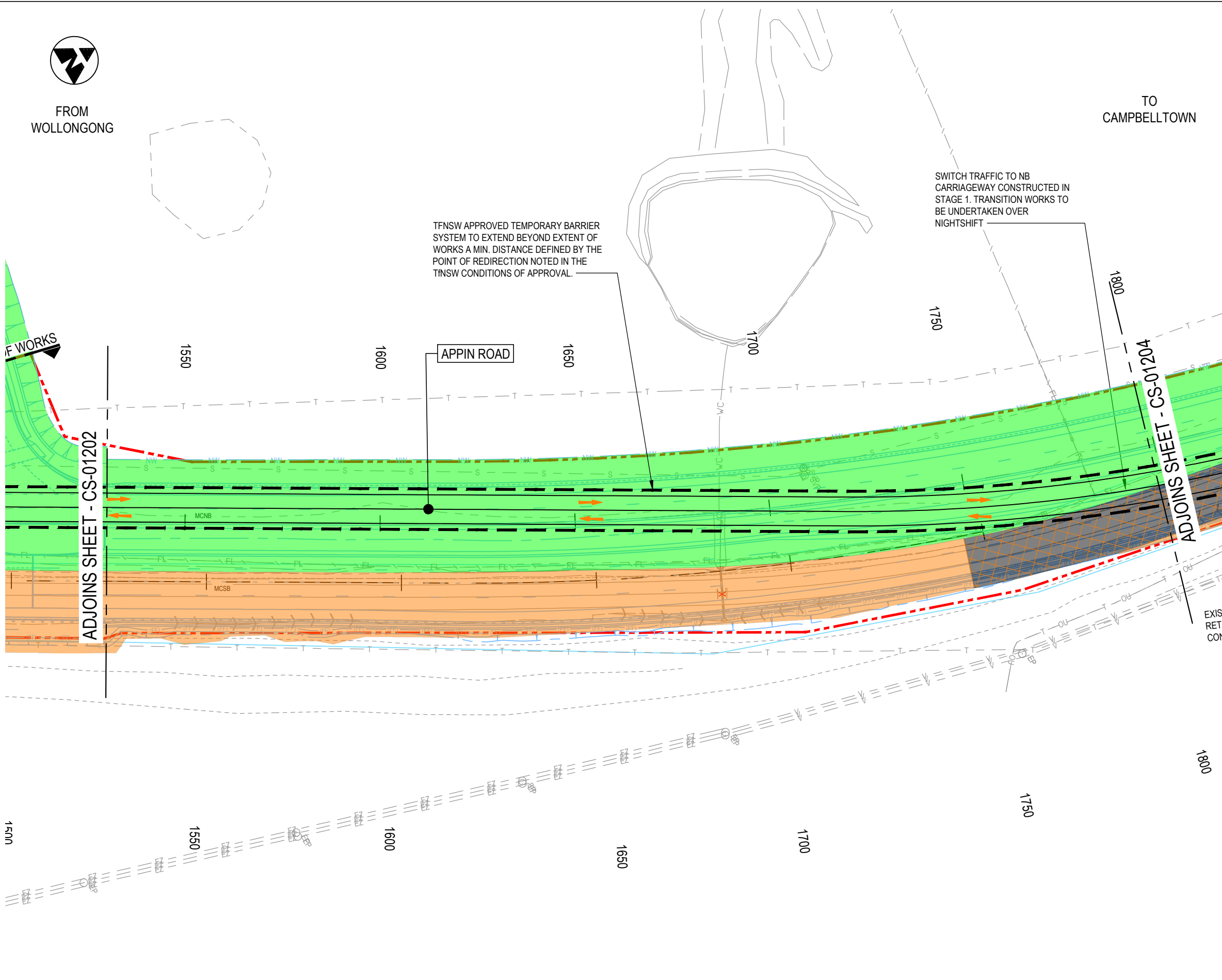
TO  
CAMPBELLTOWN

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**GENERAL LEGEND**

- PROJECT BOUNDARY (Red dashed line)
- CONSTRUCTION BOUNDARY (Green dashed line)
- EXISTING CADASTRAL BOUNDARY (Blue dashed line)
- DESIGN (WSP) (Black dashed line)
- PROPOSED ROAD DESIGN (Blue solid line)
- DESIGN BY OTHERS (Red solid line)
- EXISTING ROAD PAVEMENT (Grey fill)
- UNDER CONSTRUCTION (Orange fill)
- TEMPORARY PAVEMENT - CONSTRUCTION UNDER TRAFFIC CONTROL (Brown fill)
- CONSTRUCTION COMPLETED (Light Green fill)
- PERMANENT STRUCTURE UNDER CONSTRUCTION (Pink hatched fill)
- STRUCTURE COMPLETED (Blue fill)
- TNSW APPROVED TEMPORARY WORKZONE BARRIER (Black dashed line with triangles)
- CONSTRUCTION TRAFFIC DIRECTION (Purple arrows)
- GENERAL TRAFFIC DIRECTION (Orange arrows)
- TNSW APPROVED TEMPORARY CRASH CUSHION (LEADING) OR TERMINAL (TRAILING) (Blue solid line)



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150mm ON A3 SIZE ORIGINAL  
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DOCUMENT NUMBER / NAME <b>PS107784-1B-CS-DRG-01203</b>		DESIGN LOT CODE	DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING	PLOT DATE / TIME 29 September 2022 - 5:26:05 PM	PLOT BY Zhang, Cathy	CLIENT 	CAMPBELLTOWN CITY COUNCIL MR177 APPIN ROAD GLEN LORNE AND BROWNS BUSH FAUNA UNDERPASS A3																						
EXTERNAL REFERENCE FILES	REV 01 02	DATE 11.03.22 30.09.22	AMENDMENT / REVISION DESCRIPTION ISSUED FOR CONCEPT DESIGN UPDATED CONCEPT DESIGN	WVR No.	APPROVAL	PREPARED FOR TBC	STAGE 2 GENERAL ARRANGEMENT PLAN SHEET No. 3 OF 4																						
SCALES ON A3 SIZE DRAWING SCALE 1:1000m			DRAWINGS / DESIGN PREPARED BY Level 27, 680 George Street, Sydney GPO Box 5394, NSW 2001, Australia Tel: +61 2 9272 5100 Fax: +61 2 9272 5101 wsp.com		<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>TITLE</th> <th>NAME</th> <th>DATE</th> </tr> </thead> <tbody> <tr> <td>DRAWN</td> <td>CATHY ZHANG</td> <td>30.09.22</td> </tr> <tr> <td>DRG CHECK</td> <td>CLAUDIO BIDART</td> <td>30.09.22</td> </tr> <tr> <td>DESIGN</td> <td>CHRIS MUNDY</td> <td>30.09.22</td> </tr> <tr> <td>DESIGN CHECK</td> <td>CHRIS CHUN</td> <td>30.09.22</td> </tr> <tr> <td>DESIGN MNGR</td> <td>DANIEL PARK</td> <td>30.09.22</td> </tr> <tr> <td>PROJECT MNGR</td> <td>JONATHAN EPSELIS</td> <td>30.09.22</td> </tr> </tbody> </table>		TITLE	NAME	DATE	DRAWN	CATHY ZHANG	30.09.22	DRG CHECK	CLAUDIO BIDART	30.09.22	DESIGN	CHRIS MUNDY	30.09.22	DESIGN CHECK	CHRIS CHUN	30.09.22	DESIGN MNGR	DANIEL PARK	30.09.22	PROJECT MNGR	JONATHAN EPSELIS	30.09.22	RMS REGISTRATION No. <b>DS2019/000540</b> ISSUE STATUS CONCEPT DESIGN	EDMS No. SHEET No. <b>CS-01203</b> ISSUE <b>02</b>
TITLE	NAME	DATE																											
DRAWN	CATHY ZHANG	30.09.22																											
DRG CHECK	CLAUDIO BIDART	30.09.22																											
DESIGN	CHRIS MUNDY	30.09.22																											
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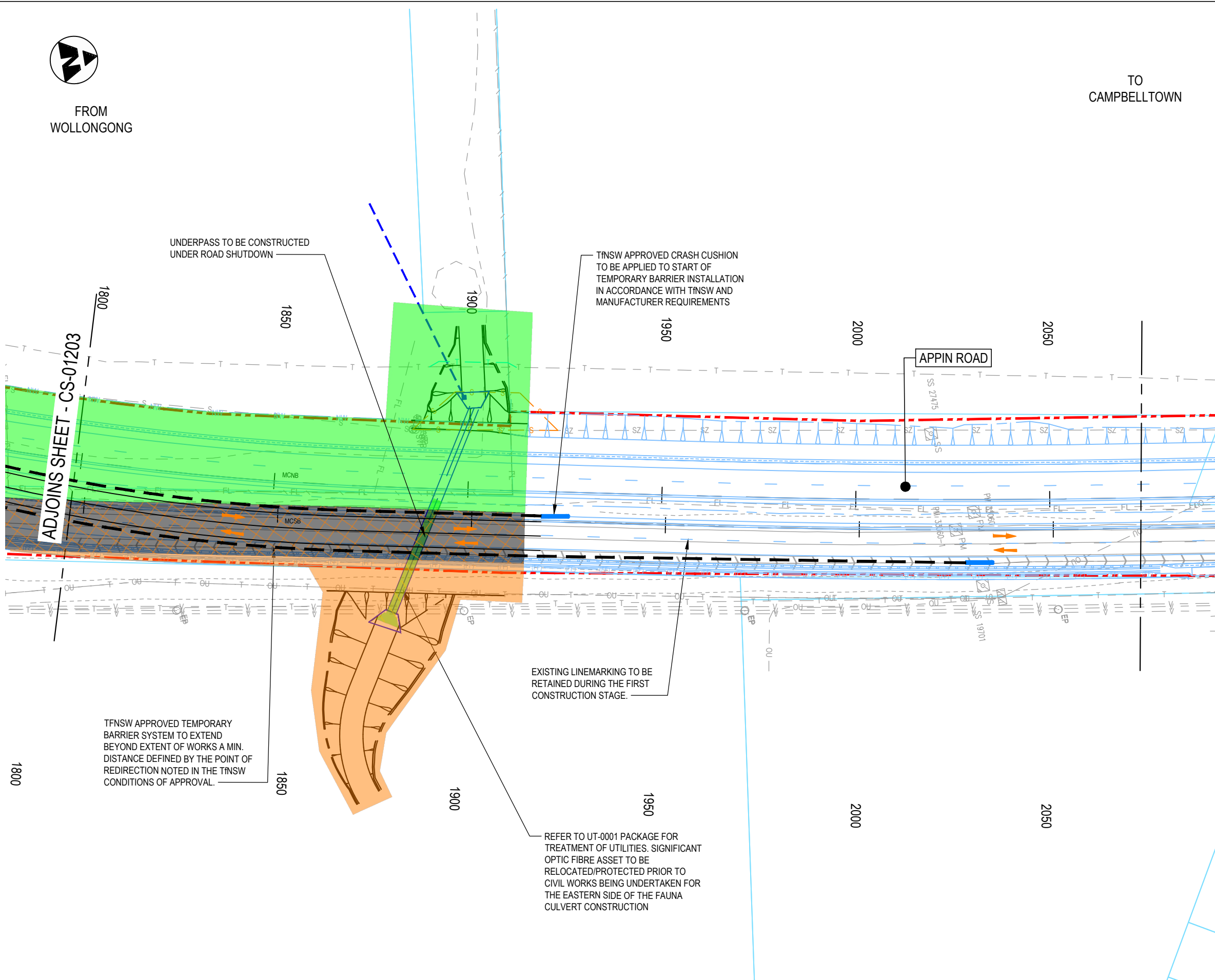
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150mm ON A3 SIZE ORIGINAL

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DOCUMENT NUMBER / NAME <b>PS107784-1B-CS-DRG-01204</b>		DESIGN LOT CODE	DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING		PLOT DATE / TIME 29 September 2022 - 5:27:21 PM	PLOT BY Zhang, Cathy	CLIENT 	CAMPBELLTOWN CITY COUNCIL MR177 APPIN ROAD GLEN LORNE AND BROWNS BUSH FAUNA UNDERPASS	<b>A3</b>							
EXTERNAL REFERENCE FILES	REV 01 02	DATE 11.03.22 30.09.22	AMENDMENT / REVISION DESCRIPTION ISSUED FOR CONCEPT DESIGN UPDATED CONCEPT DESIGN	WVR No.	APPROVAL	SCALES ON A3 SIZE DRAWING	DRAWINGS / DESIGN PREPARED BY	TITLE	NAME	DATE	PREPARED FOR TBC	RMS REGISTRATION No. <b>DS2019/000540</b>	ISSUE STATUS CONCEPT DESIGN	EDMS No.	SHEET No. <b>CS-01204</b>	ISSUE <b>02</b>
				SCALE 1:1000m				DRAWN	CATHY ZHANG	30.09.22	PART					
				CO-ORDINATE SYSTEM MGA ZONE 56		HEIGHT DATUM A.H.D.		DRG CHECK	CLAUDIO BIDART	30.09.22	STAGE 2 GENERAL ARRANGEMENT PLAN					
						Level 27, 680 George Street, Sydney GPO Box 5394, NSW 2001, Australia Tel: +61 2 9272 5100 Fax: +61 2 9272 5101 wsp.com		DESIGN	CHRIS MUNDY	30.09.22	SHEET No. 4 OF 4					
								DESIGN CHECK	CHRIS CHUN	30.09.22	PART					
								DESIGN MNGR	DANIEL PARK	30.09.22	ISSUE					
								PROJECT MNGR	JONATHAN EPSELIS	30.09.22	ISSUE					



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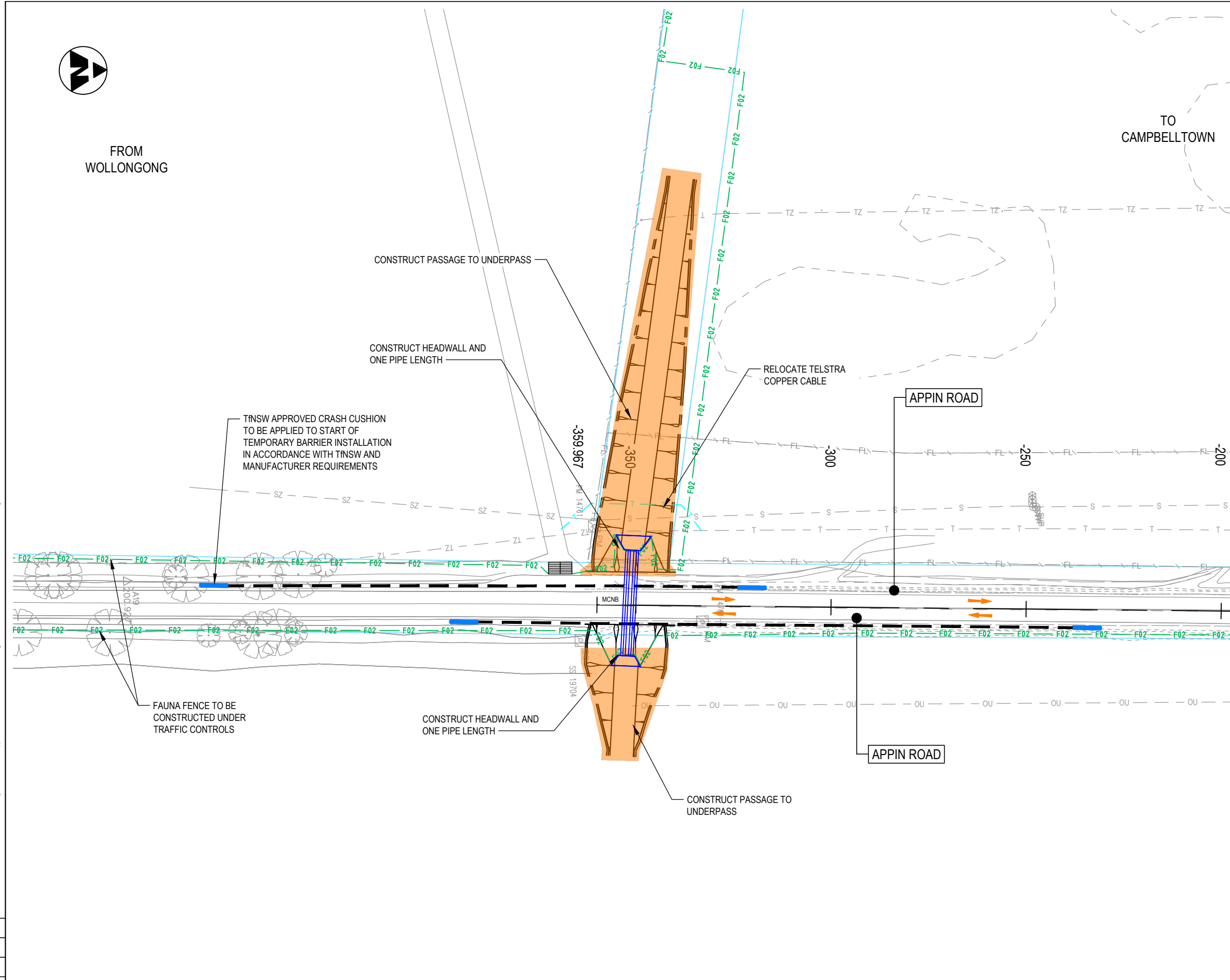
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DOCUMENT NUMBER / NAME <b>PS107784-1B-CS-DRG-01301</b>		DESIGN LOT CODE	DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING		PLOT DATE / TIME 29 September 2022 - 5:28:39 PM		PLOT BY Zhang, Cathy		CLIENT		CAMPBELLTOWN CITY COUNCIL	<b>A3</b>		
EXTERNAL REFERENCE FILES		REV	DATE	AMENDMENT / REVISION DESCRIPTION	WVR No.	APPROVAL	SCALES ON A3 SIZE DRAWING	DRAWINGS / DESIGN PREPARED BY			MR177 APPIN ROAD	GLEN LORNE AND BROWNS BUSH FAUNA UNDERPASS		
		01	30.09.22	UPDATED CONCEPT DESIGN			 SCALE 1:1000m	 Level 27, 680 George Street, Sydney GPO Box 5394, NSW 2001, Australia Tel: +61 2 9272 5100 Fax: +61 2 9272 5101 wsp.com		STAGE 1 GENERAL ARRANGEMENT PLAN	SHEET No. 1 OF 1			
							CO-ORDINATE SYSTEM MGA ZONE 56	HEIGHT DATUM A.H.D.			RMS REGISTRATION No. <b>DS2019/000540</b>	PART		
										PREPARED FOR TBC	ISSUE STATUS CONCEPT DESIGN	EDMS No.	SHEET No. <b>CS-01301</b>	ISSUE <b>01</b>





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TO  
CAMPBELLTOWN

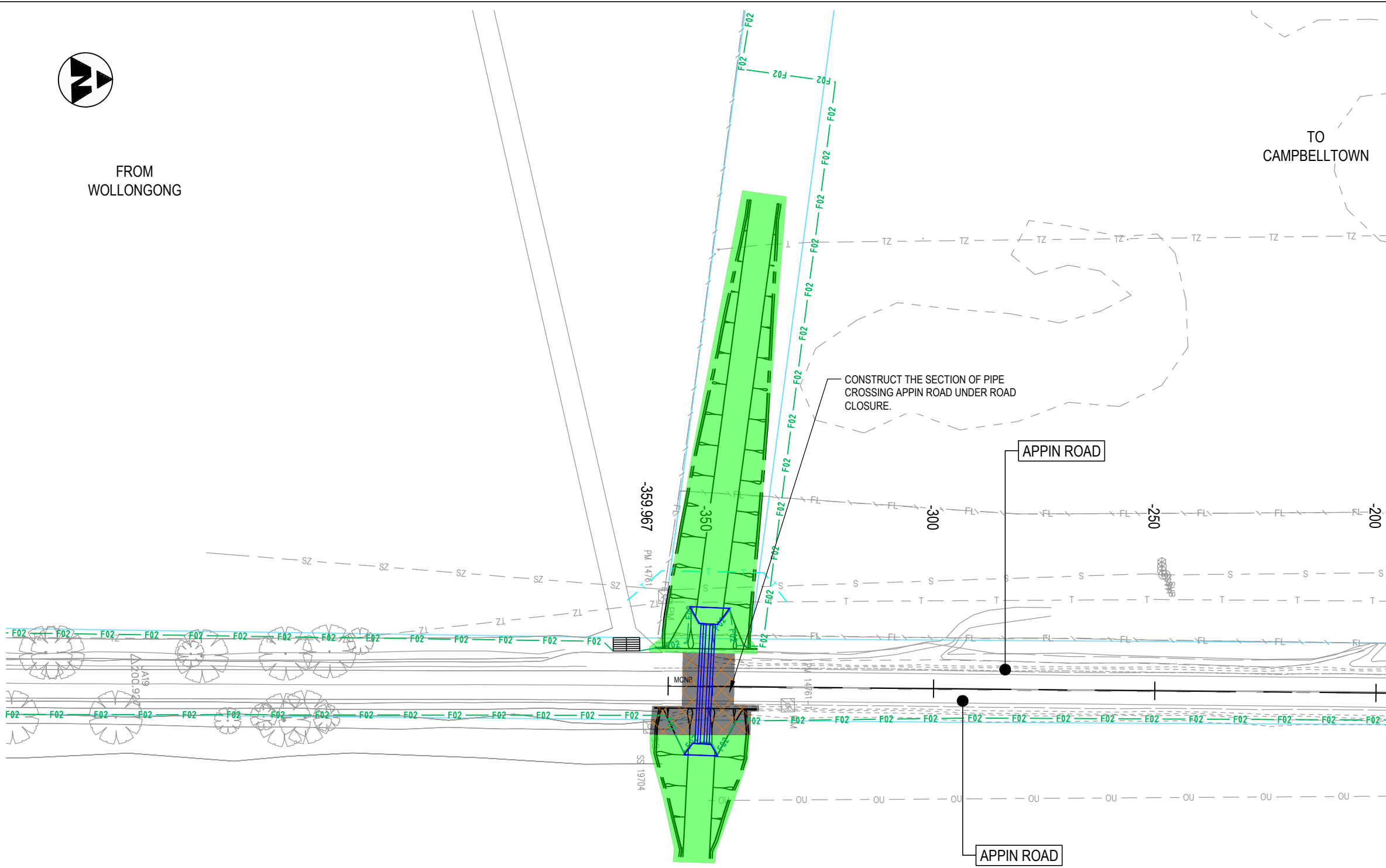
THE UTILITIES/SERVICES SHOWN IN THESE PLANS HAVE BEEN COMPILED FROM MULTIPLE SOURCES OF INFORMATION. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO UNDERTAKE THEIR OWN SITE INVESTIGATIONS PRIOR TO ANY CONSTRUCTION ACTIVITIES. THESE DRAWINGS ARE NEVER TO BE USED FOR THE PURPOSE OF LOCATING SERVICES. WSP SHALL NOT BE LIABLE FOR ANY LOSS OR DAMAGE CAUSED USING THE UTILITIES/SERVICES INFORMATION SHOWN ON THESE DRAWINGS.

NOTES

1. ALL DIMENSIONS, LEVELS, CHAINAGES AND CO-ORDINATES ARE EXPRESSED IN METRES UNLESS SPECIFIED OTHERWISE.
2. GENERAL ARRANGEMENT PLAN DRAWINGS TO BE READ IN CONJUNCTION WITH SUPPORTING TYPICAL SECTIONS AND DESIGN REPORT.
3. TW DESIGN PACKAGE IS FOR INFORMATION ONLY. IT IS THE RESPONSIBILITY OF THE CONSTRUCTION CONTRACTOR TO VALIDATE THE STAGING STRATEGY, ACCESS AND TEMPORARY WORKS REQUIRED FOR THE PROJECT.

GENERAL LEGEND

- PROJECT BOUNDARY
- CONSTRUCTION BOUNDARY
- EXISTING CADASTRAL BOUNDARY
- DESIGN (WSP)
- PROPOSED ROAD DESIGN
- DESIGN BY OTHERS
- EXISTING ROAD PAVEMENT
- UNDER CONSTRUCTION
- TEMPORARY PAVEMENT - CONSTRUCTION UNDER TRAFFIC CONTROL
- CONSTRUCTION COMPLETED
- PERMANENT STRUCTURE UNDER CONSTRUCTION
- STRUCTURE COMPLETED
- TNSW APPROVED TEMPORARY WORKZONE BARRIER
- CONSTRUCTION TRAFFIC DIRECTION
- GENERAL TRAFFIC DIRECTION
- TNSW APPROVED TEMPORARY CRASH CUSHION (LEADING) OR TERMINAL (TRAILING)

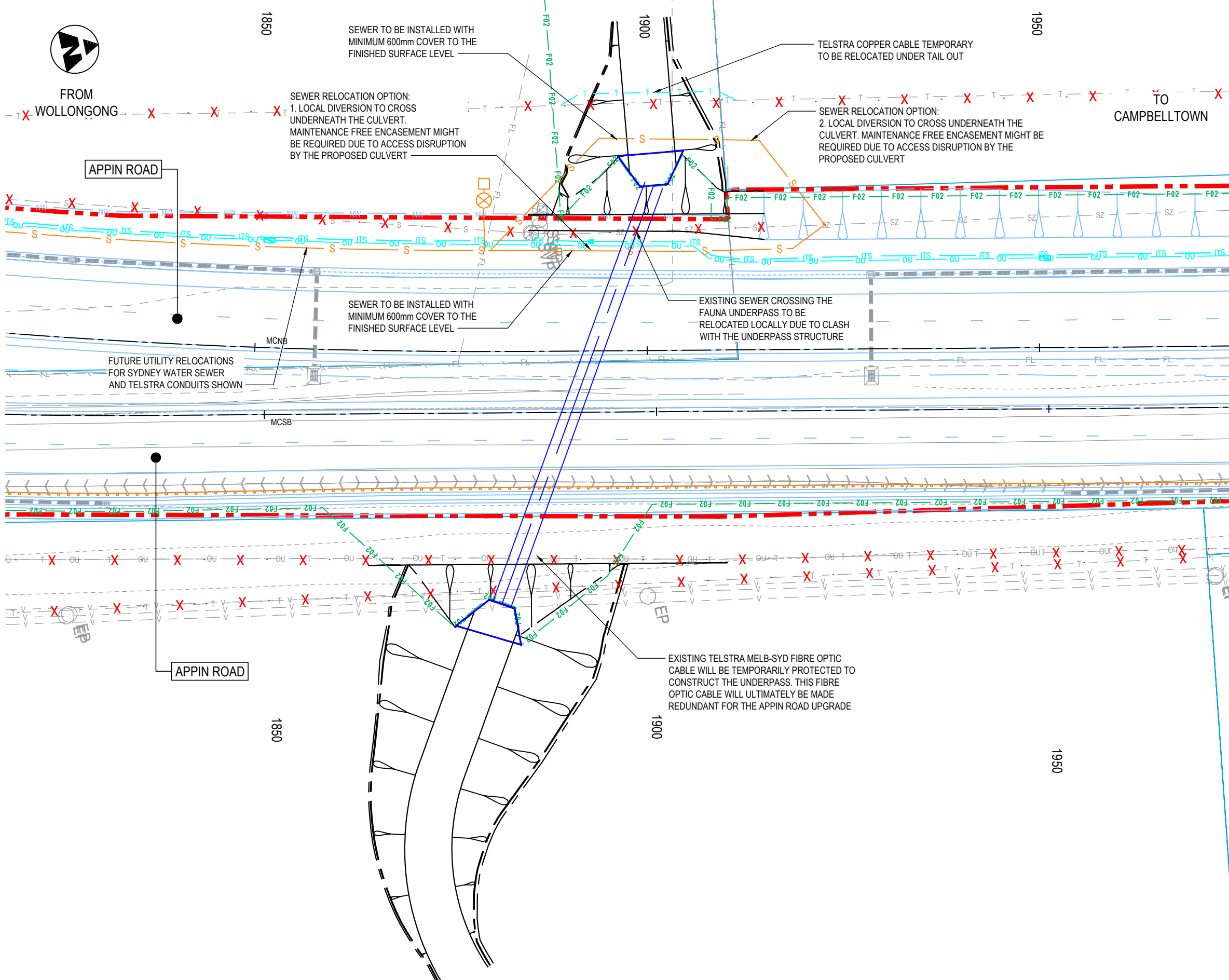


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**NOT FOR CONSTRUCTION**

DOCUMENT NUMBER / NAME <b>PS107784-1B-CS-DRG-01401</b>		DESIGN LOT CODE	DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING		PLOT DATE / TIME 29 September 2022 - 5:30:00 PM		PLOT BY Zhang, Cathy		CLIENT	CAMPBELLTOWN CITY COUNCIL MR177 APPIN ROAD GLEN LORNE AND BROWNS BUSH FAUNA UNDERPASS		A3																							
EXTERNAL REFERENCE FILES		REV	DATE	AMENDMENT / REVISION DESCRIPTION	WVR No.	APPROVAL	SCALES ON A3 SIZE DRAWING		DRAWINGS / DESIGN PREPARED BY		PREPARED FOR TBC																								
		01	30.09.22	UPDATED CONCEPT DESIGN			 SCALE 1:1000m		 Level 27, 680 George Street, Sydney GPO Box 5394, NSW 2001, Australia Tel: +61 2 9272 5100 Fax: +61 2 9272 5101 wsp.com		 STAGE 2 GENERAL ARRANGEMENT PLAN SHEET No. 1 OF 1																								
				CO-ORDINATE SYSTEM MGA ZONE 56		HEIGHT DATUM A.H.D.		<table border="1"> <thead> <tr> <th>TITLE</th> <th>NAME</th> <th>DATE</th> </tr> </thead> <tbody> <tr> <td>DRAWN</td> <td>CATHY ZHANG</td> <td>30.09.22</td> </tr> <tr> <td>DRG CHECK</td> <td>CLAUDIO BIDART</td> <td>30.09.22</td> </tr> <tr> <td>DESIGN</td> <td>CHRIS MUNDY</td> <td>30.09.22</td> </tr> <tr> <td>DESIGN CHECK</td> <td>CHRIS CHUN</td> <td>30.09.22</td> </tr> <tr> <td>DESIGN MNGR</td> <td>DANIEL PARK</td> <td>30.09.22</td> </tr> <tr> <td>PROJECT MNGR</td> <td>JONATHAN EPSELIS</td> <td>30.09.22</td> </tr> </tbody> </table>		TITLE	NAME	DATE	DRAWN	CATHY ZHANG	30.09.22	DRG CHECK	CLAUDIO BIDART	30.09.22	DESIGN	CHRIS MUNDY	30.09.22	DESIGN CHECK	CHRIS CHUN	30.09.22	DESIGN MNGR	DANIEL PARK	30.09.22	PROJECT MNGR	JONATHAN EPSELIS	30.09.22	RMS REGISTRATION No. <b>DS2019/000540</b> ISSUE STATUS CONCEPT DESIGN		EDMS No.	SHEET No. <b>CS-01401</b>	ISSUE <b>01</b>
TITLE	NAME	DATE																																	
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**NOTES**  
 1. FOR GENERAL NOTES REFER TO DRAWING PS107784-1B-GE-DRG-00010 AND 00011.

- GENERAL LEGEND**
- NEW ROAD RESERVE BOUNDARY
  - EXISTING CADASTRAL BOUNDARY
  - EASEMENT BOUNDARY
  - PROPOSED ROAD DESIGN
  - FAUNA UNDERPASS
  - EZY GUARD HC BARRIER
  - FAUNA (KOALA) FENCE
- UTILITIES LEGEND**
- NEW**
- COMM TELEPHONE UNDERGROUND
  - SEWER MAIN
- EXISTING RETAINED**
- SEWER MAIN
  - OPTICAL FIBRE UNDERGROUND
  - TELEPHONE LINE
  - LINE MAJOR TRANSMISSION
  - GAS MAIN
  - WATER MAIN
- DECOMMISSIONED**
- EXISTING SERVICES TO BE DECOMMISSIONED

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DOCUMENT NUMBER / NAME <b>PS107784-1B-UT-DRG-00101</b>		DESIGN LOT CODE	DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING	PLOT DATE / TIME 30 September 2022 - 9:51:18 AM	PLOT BY Zhang, Cathy	CLIENT CAMPBELLTOWN CITY COUNCIL	<b>A3</b>																		
EXTERNAL REFERENCE FILES		WVR No.	APPROVAL	TITLE	NAME	DATE																			
REV	DATE	AMENDMENT / REVISION DESCRIPTION		<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td>DRAWN</td> <td>CATHY ZHANG</td> <td>30.09.22</td> </tr> <tr> <td>DRG CHECK</td> <td>CLAUDIO BIDART</td> <td>30.09.22</td> </tr> <tr> <td>DESIGN</td> <td>ROISIN MCNEILL</td> <td>30.09.22</td> </tr> <tr> <td>DESIGN CHECK</td> <td>ELIAS KOURY</td> <td>30.09.22</td> </tr> <tr> <td>DESIGN MNGR</td> <td>DANIEL PARK</td> <td>30.09.22</td> </tr> <tr> <td>PROJECT MNGR</td> <td>JONATHAN EPSELIS</td> <td>30.09.22</td> </tr> </table>				DRAWN	CATHY ZHANG	30.09.22	DRG CHECK	CLAUDIO BIDART	30.09.22	DESIGN	ROISIN MCNEILL	30.09.22	DESIGN CHECK	ELIAS KOURY	30.09.22	DESIGN MNGR	DANIEL PARK	30.09.22	PROJECT MNGR	JONATHAN EPSELIS	30.09.22
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PROJECT MNGR	JONATHAN EPSELIS	30.09.22																							
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02	30.09.22	UPDATED CONCEPT DESIGN																							
CO-ORDINATE SYSTEM MGA ZONE 56		HEIGHT DATUM A.H.D.		<p>Level 27, 680 George Street, Sydney          GPO Box 5394, NSW 2001, Australia          Tel: +61 2 9272 5100 Fax: +61 2 9272 5101          wsp.com</p>																					
PREPARED FOR TBC		RMS REGISTRATION No. <b>DS2019/000540</b>																							
ISSUE STATUS CONCEPT DESIGN		EDMS No.		SHEET No. <b>UT-00101</b>		ISSUE <b>02</b>																			



FROM  
WOLLONGONG

TO  
CAMPBELLTOWN

THE UTILITIES/SERVICES SHOWN IN THESE PLANS HAVE BEEN COMPILED FROM MULTIPLE SOURCES OF INFORMATION. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO UNDERTAKE THEIR OWN SITE INVESTIGATIONS PRIOR TO ANY CONSTRUCTION ACTIVITIES. THESE DRAWINGS ARE NEVER TO BE USED FOR THE PURPOSE OF LOCATING SERVICES. WSP SHALL NOT BE LIABLE FOR ANY LOSS OR DAMAGE CAUSED USING THE UTILITIES/SERVICES INFORMATION SHOWN ON THESE DRAWINGS.

NOTES

- 1. FOR GENERAL NOTES REFER TO DRAWING PS107784-1B-GE-DRG-00010 AND 00011.

GENERAL LEGEND

- NEW ROAD RESERVE BOUNDARY
- EXISTING CADASTRAL BOUNDARY
- EASEMENT BOUNDARY
- PROPOSED ROAD DESIGN
- FAUNA UNDERPASS
- EZY GUARD HC BARRIER
- FAUNA (KOALA) FENCE

UTILITIES LEGEND

NEW

- COMM TELEPHONE UNDERGROUND
- SEWER MAIN

EXISTING RETAINED

- SEWER MAIN
- OPTICAL FIBRE UNDERGROUND
- TELEPHONE LINE
- LINE MAJOR TRANSMISSION
- GAS MAIN
- WATER MAIN

DECOMMISSIONED

- EXISTING SERVICES TO BE DECOMMISSIONED

EXISTING SEWER TO BE REMAIN UNDER THE FAUNA UNDERPASS DUE TO SUFFICIENT COVER AGAINST THE FINISH SURFACE LEVEL. SPECIALIST ENGINEERING ASSESSMENT IS LIKELY TO BE REQUIRED TO GAIN SYDNEY WATER ACCEPTANCE FOR PROPOSALS

EXISTING SEWER AS SHOWN IS QUALITY LEVEL D. MAIN TO BE POTHOLED TO CONFIRM LOCATION AND CONFIRM ANY IMPACTS FROM THE WORKS

TELSTRA COPPER CABLE TEMPORARY TO BE RELOCATED UNDER TAIL OUT

TELSTRA CONDUITS TO BE INSTALLED TO ACHIEVE MINIMUM 600mm COVER TO THE FINISHED SURFACE LEVEL. FOR THE ULTIMAT APPIN ROAD UPGRADE

TELSTRA CONDUITS TO BE INSTALLED TO ACHIEVE MINIMUM 1200mm COVER TO THE FINISHED SURFACE LEVEL AT THE ROAD CROSSING. THIS WORKS TO BE UNDERTAKEN FOR THE ULTIMATE APPIN ROAD UPGRADE.

EXISTING TELSTRA OPTIC FIBRE TO BE TEMPORARILY PROTECTED TO CONSTRUCT THE UNDERPASS. POTHOLING REQUIRED AT THIS SECTION FOR FURTHER ASSESSMENT. THIS FIBRE OPTIC CABLE WILL ULTIMATELY BE MADE REDUNDANT FOR THE APPIN ROAD UPGRADE

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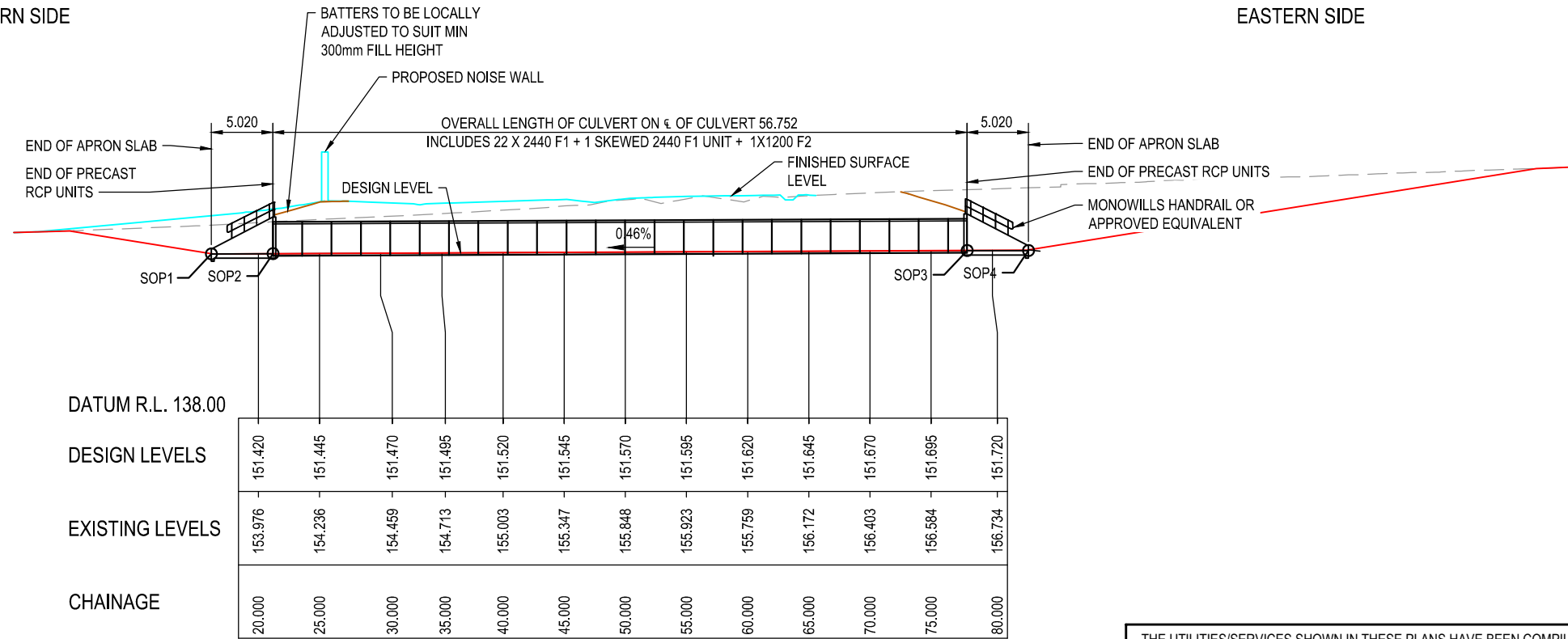
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U:\Projects\PS107784\_Appin\_Road\_Mc\_Coll\_WIP\BIM\Drawings\PORTION-1\BUT\PS107784-1B-UT-DRG-00102.dwg  
150mm ON A3 SIZE ORIGINAL

DOCUMENT NUMBER / NAME <b>PS107784-1B-UT-DRG-00102</b>		DESIGN LOT CODE	DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING		PLOT DATE / TIME 30 September 2022 - 9:51:04 AM	PLOT BY Zhang, Cathy	CLIENT CAMPBELLTOWN CITY COUNCIL MR177 APPIN ROAD GLEN LORNE AND BROWNS BUSH FAUNA UNDERPASS	A3					
EXTERNAL REFERENCE FILES	REV 01	DATE 30.09.22	AMENDMENT / REVISION DESCRIPTION UPDATED CONCEPT DESIGN	WVR No. APPROVAL	SCALES ON A3 SIZE DRAWING 0 5 10 15 20 25 SCALE 1:500m	DRAWINGS / DESIGN PREPARED BY <b>wsp</b> Level 27, 680 George Street, Sydney GPO Box 5394, NSW 2001, Australia Tel: +61 2 9272 5100 Fax: +61 2 9272 5101 wsp.com	TITLE DRAWN DRG CHECK DESIGN DESIGN CHECK DESIGN MNGR PROJECT MNGR	NAME CATHY ZHANG CLAUDIO BIDART ROISIN MCNEILL ELIAS KOURY DANIEL PARK JONATHAN EPSELIS	DATE 30.09.22 30.09.22 30.09.22 30.09.22 30.09.22 30.09.22	PREPARED FOR TBC	GENERAL ARRANGEMENT PLAN RMS REGISTRATION No. <b>DS2019/000540</b> ISSUE STATUS CONCEPT DESIGN	SHEET No. 1 OF 1 PART	ISSUE 01



WESTERN SIDE

EASTERN SIDE



SECTION A  
SCALE 1:500

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TABLE 1 - SET OUT POINTS

SET OUT POINT (SOP)	INVERT LEVEL	COORDINATES EASTING	COORDINATES NORTHING
SOP1	151.428	296749.876	6222442.822
SOP2	151.426	296754.840	6222442.105
SOP3	151.710	296802.922	6222412.392
SOP4	151.754	296807.190	6222409.754

TABLE 2 - ASSUMED PRECAST CONCRETE PIPE DIMENSIONS

FAMILY SEQUENCE	NOMINAL SIZE ▲	DIA (INT) ▲	DIA(EXT) ▲	OVERALL LENGTH ▲
F1	Ø2400	2438	2768	2440
F2	Ø2400	2438	2768	1200

GENERAL NOTES

- DIMENSIONS ARE IN MILLIMETRES. CHAINAGES AND REDUCED LEVELS ARE IN METRES. REDUCED LEVELS ARE TO AHD. CO-ORDINATES ARE TO MGA ZONE 56.
- RCP UNITS TO BE DESIGNED FOR THE FOLLOWING FILL HEIGHTS UNDER THE ROAD ALIGNMENT:  
MIN FILL HEIGHT: TBC  
MAX FILL HEIGHT: TBC
- PRECAST PIPES SHALL BE IN ACCORDANCE WITH AS/NZS 4058:2007.
- CONCRETE EXPOSURE CLASSIFICATION FOR PIPE UNITS: B1
- ▲ DENOTES CONCRETE DIMENSIONS ARE BASED ON ASSUMED ROCLA PRECAST PIPE UNIT DIMENSIONS. ACTUAL DIMENSIONS TO BE CONFIRMED BY CHOSEN PIPE UNITS SUPPLIER.
- LIFTING HOLES IN ALL PRECAST ELEMENTS TO BE FILLED WITH GROUT AFTER INSTALLATION.

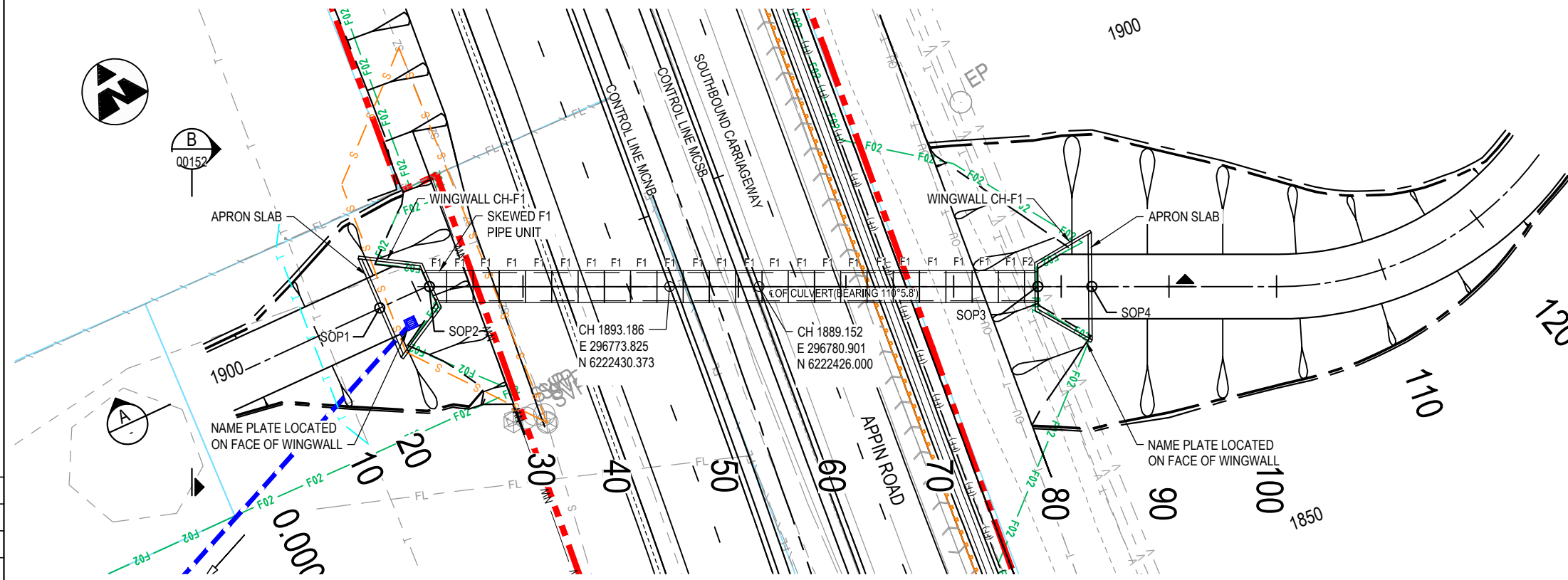
SURFACE PREPARATION

- TOPSOIL BENEATH THE CULVERT IS TO BE REMOVED. DESIGN GROUND CONDITIONS AND EXTENT OF UNSUITABLE MATERIAL (REMOVE AND REPLACE) MUST BE VERIFIED ON SITE BY THE PRINCIPAL.
- FOUNDING STRATUM FOR RCP IS TO BE FIRM CLAY (MIN  $C_u=25\text{KPa}$ ) OR MEDIUM DENSE SAND ( $\phi=32$  DEGREES /  $\text{SPT}'N>10$  /  $\text{DCP} > 3$  BLOWS/100mm). WHERE FOUNDING STRATUM IS FOUND TO BE WEAKER, THEN FOUNDATION TREATMENT E2 (BRIDGING) IS TO BE APPLIED. THICKNESS OF THE E2 (BRIDGING) LAYER IS TO BE CONFIRMED ON SITE BY THE PRINCIPAL.

GENERAL LEGEND

- NEW ROAD RESERVE BOUNDARY
  - EXISTING CADASTRAL BOUNDARY
  - EASEMENT BOUNDARY
  - PROPOSED ROAD DESIGN
  - EZY GUARD HC BARRIER
  - FAUNA (KOALA) FENCE
  - COMM TELEPHONE UNDERGROUND
  - SEWER MAIN
  - STORMWATER DRAINAGE PIT AND PIPE
  - STORMWATER DRAINAGE CHANNEL
  - SEWER MAIN
- EXISTING RETAINED
- SEWER MAIN
  - OPTICAL FIBRE UNDERGROUND
  - LINE MAJOR TRANSMISSION
  - COMM TELEPHONE

NOT FOR CONSTRUCTION



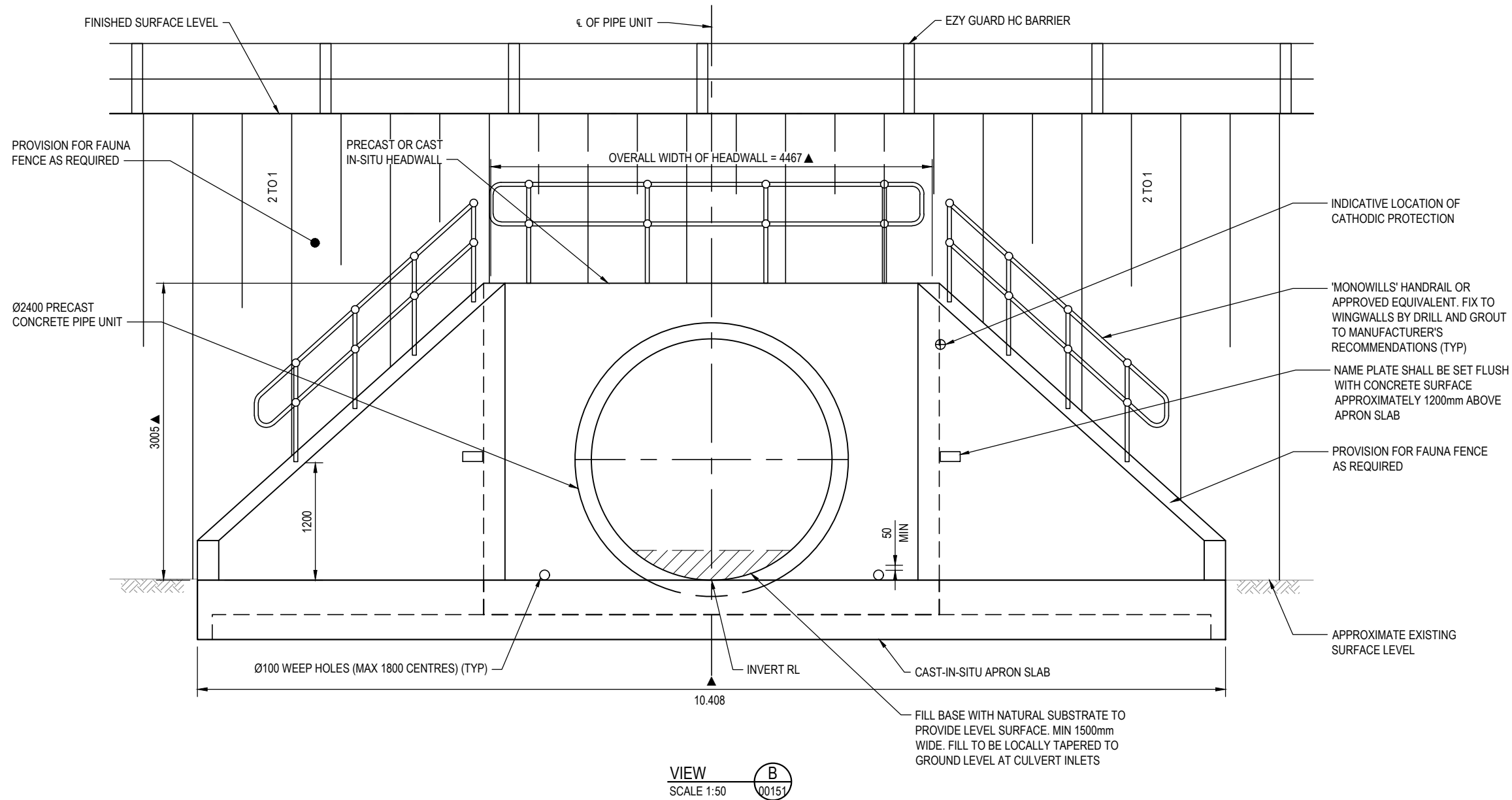
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DOCUMENT NUMBER / NAME PS107784-1B-MS-DRG-00151		DESIGN LOT CODE	DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING	PLOT DATE / TIME 29 September 2022 - 5:46:06 PM	PLOT BY Zhang, Cathy	CLIENT CAMPBELLTOWN CITY COUNCIL MR177 APPIN ROAD GLEN LORNE AND BROWNS BUSH FAUNA UNDERPASS
EXTERNAL REFERENCE FILES	REV 01	DATE 30.09.22	AMENDMENT / REVISION DESCRIPTION UPDATED CONCEPT DESIGN	WVR No.	APPROVAL	SCALE(S) ON A3 SIZE DRAWING 0 5 10 15 20 25 SCALE 1:500m
DRAWINGS / DESIGN PREPARED BY wsp			TITLE DRAWN CATHY ZHANG 30.09.22		DATE 30.09.22	
CO-ORDINATE SYSTEM MGA ZONE 56			HEIGHT DATUM A.H.D.		DATE 30.09.22	
PREPARED FOR TBC			DATE 30.09.22		DATE 30.09.22	
RMS REGISTRATION No. DS2019/000540			DATE 30.09.22		DATE 30.09.22	
ISSUE STATUS CONCEPT DESIGN			EDMS No.		SHEET No. MS-00151	
PART A3			ISSUE 01		ISSUE 01	

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**CROWN UNITS AND PRECAST CONCRETE ELEMENTS:**

1. CONCRETE EXPOSURE CLASSIFICATION OF PRECAST CONCRETE ELEMENTS SHALL BE B1.
2. THE DESIGN LIFE FOR PRECAST CROWN UNITS SHALL BE 100 YEARS
3. ALL PRECAST ELEMENTS ARE TO BE DESIGNED AND CERTIFIED BY THE MANUFACTURER.
4. ALL PRECAST CONCRETE ELEMENTS SHALL COMPLY WITH RMS D&C SPECIFICATION B80
5. CROWN UNITS SHALL BE SUPPLIED IN ACCORDANCE WITH RMS SPECIFICATION R16.
6. TRAFFIC LOADING SHALL BE SM1600 AND HLP400 IN ACCORDANCE WITH AS5100.2
7. THE MINIMUM CHARACTERISTIC COMPRESSIVE CYLINDER STRENGTH OF PRECAST CONCRETE AT 28 DAYS SHALL BE 40MPa

**CAST-IN-SITU CONCRETE:**

1. CONCRETE EXPOSURE CLASSIFICATION SHALL BE B1.
2. THE DESIGN LIFE FOR BOX CULVERT BASE SLABS, CAST-IN-SITU WING WALLS, HEADWALLS AND APRON SLABS, SHALL BE 100 YEARS.
3. ALL CAST-IN-SITU CONCRETE ELEMENTS SHALL COMPLY WITH RMS D&C SPECIFICATION B80 UNLESS SPECIFIED OTHERWISE
4. THE MINIMUM CHARACTERISTIC COMPRESSIVE CYLINDER STRENGTH OF CAST-IN-SITU CONCRETE AT 28 DAYS SHALL BE 40MPa UNLESS SPECIFIED OTHERWISE
5. NOMINAL COVER TO REINFORCEMENT NEAREST TO THE CONCRETE SURFACE FOR CAST-IN-PLACE CONCRETE SHALL BE 45mm UNLESS SPECIFIED OTHERWISE.
9. WHERE CONCRETE IS CAST AGAINST NATURAL GROUND THE COVER SHALL BE INCREASED BY 30mm, OR 10mm IF PROTECTED BY A DAMP PROOF MEMBRANE

**REINFORCEMENT:**

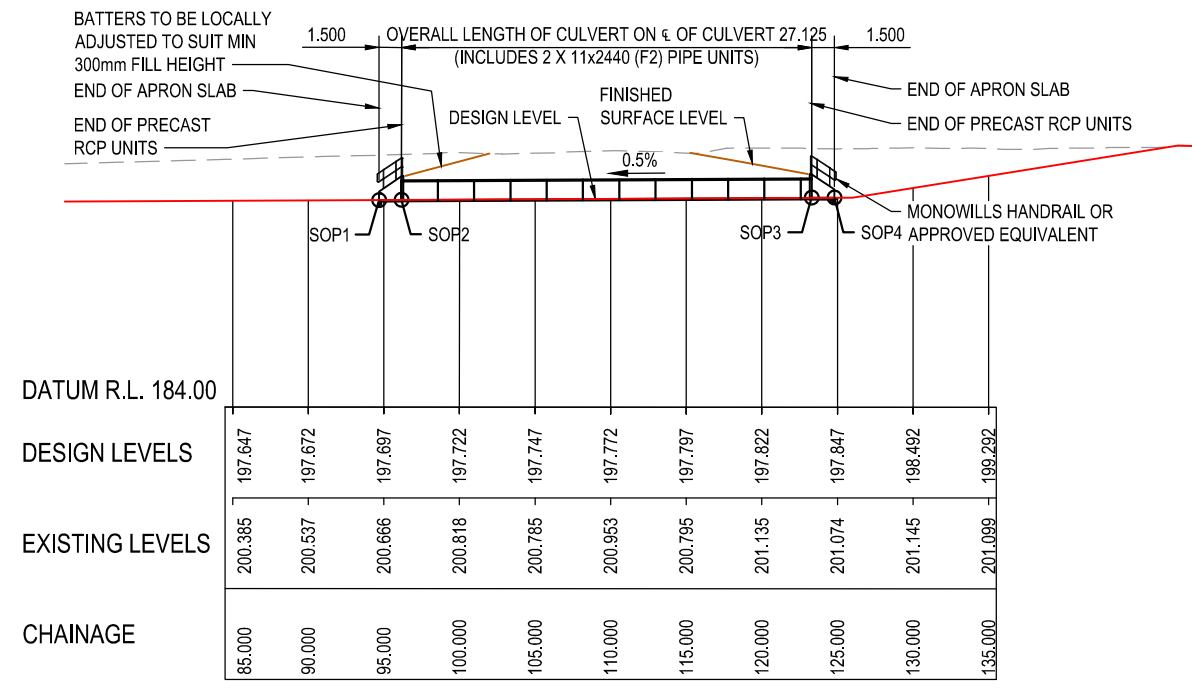
1. THE GRADE OF REINFORCEMENT BARS SHALL BE D500N TO AS/NZS 4671.
2. THE GRADE OF REINFORCEMENT MESH SHALL BE D500L TO AS/NZS 4671.
3. BAR BENDING AND HOOK DETAILS SHALL BE IN ACCORDANCE WITH AS5100 BRIDGE DESIGN PART 5 SECTION 16.2.3.
4. STAINLESS STEEL DOWELS SHALL BE GRADE 304 TO ASTM A276.
5. BAR SHAPE CODES WHERE USED ARE IN ACCORDANCE WITH RMS STANDARD DRAWING B0013.

NOT FOR CONSTRUCTION

DOCUMENT NUMBER / NAME <b>PS107784-1B-MS-DRG-00152</b>			DESIGN LOT CODE	DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING			PLOT DATE / TIME 29 September 2022 - 5:46:30 PM		PLOT BY Zhang, Cathy		CLIENT		CAMPBELLTOWN CITY COUNCIL MR177 APPIN ROAD GLEN LORNE AND BROWNS BUSH FAUNA UNDERPASS	A3		
EXTERNAL REFERENCE FILES	REV 01	DATE 30.09.22	AMENDMENT / REVISION DESCRIPTION UPDATED CONCEPT DESIGN	WVR No.	APPROVAL	SCALES ON A3 SIZE DRAWING	DRAWINGS / DESIGN PREPARED BY		TITLE	NAME	DATE		PREPARED FOR TBC	CULVERT HEADWALL ELEVATION	SHEET No. 1 OF 1	
						SCALE 1:50m			DRGN CHECK	CLAUDIO BIDART	30.09.22	RMS REGISTRATION No. <b>DS2019/000540</b>				
						CO-ORDINATE SYSTEM MGA ZONE 56		HEIGHT DATUM A.H.D.		DESIGN	ANITA KHANDARE		30.09.22			
						Level 27, 680 George Street, Sydney GPO Box 5394, NSW 2001, Australia Tel: +61 2 9272 5100 Fax: +61 2 9272 5101 wsp.com		DESIGN CHECK	MARCUS BAKER	30.09.22						
								DESIGN MNGR	DANIEL PARK	30.09.22				ISSUE STATUS CONCEPT DESIGN	EDMS No.	SHEET No. MS-00152
								PROJECT MNGR	JONATHAN EPSELIS	30.09.22			© Roads and Maritime Services			

WESTERN SIDE

EASTERN SIDE



SET OUT POINT (SOP)	INVERT LEVEL	COORDINATES EASTING	COORDINATES NORTHING
SOP1	197.694	296289.317	6220286.505
SOP2	197.703	296290.806	6220286.327
SOP3	197.841	296317.843	6220284.123
SOP4	197.848	296319.338	6220284.001

FAMILY SEQUENCE	NOMINAL SIZE ▲	DIA (INT) ▲	DIA(EXT) ▲	OVERALL LENGTH ▲
F2	Ø1200	1200	1372	2440

GENERAL NOTES

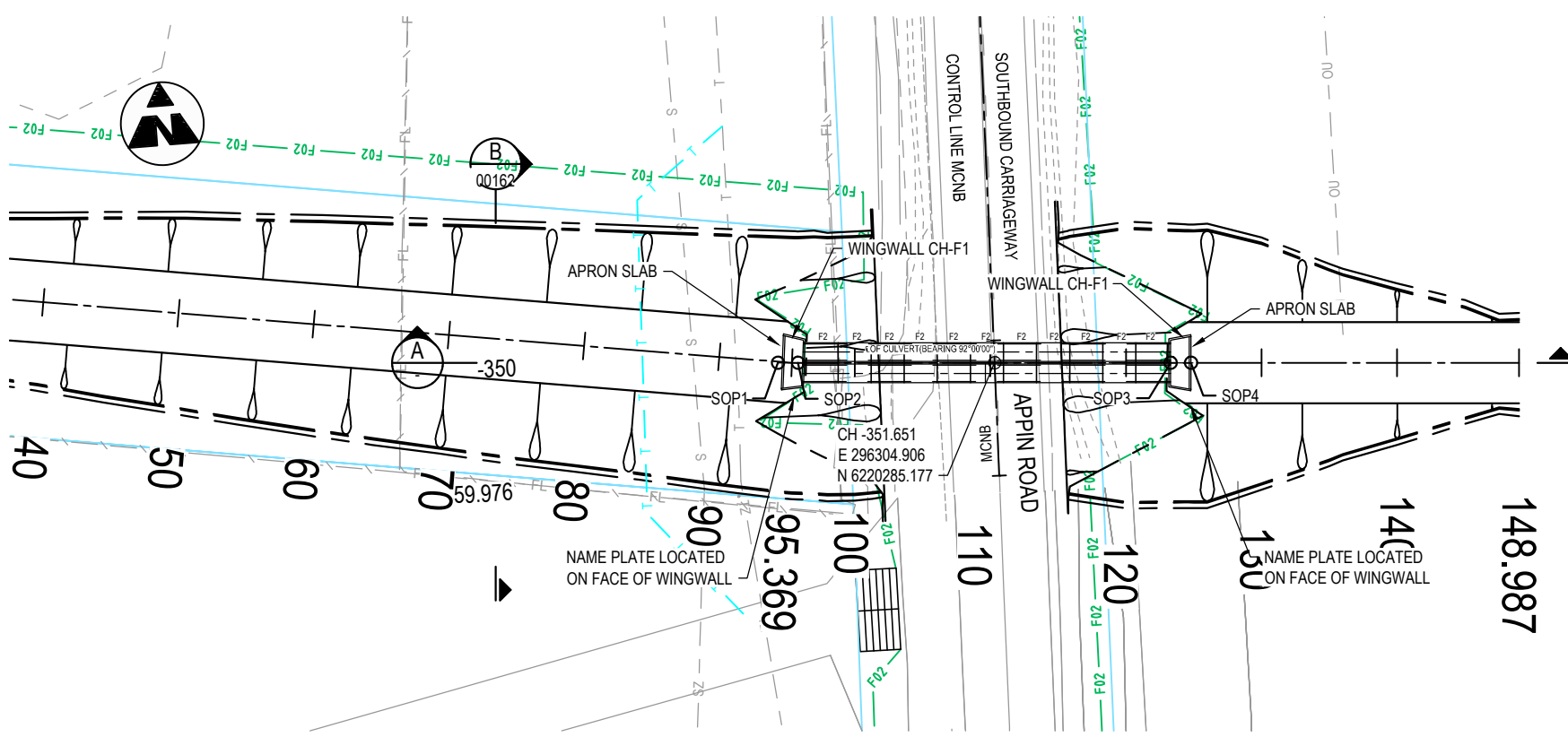
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- RCP UNITS TO BE DESIGNED FOR THE FOLLOWING FILL HEIGHTS UNDER THE ROAD ALIGNMENT:  
MIN FILL HEIGHT: TBC  
MAX FILL HEIGHT: TBC
- PRECAST PIPES SHALL BE IN ACCORDANCE WITH AS/NZS 4058:2007.
- CONCRETE EXPOSURE CLASSIFICATION FOR PIPE UNITS: B1
- ▲ DENOTES CONCRETE DIMENSIONS ARE BASED ON ASSUMED ROCLA PRECAST PIPE UNIT DIMENSIONS. ACTUAL DIMENSIONS TO BE CONFIRMED BY CHOSEN PIPE UNITS SUPPLIER.
- LIFTING HOLES IN ALL PRECAST ELEMENTS TO BE FILLED WITH GROUT AFTER INSTALLATION.

SURFACE PREPARATION

- TOPSOIL BENEATH THE CULVERT IS TO BE REMOVED. DESIGN GROUND CONDITIONS AND EXTENT OF UNSUITABLE MATERIAL (REMOVE AND REPLACE) MUST BE VERIFIED ON SITE BY THE PRINCIPAL.
- FOUNDING STRATUM FOR RCP IS TO BE FIRM CLAY (MIN  $C_u=25\text{KPa}$ ) OR MEDIUM DENSE SAND ( $\phi^i=32$  DEGREES /  $\text{SPT}'N>10$  /  $\text{DCP} > 3$  BLOWS/100mm). WHERE FOUNDING STRATUM IS FOUND TO BE WEAKER, THEN FOUNDATION TREATMENT E2 (BRIDGING) IS TO BE APPLIED. THICKNESS OF THE E2 (BRIDGING) LAYER IS TO BE CONFIRMED ON SITE BY THE PRINCIPAL.

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SECTION A  
SCALE 1:500



GENERAL LEGEND

- NEW ROAD RESERVE BOUNDARY
- EXISTING CADASTRAL BOUNDARY
- EASEMENT BOUNDARY
- PROPOSED ROAD DESIGN
- EZY GUARD HC BARRIER
- F02 - F02 - FAUNA (KOALA) FENCE
- T - T - T - COMM TELEPHONE UNDERGROUND
- S - S - S - SEWER MAIN
- STORMWATER DRAINAGE PIT AND PIPE
- STORMWATER DRAINAGE CHANNEL
- SEWER MAIN
- EXISTING RETAINED
- SZ - SEWER MAIN
- OU - OPTICAL FIBRE UNDERGROUND
- V - LINE MAJOR TRANSMISSION
- T - T - T - COMM TELEPHONE

**NOT FOR CONSTRUCTION**

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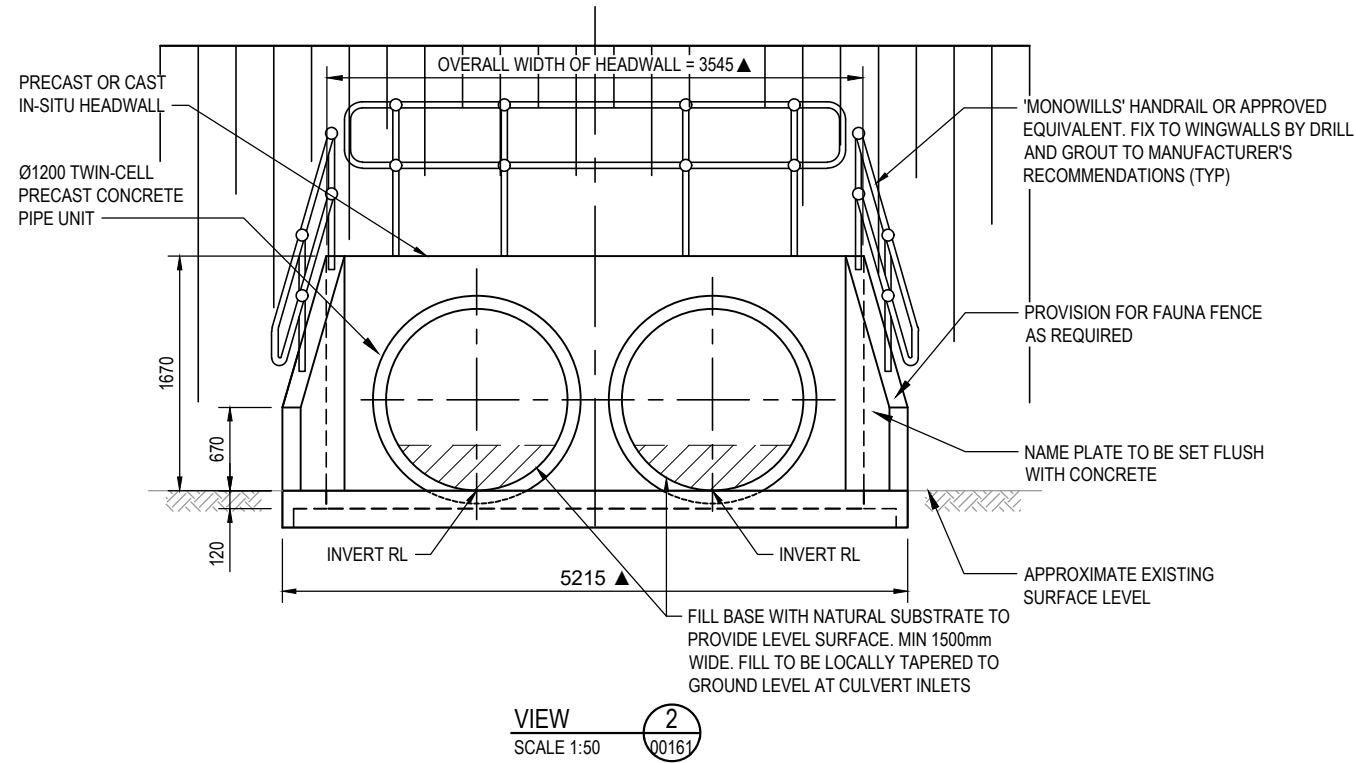
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DOCUMENT NUMBER / NAME PS107784-1B-MS-DRG-00161		DESIGN LOT CODE	DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING	PLOT DATE / TIME 29 September 2022 - 5:48:13 PM	PLOT BY Zhang, Cathy	CLIENT CAMPBELLTOWN CITY COUNCIL MR177 APPIN ROAD GLEN LORNE AND BROWNS BUSH FAUNA UNDERPASS
EXTERNAL REFERENCE FILES	REV 01	DATE 30.09.22	AMENDMENT / REVISION DESCRIPTION UPDATED CONCEPT DESIGN	WVR No.	APPROVAL	SCALE(S) ON A3 SIZE DRAWING 0 5 10 15 20 25 SCALE 1:500m
				DRAWINGS / DESIGN PREPARED BY <b>wsp</b> Level 27, 680 George Street, Sydney GPO Box 5394, NSW 2001, Australia Tel: +61 2 9272 5100 Fax: +61 2 9272 5101 wsp.com		TITLE DRAWN CATHY ZHANG 30.09.22 DRG CHECK CLAUDIO BIDART 30.09.22 DESIGN ANITA KHANDARE 30.09.22 DESIGN CHECK MARCUS BAKER 30.09.22 DESIGN MNGR DANIEL PARK 30.09.22 PROJECT MNGR JONATHAN EPSSELIS 30.09.22
				PREPARED FOR TBC		RMS REGISTRATION No. <b>DS2019/000540</b>
				CO-ORDINATE SYSTEM MGA ZONE 56		HEIGHT DATUM A.H.D.
				SHEET No. 1 OF 1		ISSUE STATUS CONCEPT DESIGN
				EDMS No.		SHEET No. MS-00161
				ISSUE No. 01		ISSUE No. 01



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- NOTES:**
1. GEOMETRY OF HEADWALLS INDICATIVE AND TO BE CONFIRMED
  2. REFER SHEET MS-00152 FOR PRECAST CONCRETE ELEMENT, CAST IN-SITU CONCRETE AND REINFORCEMENT NOTES.

**NOT FOR CONSTRUCTION**

DOCUMENT NUMBER / NAME <b>PS107784-1B-MS-DRG-00162</b>			DESIGN LOT CODE	DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING	PLOT DATE / TIME 29 September 2022 - 5:48:42 PM	PLOT BY Zhang, Cathy	CLIENT CAMPBELLTOWN CITY COUNCIL MR177 APPIN ROAD GLEN LORNE AND BROWNS BUSH FAUNA UNDERPASS	A3
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				CO-ORDINATE SYSTEM MGA ZONE 56	HEIGHT DATUM A.H.D.	Level 27, 680 George Street, Sydney GPO Box 5394, NSW 2001, Australia Tel: +61 2 9272 5100 Fax: +61 2 9272 5101 wsp.com	DATE 30.09.22 30.09.22 30.09.22 30.09.22 30.09.22 30.09.22	PREPARED FOR TBC
					RMS REGISTRATION No. <b>DS2019/000540</b>		SHEET No. 1 OF 1	
					ISSUE STATUS CONCEPT DESIGN		EDMS No.	SHEET No. <b>MS-00162</b>
							ISSUE <b>01</b>	

## Appendix C

Consideration of section 171(2) factors and matters of National Environmental Significance and Commonwealth land

## A.1. Section 171(2) checklist

In addition to the requirements of the Is an EIS required? (1995/1996) guideline and the *Roads and Related Facilities EIS Guideline* (DUAP, 1996) as detailed in the addendum REF, the following factors, listed in section 171(2) of the Environmental Planning and Assessment Regulation 2021, have also been considered to assess the likely impacts of the proposed modification on the natural and built environment.

Factor	Impact
<p><b>Any environmental impact on a community?</b></p> <p>The proposal would result in noise impacts to surrounding receivers, both while the proposal is built.</p> <p>Increased safety for the local native fauna would have a positive long term impact on the community.</p>	<p>Short term negative</p> <p>Long term positive</p>
<p><b>Any transformation of a locality?</b></p> <p>There would only be minor physical and visual impacts on the locality. The existing land use/form would not change. Proposed modification area would be landscaped according to the project landscape and urban design plan.</p>	<p>Short term negative</p>
<p><b>Any environmental impact on the ecosystems of the locality?</b></p> <p>The proposed modification would result in increased safety of native fauna from risks such as traffic and potentially domestic dogs.</p>	<p>Long term positive</p>
<p><b>Any reduction of the aesthetic, recreational, scientific or other environmental quality or value of a locality?</b></p> <p>There would only be minor physical and visual impacts on the locality. The existing land use/form would not change. Proposed modification area would be landscaped according to the Project landscape and urban design plan. The environmental quality would be increased.</p>	<p>Short term negative</p> <p>Long term positive</p>
<p><b>Any effect on a locality, place or building having aesthetic, anthropological, archaeological, architectural, cultural, historical, scientific or social significance or other special value for present or future generations?</b></p> <p>The proposed modification would not have an impact on any heritage items. An Archaeological Research Design has been developed to further assess the Aboriginal Cultural Heritage of the proposed modification.</p>	<p>Nil</p>
<p><b>Any impact on the habitat of protected fauna (within the meaning of the <i>National Parks and Wildlife Act 1974</i>)?</b></p> <p>The proposed modification would remove some foraging habitat for native fauna species; however the proposed modification would improve the safety of native fauna by reducing risk of harm from traffic.</p>	<p>Short term negative</p> <p>Long term positive</p>
<p><b>Any endangering of any species of animal, plant or other form of life, whether living on land, in water or in the air?</b></p> <p>No species would be endangered as a result of the proposal and mitigation measures are proposed</p>	<p>Nil</p>
<p><b>Any long-term effects on the environment?</b></p> <p>Vegetation would be removed, however landscape would be revegetated in accordance with the Project urban design and landscape plan. Fauna furniture would be installed in and around the underpasses.</p> <p>The proposed modification would increase the safety of the native fauna by reducing the risk of harm from traffic. It is hoped the use of fauna fencing would help limit interactions between koalas and domestic dogs.</p>	<p>Long term positive</p>

Factor	Impact
<p><b>Any degradation of the quality of the environment?</b></p> <p>Short term impacts are likely due to the construction activity. Mitigation measures would reduce these impacts.</p>	Short term negative
<p><b>Any risk to the safety of the environment?</b></p> <p>There is potential for road safety to be decreased during construction due to altered traffic conditions and detours. Traffic management safeguards including the reparation of a traffic management plan, would address safety risks.</p> <p>The proposal would improve safety for road users and wildlife during operation by reducing the likelihood of native fauna wandering onto the road.</p>	Short term negative Long term positive
<p><b>Any reduction in the range of beneficial uses of the environment?</b></p> <p>The proposal would not result in the reduction in the range of beneficial uses of any property.</p> <p>During construction, minor traffic impacts due to an increase in heavy vehicle movements and interruptions to traffic flow would temporarily reduce the beneficial use of the local road network.</p>	Short term negative
<p><b>Any pollution of the environment?</b></p> <p>The proposal could potentially result in minor short-term water pollution from sediments, soil nutrients, waste, and spilt fuels and chemicals. Management of water quality impacts would be undertaken in accordance with the mitigation measures outlined in Chapter 7.</p> <p>The proposal would result in minor short-term air pollution from plant and machinery and the generation of dust during construction. Management of air quality impacts would be undertaken in accordance with the mitigation measures outlined in Chapter 7.</p>	Short term negative
<p><b>Any environmental problems associated with the disposal of waste?</b></p> <p>The waste streams generated during construction are common and would pose no difficulty in their disposal. Waste would be recycled wherever possible.</p>	Nil
<p><b>Any increased demands on resources (natural or otherwise) that are, or are likely to become, in short supply?</b></p> <p>All resources required for the proposal are readily available and are not in short supply.</p>	Nil
<p><b>Any cumulative environmental effect with other existing or likely future activities?</b></p> <p>Temporary potential cumulative impacts may occur as a result of construction activities occurring simultaneously with the construction of the proposal.</p>	Short term negative
<p><b>Any impact on coastal processes and coastal hazards, including those under projected climate change conditions?</b></p> <p>The proposal is not located within a coastal area and therefore would not result in any impact on coastal processes and coastal hazards.</p>	Nil
<p><b>Applicable local strategic planning statements, regional strategic plans or district strategic plans made under the Act, Division 3.1,</b></p> <p>Refer to Section 4 for how the proposed modification aligns to the applicable planning statements and plans for the area.</p>	
<p><b>Other relevant environmental factors</b></p>	In considering the potential impacts of this proposal all relevant environmental factors have been considered, refer to Chapter 7 of this assessment.

## A.2. Matters of National Environmental Significance and Commonwealth land

Under the environmental assessment provisions of the EPBC Act, the following matters of national environmental significance and impacts on Commonwealth land are required to be considered to assist in determining whether the proposed modification should be referred to the Australian Government Department of Climate Change, Energy, the Environment and Water.

Under the EPBC Act strategic assessment approval is not required for proposed road actions that may affect nationally listed threatened species, populations, endangered ecological communities and migratory species. Impacts on these matters are assessed in detail as part of this addendum REF in accordance with Australian Government significant impact criteria and taking into account relevant guidelines and policies.

Factor	Impact
Any impact on a World Heritage property?	Nil
Any impact on a National Heritage place?	Nil
Any impact on a wetland of international importance?	Nil
Any impact on a listed threatened species or communities?	Yes – negligible impacts on habitat/ TECs and overall positive impacts on koala connectivity
Any impacts on listed migratory species?	Nil
Any impact on a Commonwealth marine area?	Nil
Does the proposed modification involve a nuclear action (including uranium mining)?	Nil
Additionally, any impact (direct or indirect) on Commonwealth land?	Nil

### A.3. Matters of National Environmental Significance and Commonwealth land

Certain development types

Development type	Description	Yes / No	If 'yes' consult with	SEPP (Transport and Infrastructure) section
Car park	Does the project include a car park intended for the use by commuters using regular bus services?	No	[Local council and the occupiers of adjoining land]  [Use ISEPP consultation letter template where required.]	Section 2.110
Bus depots	Does the project propose a bus depot?	No	[Local council and the occupiers of adjoining land]	Section 2.110
Permanent road maintenance depot and associated infrastructure	Does the project propose a permanent road maintenance depot or associated infrastructure such as garages, sheds, tool houses, storage yards, training facilities and workers' amenities?	No	[Local council and the occupiers of adjoining land]	Section 2.110

Development within the Coastal Zone

Issue	Description	Yes / No / N/A	If 'yes' consult with	SEPP (Transport and Infrastructure) section
Development with impacts on certain land within the coastal zone	Is the proposal within a coastal vulnerability area and is inconsistent with a certified coastal management program applying to that land?	N/A	[Local council]  [Use ISEPP consultation letter template where required.]	Section 2.14

Note: See interactive map [Coastal management - \(nsw.gov.au\)](http://www.nsw.gov.au). Note the coastal vulnerability area has not yet been mapped.

Note: a certified coastal zone management plan is taken to be a certified coastal management program.



Council related infrastructure or services

Development type	Potential impact	Yes / No	If 'yes' consult with the relevant local council(s).	SEPP (Transport and Infrastructure) section
Stormwater	Are the works likely to have a substantial impact on the stormwater management services which are provided by council?	No	[insert name of relevant local council/s]  [Use ISEPP consultation letter template where required.]	Section 2.10
Traffic	Are the works likely to generate traffic to an extent that would strain the capacity of the existing road system in a local government area?	No		Section 2.10
Sewerage system	Would the works involve connection to a council owned sewerage system? If so, would this connection have a substantial impact on the capacity of any part of the system?	No		Section 2.10
Water usage	Would the works involve connection to a council owned water supply system? If so, would this require the use of a substantial volume of water?	No		Section 2.10
Temporary structures	Would the works involve the installation of a temporary structure on, or the enclosing of, a public place which is under local council management or control? If so, would this cause more than a minor or inconsequential disruption to pedestrian or vehicular flow?	No		Section 2.10
Road and footpath excavation	Would the works involve more than minor or inconsequential excavation of a road or adjacent footpath for which council is the roads authority and responsible for maintenance?	No		Section 2.10

Local heritage items

Development type	Potential impact	Yes / No	If 'yes' consult with the relevant local council(s).	SEPP (Transport and Infrastructure) section
Local heritage	Is there is a local heritage item (that is not also a State heritage item) or a heritage conservation area in the study area for the works?  If yes, does a heritage assessment indicate that the potential impacts to the heritage significance of the item/area are more than minor or inconsequential?	No	[insert name of relevant local council/s]  [Use ISEPP consultation letter template where required.]	Section 2.11

Flood liable land

Development type	Potential impact	Yes / No	If 'yes' consult with	SEPP (Transport and Infrastructure) section
Flood liable land	Are the works located on flood liable land? If so, would the works change flood patterns to more than a minor extent?		[Local council]	Section 2.12
Flood liable land	Are the works located on flood liable land? (to any extent). If so, do the works comprise more than minor alterations or additions to, or the demolition of, a building, emergency works or routine maintenance		State Emergency Services  Email: erm@ses.nsw.gov.au	Section 2.13

Note: Flood liable land means land that is susceptible to flooding by the probable maximum flood event, identified in accordance with the principles set out in the manual entitled Floodplain Development Manual: the management of flood liable land published by the New South Wales Government.

Public authorities other than councils

Development type	Potential impact	Yes / No	If 'yes' consult with the relevant local council(s).	SEPP (Transport and Infrastructure) section
National parks and reserves	Are the works adjacent to a national park or nature reserve, or other area reserved under the <i>National Parks and Wildlife Act 1974</i> , or on land acquired under that Act?		DPE  [Use ISEPP consultation letter template where required.]	Section 2.15
National parks and reserves	Are the works on land in Zone E1 National Parks and Nature Reserves or in a land use zone equivalent to that zone?		DPE	Section 2.15
Aquatic reserves and marine parks	Are the works adjacent to an aquatic reserve or a marine park declared under the <i>Marine Estate Management Act 2014</i> ?		Department of Industry	Section 2.15
Sydney Harbour foreshore	Are the works in the Sydney Harbour Foreshore Area as defined by the <i>Sydney Harbour Foreshore Authority Act 1998</i> ?		Sydney Harbour Foreshore Authority	Section 2.15
Bush fire prone land	Are the works for the purpose of residential development, an educational establishment, a health services facility, a correctional centre or group home in bush fire prone land?		Rural Fire Service  [Refer to the NSW Rural Fire Service publication <i>Planning for Bush Fire Protection</i> (2006)]	Section 2.15
Artificial light	Would the works increase the amount of artificial light in the night sky and that is on land within the dark sky region as identified on the dark sky region map? (Note: the dark sky region is within 200 kilometres of the Siding Spring Observatory)		Director of the Siding Spring Observatory	Section 2.15

Development type	Potential impact	Yes / No	If 'yes' consult with the relevant local council(s).	SEPP (Transport and Infrastructure) section
Defence communications buffer land	Are the works on buffer land around the defence communications facility near Morundah? (Note: refer to Defence Communications Facility Buffer Map referred to in section 5.15 of Lockhart LEP 2012, Narrandera LEP 2013 and Urana LEP 2011).		Secretary of the Commonwealth Department of Defence	Section 2.15
Mine subsidence land	Are the works on land in a mine subsidence district within the meaning of the <i>Mine Subsidence Compensation Act 1961</i> ?		Mine Subsidence Board	Section 2.15

#### A.4. SEPP (Precincts – Central River City) 2021 and SEPP Precincts – Western Parkland City) 2021

Development type	Potential impact	Yes / No	If 'yes' consult with the relevant local council(s).	SEPP (Transport and Infrastructure) section
Clearing native vegetation	Do the works involve clearing native vegetation (as defined in the Local Land Services Act 2013) on land that is not subject land (as defined in cl 17 of schedule 7 of the <i>Threatened Species Conservation Act 1995</i> )?		Department of Planning and Environment	Section 3.24

# Appendix D

## Statutory consultation checklists

Neutral or beneficial effect on water quality assessment

## Neutral or beneficial effect assessment

Chapter 8 (Sydney Water Drinking Catchment) of SEPP (Biodiversity and Conservation) relates to the use of land within the Sydney drinking water catchment. In accordance with Section 8.11 of the SEPP, Transport for NSW is required to consider whether or not an activity to which Division 5.1 of the EP&A Act applies would have a neutral or beneficial effect on water quality before carrying out the activity.

Factor	Impact
<p>1</p> <p>Are there any identifiable potential impacts on water quality?</p> <p>What pollutants are likely?</p> <p>During construction and/or post construction?</p>	<p>Potential pollutants are sediments (fine and coarse), and contaminants such as oil/fuel during construction.</p>
<p>2</p> <p>For each pollutant, list the safeguards needed to prevent or mitigate potential impacts on water quality (these may be DPE Water endorsed current recommended practices and/or equally effective other practices)</p>	<p>Relevant safeguards, or water quality protection measures, that need to be in place during the construction and operational stages of the project are set out in Table 7-1 of this REF Addendum.</p> <ul style="list-style-type: none"> <li>•</li> <li>•</li> </ul>
<p>3</p> <p>Would the safeguards be adequate for the time required? How will they need to be maintained?</p>	<p>Measures will be designed to cope with expected seasonal weather conditions, e.g., high-intensity summer storms.</p>
<p>4</p> <p>Will all impacts on water quality be effectively contained on the site by the identified safeguards (above) and not reach any watercourse, waterbody or drainage depression?</p> <p>Or will impacts on water quality be transferred outside the site for treatment? How? Why?</p>	<p>Yes, all construction impacts will be contained on site.</p>
<p>5</p> <p>Is it likely that a neutral or beneficial effect on water quality will occur? Why?</p>	<p>It is expected that the proposed works will result in a neutral impact on water quality as the nature of the works is minor and all expected impacts can be contained on site.</p>



# Appendix E

## Biodiversity assessment

Mark Anderson  
Senior Development Manager - Communities  
Level 14, Tower Three, International Towers Sydney  
Exchange Place, 300 Barangaroo Avenue, Barangaroo NSW 2000

ELA Reference Number: 22SUT – 1581

16 November 2022

Dear Mark

**RE: Biodiversity Assessment for Appin Road Upgrade Review of Environmental Factors – Addendum, Gilead NSW**

I refer to your request for ecological ‘advice’ to inform an addendum to the Appin Road REF prepared by Roads and Maritime Services in November 2018 (RMS 2018) to accommodate two Koala underpasses (a northern underpass at Glen Lorne / Noorumba Reserve and a southern underpass at Browns Bush / Beulah Biobank site) (**Figure 1**).

The REF prepared for RMS by WSP in 2018 proposed to erect Koala exclusion fencing along the eastern side of Appin Road which would prevent the east-west and west-east movement of Koalas across Appin Road and mitigate a significant risk to the local Koala population (road mortality). The assessment concluded that the impact to Koala would not be significant under Part 7.3 of the Biodiversity Conservation Act 2016 (BC Act) or the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act). However, it is understood that this conclusion has been challenged on the basis that the Koala exclusion fence, while mitigating road mortality will prevent the movement and expansion of the local Koala population into important habitat areas west of Appin Rd and thus would lead to a significant impact to the local population.

The proposed underpasses coincide with the priority east-west koala movement corridors (Menangle Creek Corridor A and Woodhouse Creek Corridor B) connecting the Georges and Nepean Rivers identified by the NSW Chief Scientist and Engineer (OCSE February 2021) and will help in addressing a known koala road mortality hotspot along Appin Rd (with combined koala exclusion fencing to funnel animals to these two safe crossing points). Further, the residential development proposed by Lendlease Communities at Mt Gilead includes a 250 ha Koala Conservation area (225 ha of which will be registered as a Biodiversity Stewardship site providing in perpetuity protection and fully funded, active conservation management) that will also be fully fenced with Koala exclusion fencing providing a fully contained Koala movement corridor connecting the Georges and Nepean River corridors (ELA 2022).

We understand that the activity will be assessed under Part 5 of the EP&A Act 1979 and that EMM Consulting will use this advice to complete an addendum REF on behalf of TfNSW for this ‘Activity’ together with the original Biodiversity Assessment prepared by WSP Consulting in October 2018 (WSP 21018). The addendum REF will be assessed/determined by Roads and Maritime as the Part 5 determining Authority.

Details of the design of the Koala underpasses and justification of their efficacy to allow Koala movement under the proposed road widening are provided in the amended REF.

Accordingly the following is an assessment of the 'likely' threatened species that may be 'directly' or 'indirectly' impacted by the proposed amended activity together with an "Assessment of Significance" under Part 7.3 of the BC Act (to determine whether a 'Species Impact Statement' (SIS) is required) and an assessment of MNES under the EPBC Act (to determine whether a referral to the Department of Climate Change, Energy, the Environment and Water (DCCEEW) is required).

### **Background and Methodology**

The location of the two proposed underpasses (Glen Lorne in the north and Browns Bush in the south), is shown in **Figure 1**.

**Figures 2 and 3** show the location of the earth works required to construct the underpasses and the expected 'limit of disturbance' overlaid on the verified vegetation mapping undertaken for the Browns Bush Biobank site application (ELA 2019).

The extent of previous targeted threatened flora and fauna survey effort in the vicinity of the underpass locations is shown in **Figures 4 and 5**.

The addendum REF prepared by EMM Consulting (EMM September 2022) provides a detailed description of the works required to establish a 2.4m wide concrete pipe tunnel at Glen Lorne (northern underpass) and two 1.2M wide pipes at Browns Bush (southern underpass). Details of the design of the Koala underpasses and justification of their efficacy to allow Koala movement under the proposed road widening are provided in the amended REF along with the timing and sequence of fencing.

The combined footprints will impact an additional 0.25 ha of land, comprising 0.22 ha of native vegetation (0.12 ha of moderate condition Cumberland Plain Woodland (CPW)(EPBC Condition Category A) and 0.09 ha of modified Shale Sandstone Transition Forest (SST) (0.05 ha of which meets EPBC Condition Category D) that was not assessed by WSP in 2018 and that is not within the Biodiversity Certified land within the Figtree Hill development area (**Figure 1**). Once the underpasses have been constructed, the disturbed area will be revegetated back to CPW and SSTF and managed as part of the proposed 28 ha Browns Bush Biodiversity Stewardship site (ELA 2022) that is adjacent to the proposed Georges River Koala National Park (Cumberland Plain Conservation Plan, DPE 2022).

ELA have undertaken extensive ecological studies of the Mt Gilead and Noorumba Reserve since 2013 (ELA 2014, 2018a, b and c, 2019, 2020 and 2022), in addition to the surveys undertaken by WSP for the Appin Road REF (WSP 2018), and have used this information and an updated review of BioNet threatened species records within 5km of the study area (**Figures 6 and 7**), to undertake this assessment of the likely impacts to biodiversity values. **Attachment 1** is a summary of all the listed threatened species known or likely to occur in the vicinity of the proposed underpasses.

### **Results of database review and site assessment undertaken as part of the assessment for the Browns Bush Biobank site (ELA 2020)**

This database review and the results of previous investigations have found the following:-

- The presence of two ecological communities (Cumberland Plain Woodland (CPW) and Shale Sandstone Transition Forest (SSTF), which are listed on both the NSW Biodiversity Conservation Act (BC Act 2016) and C'wealth Environmental Protection and Biodiversity Conservation Act 1999 (EPBC Act) as critically endangered ecological communities
  - The site comprises 0.12 ha of highly degraded, young regrowth CPW (slashed powerline corridors and previously grazed paddock) that meets the definition of CPW under the BC Act

(presence of tree canopy) and the condition thresholds for CPW Category A under the EPBC Act. There are no hollow bearing trees (HBTs) in the footprint.

- 0.09 ha of degraded/modified SSTF comprising advance regrowth (no hollows) and an access track to an existing powerline (Meets SSTF Condition Category D under the EPBC Act).
- Potential foraging habitat for Koala (the area is mapped as “Core Habitat” in Campbelltown Councils approved Comprehensive Koala Management Plan (CCC 2018), although the Koala SEPP 2020 & 2021 does not apply to Part 5 Activities),
  - The 0.16 ha area of regrowth at Glenlorne (the northern underpass) is young Forest Red Gum (*Eucalyptus tereticornis*) which is classified as a ‘koala food tree’ (KFT) species in the Campbelltown Comprehensive Koala Plan of Management (BioLink 2018).
  - The 0.05 ha at Browns Bush is predominantly Narrow and Broad-leaved Ironbark (*Eucalyptus fibrosa* and *crebra*) which are not recognised as ‘koala food tree’ (KFT) species in the Campbelltown Comprehensive Koala Plan of Management (BioLink 2018) but are classified as Koala ‘use’ trees in SEPP 2020/2021.
- Potential foraging habitat for the Squirrel Glider, threatened owl species including Powerful and Barking Owls, Glossy-Black and Gang-gang Cockatoos (Gang-gang Cockatoos were recorded breeding at St Helens Park in 2020 and 2021) and potential foraging habitat for the Swift Parrot (although the area is not mapped by DPE as “important Habitat” for the Swift Parrot. As there are no hollows present, the area is not regarded as breeding habitat for Squirrel Glider, threatened owl or Cockatoo species.
- There were no raptor nests observed in the impact areas
- Whilst there are records of the Cumberland Plain Land Snail (CPLS) in Browns Bush to the north of the northern underpass, there is little deep litter present in the impact areas and the habitat is considered marginal for CPLS.
- A number of threatened plants may also occur (*Pomaderris brunnea* (recorded along Woodhouse Creek in Mt Gilead Stage 2 between 2015-2018 and the Georges River corridor), *Pimelea spicata* (recorded on the eastern side of Appin Rd opposite Noorumba Reserve, and north of the proposed koala underpass in 2020) and *Pterostylis saxicola* (recorded on the western side of the Nepean River at Menangle in 2019).
  - No threatened plants species have been recorded in the impact areas despite several seasons of targeted survey during appropriate seasons (see ELA 2022).

The BC and EPBC Acts require consideration of whether an ‘activity’ or ‘proposed’ action respectively, is likely to ‘significantly’ affect threatened species, populations and ecological communities or their habitats (BC Act) or MNES (EPBC Act). Threatened species, populations and ecological communities that were recorded or considered likely to occur within the study area are listed in **Attachment 1**.

### Impact Assessment

An assessment of significance (five-part test) as set out in Section 7.3 of the BC Act is included for all species known, considered likely to occur in the study area (**Attachment 1**) and is provided at **Attachment 3**. The assessment has concluded that the Appin Road Upgrade project, as amended by this addendum REF (to include fauna underpasses and Koala exclusion fencing), is unlikely to result in a ‘significant effect’ on the Koala or local Koala population or any other threatened species or listed ecological community by the temporary impact to up to 0.12 ha of CPW and 0.09 ha of STF (and associated threatened fauna habitat), which will be fully revegetated

following construction within the proposed Browns Bush BSA site, and thus a species impact statement is not required. Any loss of potential foraging habitat for Koala will be offset by a significant reduction in existing road mortality that is likely to be impacting the viability of the local population.

Similarly, an assessment of whether any Matters of National Environmental Significance (MNES) under the C'wealth EPBC Act (i.e. CPW, SSTF, Koala, foraging habitat for Greater Glider, Swift Parrot and Grey-headed Flying-fox or any potential breeding sites for Gang-gang Cockatoo, Glossy Black Cockatoo and Large-eared Pied-bat) will be significantly affected is included at **Attachment 4**. The assessment has concluded that the Appin Road Upgrade project, as amended by this addendum REF (to include fauna underpasses and Koala exclusion fencing), is unlikely to result in a 'significant effect' on the Koala or local Koala population or any other EPBC Act threatened species or listed ecological community by the temporary impact to up to 0.12 ha of CPW and 0.05 ha of STF (and associated threatened fauna habitat), which will be fully revegetated following construction within the proposed Browns Bush BSA site, and thus a referral is not required. Any loss of potential foraging habitat for Koala will be offset by a significant reduction in existing road mortality that is likely to be impacting the viability of the local population and improved east-west connectivity between the Georges and Nepean River corridors.

## **Conclusion**

The 2018 REF for the Appin Road Upgrade assessed the likely significance of impact of the project on threatened species and ecological communities under both NSW and Commonwealth legislation and found no significant impacts were likely. This addendum REF by providing koala connectivity under Appin Rd, provides an important update to the original Appin Road REF. The 2018 REF, while addressing koala vehicle strike through a fencing strategy, did not support the ongoing management of the koala habitat corridors through Beulah and Noorumba Reserves by providing koala underpasses under Appin Road. The importance of these corridors for the ongoing viability of the local koala population has since been confirmed by the Office of the NSW Chief Scientist and the DPE have announced their intention to protect them through future precinct planning processes. By addressing connectivity, the conclusion is that neither the impacts anticipated by the original REF (as now amended) or the minor additional impacts arising from this addendum REF are likely to have a significant impact on the koala or any other NSW or Commonwealth listed species including the koala.

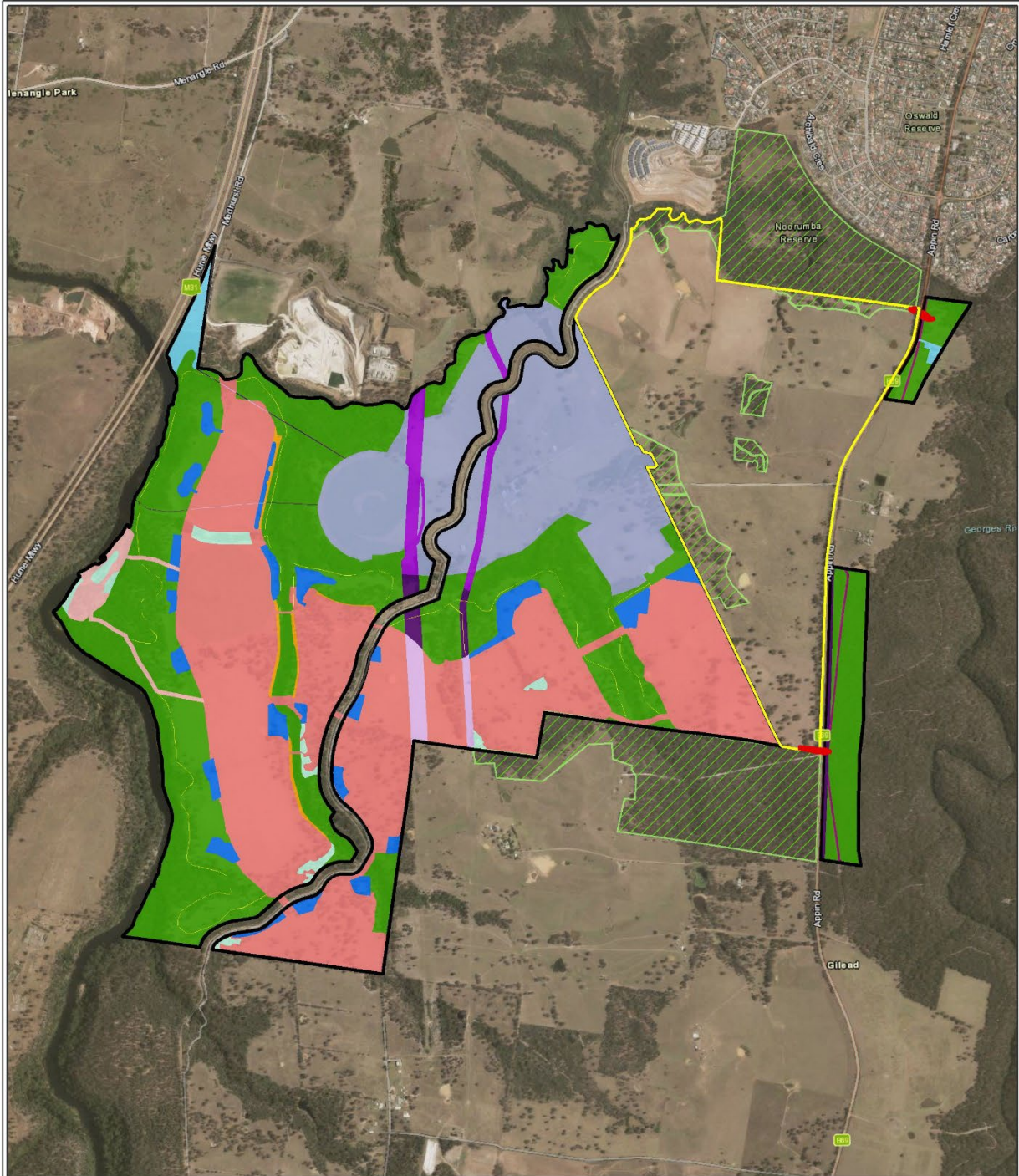
Should you have any questions on this matter, please contact me on 0417 258 264

Yours sincerely

*Robert Humphries*

**Robert Humphries**, Principal Consultant





**Browns Bush Fauna Underpasses**

- Biodiversity Certification Assessment Area Stage 2
- Mt Gilead Stage 1
- Indicative extent of fauna underpass disturbance area
- Existing Conservation Areas

- Land to be Certified**
- Development - Urban
  - Development - River Park
  - Development - APZ
  - Development - Easement
  - Bio-Retention Basin
  - Walking Tracks

- Land to be Conserved**
- Conservation
- Land to be Retained**
- Retained - Homestead
  - Retained - Open Space
  - Retained - Heritage Curtilage
  - Powerline Maintenance Corridor
  - Existing easement - Homestead
  - Existing easement



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**Figure 1: Location of proposed koala underpasses in relation to the certified Figtree Hill Biocertification Assessment Area**



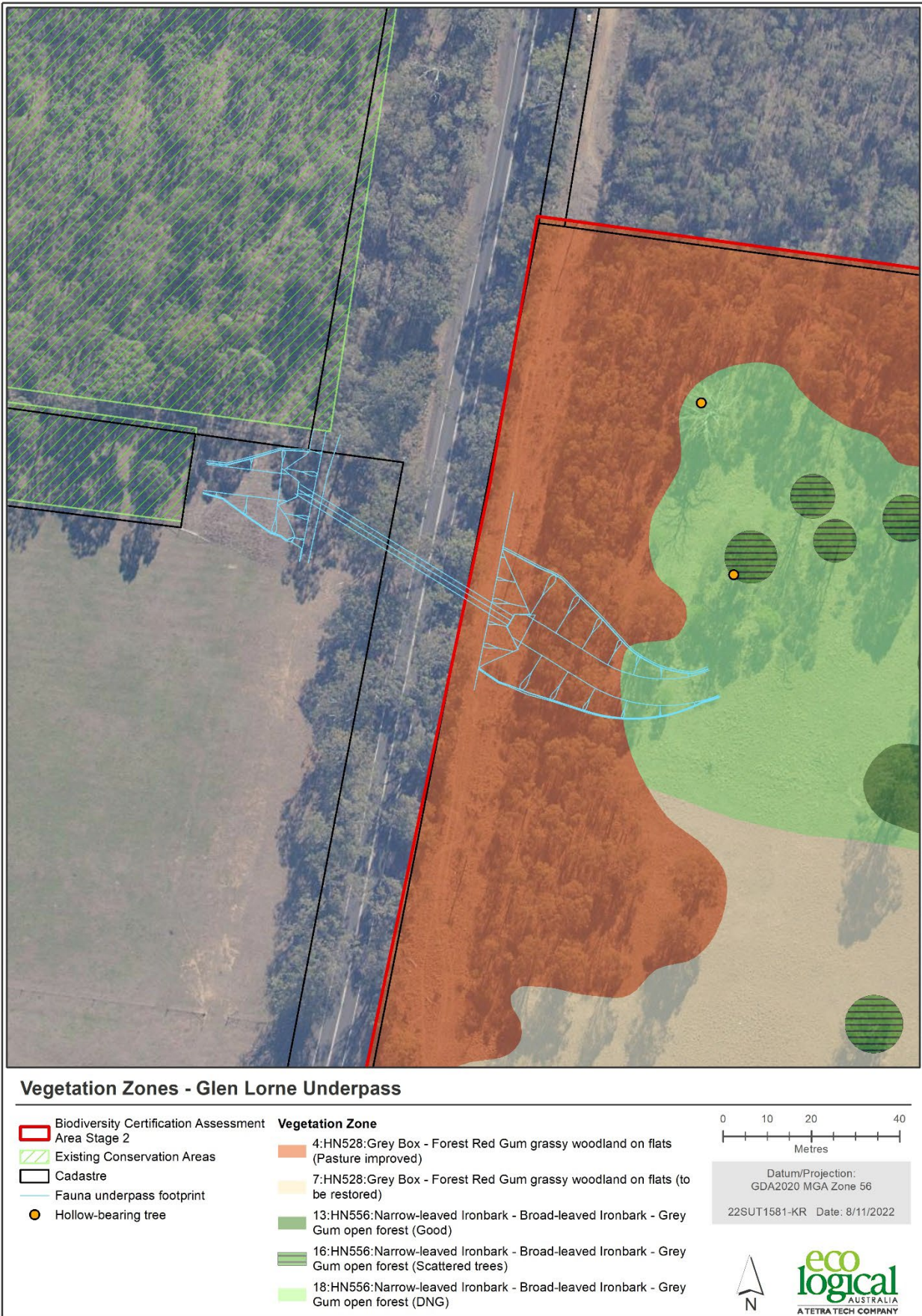


Figure 2: Location and vegetation impacts of the northern underpass at Glen Lorne



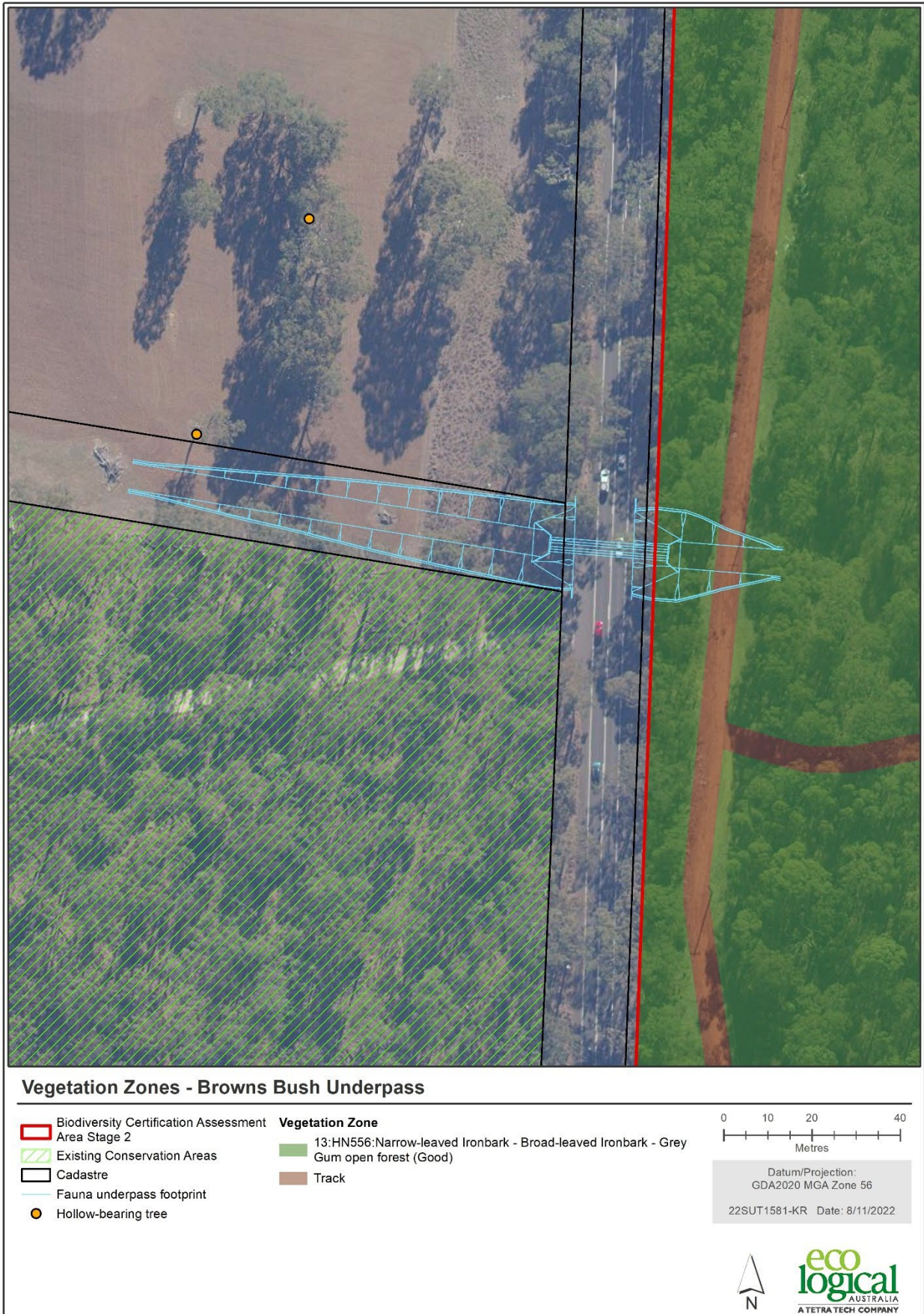
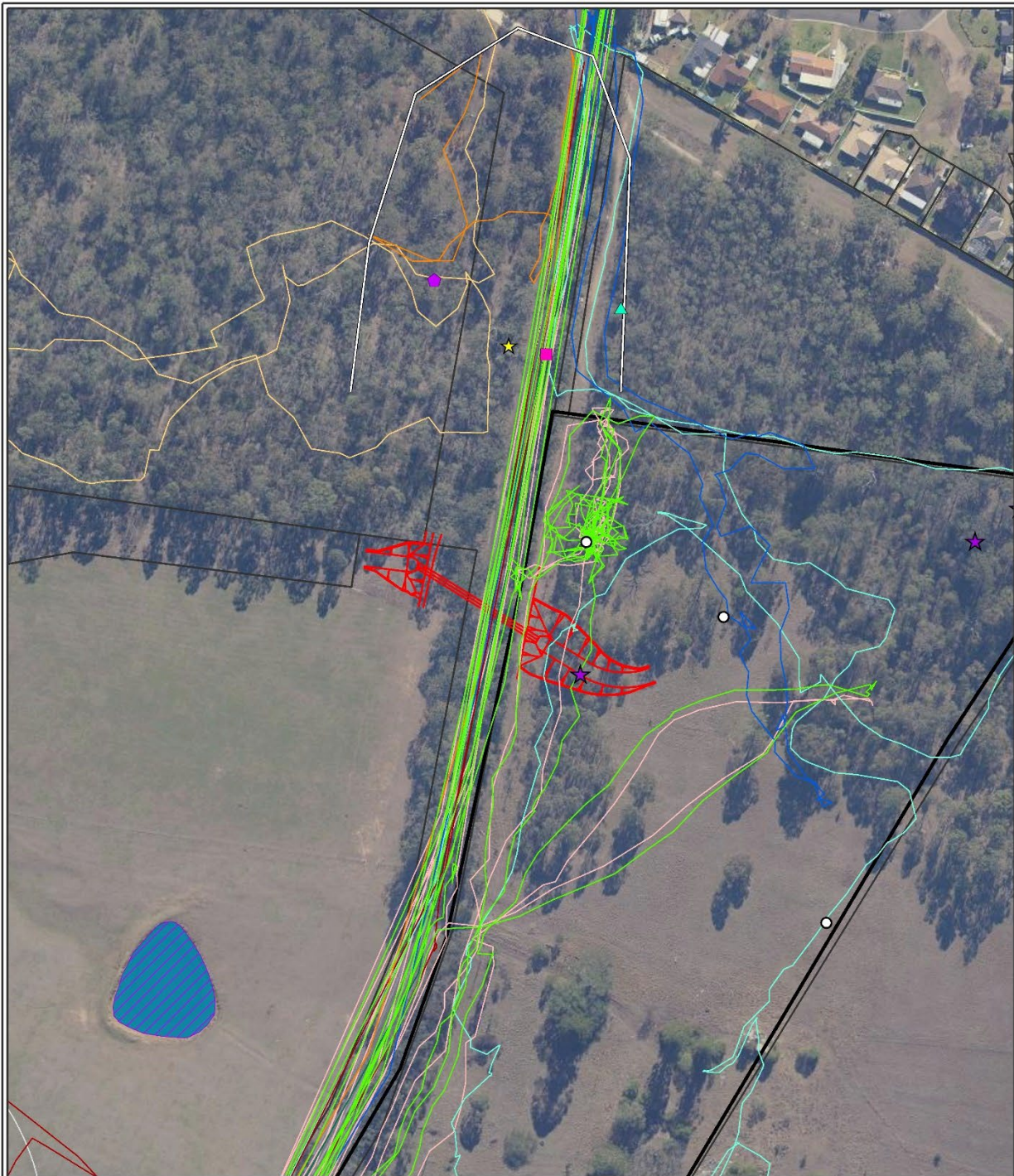


Figure 3: Location and vegetation impacts of the southern underpass at Browns Bush



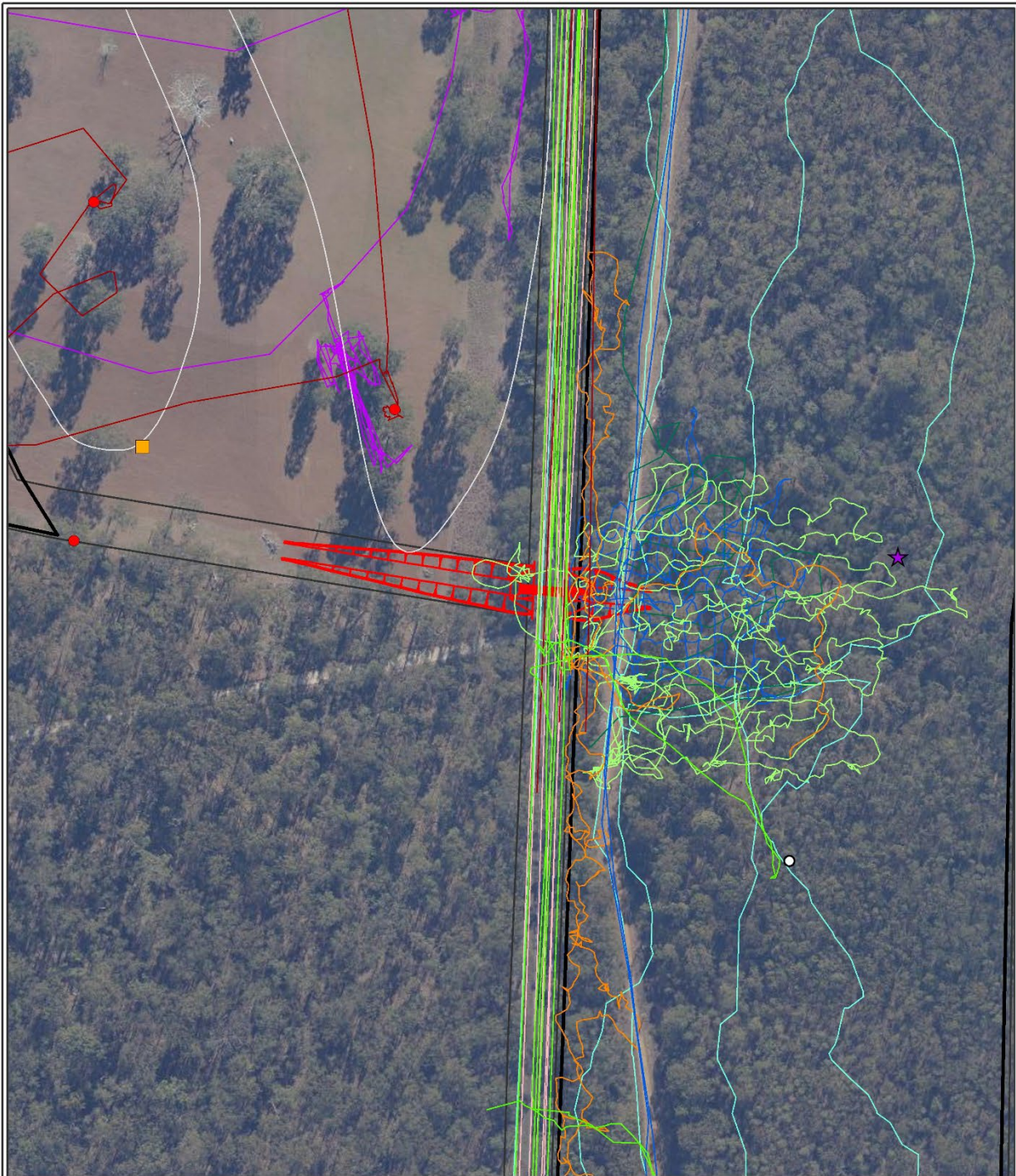


**Previous Survey Effort - Glen Lorne Underpass**

<ul style="list-style-type: none"> <li><span style="border: 1px solid black; display: inline-block; width: 15px; height: 10px; margin-right: 5px;"></span> Biodiversity Certification Assessment Area Stage 2</li> <li><span style="border-bottom: 1px solid red; width: 20px; margin-right: 5px;"></span> Fauna underpass footprint</li> <li><span style="border: 1px solid black; display: inline-block; width: 15px; height: 10px; margin-right: 5px;"></span> Cadastre</li> <li><b>Previous ELA Flora Survey Effort</b></li> <li><span style="border-bottom: 1px solid lightblue; width: 20px; margin-right: 5px;"></span> March - June 2013</li> <li><span style="border-bottom: 1px solid lightgreen; width: 20px; margin-right: 5px;"></span> January 2015</li> <li><span style="border-bottom: 1px solid lightgreen; width: 20px; margin-right: 5px;"></span> October 2015</li> <li><span style="border-bottom: 1px solid yellow; width: 20px; margin-right: 5px;"></span> January 2016</li> <li><span style="border-bottom: 1px solid pink; width: 20px; margin-right: 5px;"></span> January 2017</li> <li><span style="border: 1px solid black; border-radius: 50%; width: 10px; height: 10px; display: inline-block; margin-right: 5px;"></span> BCAM Plots (2017)</li> </ul>	<ul style="list-style-type: none"> <li><b>Previous ELA Fauna Survey Effort</b></li> <li><span style="background-color: #00a651; width: 15px; height: 10px; margin-right: 5px;"></span> Green and Golden Bell Frog Potential Foraging Habitat</li> <li><span style="background-color: #00a651; width: 15px; height: 10px; margin-right: 5px;"></span> Day and Night-time Assessment</li> <li><span style="border: 1px dashed purple; width: 15px; height: 10px; margin-right: 5px;"></span> Potential Myotis Foraging Habitat</li> <li><span style="border-bottom: 1px solid red; width: 20px; margin-right: 5px;"></span> Tracks (30 November 2016)</li> <li><span style="border-bottom: 1px solid blue; width: 20px; margin-right: 5px;"></span> Tracks (June 2020)</li> <li><span style="border-bottom: 1px solid green; width: 20px; margin-right: 5px;"></span> Cumberland Plain Land Snail search transects (January 2017)</li> <li><span style="border-bottom: 1px solid orange; width: 20px; margin-right: 5px;"></span> Spotlighting tracks (December 2016)</li> <li><span style="color: purple;">★</span> Camera Locations</li> </ul>	<ul style="list-style-type: none"> <li><b>Fauna Survey (WSP 2018)</b></li> <li><span style="color: purple;">◆</span> Bird survey</li> <li><span style="color: green;">▲</span> Call playback</li> <li><span style="color: magenta;">■</span> SPOT assessment</li> <li><span style="color: yellow;">★</span> Snail search</li> <li><span style="border-bottom: 1px solid black; width: 20px; margin-right: 5px;"></span> Spotlighting transect</li> </ul>	<div style="text-align: center;"> <p>0 20 40 80</p> <p>Metres</p> </div> <div style="border: 1px solid gray; padding: 5px; margin-top: 5px;"> <p>Datum/Projection: GDA2020 MGA Zone 56</p> <p>22SUT1581-KR Date: 8/11/2022</p> </div> <div style="text-align: right; margin-top: 10px;"> </div>
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**Figure 4: Threatened flora and fauna survey effort – Northern Underpass(ELA 2014, 2018, 2020, 2022, WSP 2018)**





**Previous Survey Effort - Browns Bush Underpass**

Biodiversity Certification Assessment Area Stage 2

Fauna underpass footprint

Cadastre

**Previous ELA Flora Survey Effort**

March - June 2013

January 2015

August 2016

13 April 2017

28 September 2018

27 November 2019

12 December 2019

January 2017

BCAM Plots (2017)

**Previous ELA Fauna Survey Effort**

Hollow-bearing Tree Internal Assessment

Bird Survey

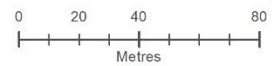
Camera Locations

Tracks (30 November 2016)

Tracks (June 2020)

Cumberland Plain Land Snail search transects (January 2017)

Spotlighting tracks (December 2016)

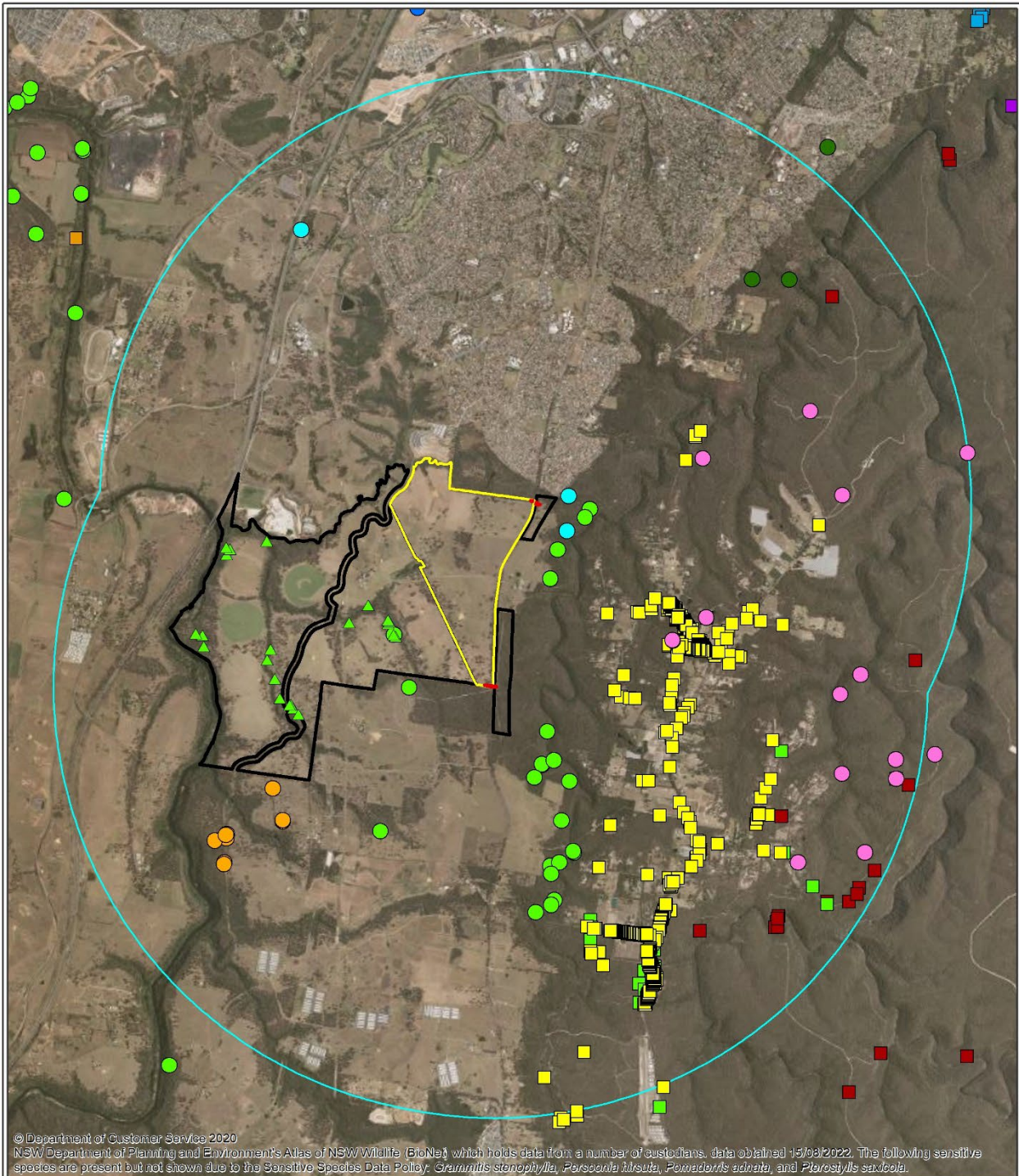


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**Figure 5: Threatened flora and fauna survey effort – Southern Underpass (ELA 2014, 2018, 2020, 2022, WSP 2018)**





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 NSW Department of Planning and Environment's Atlas of NSW Wildlife (BioNet) which holds data from a number of custodians. data obtained 15/09/2022. The following sensitive species are present but not shown due to the Sensitive Species Data Policy: *Grammitis stenophylla*, *Perseaula hirsuta*, *Pomaderris adnata*, and *Pterostylis saxicola*.

**Threatened Flora Records**

- |   |  |
|---|--|
| Biodiversity Certification Assessment Area Stage 2    | <i>Grevillea parviflora</i> subsp. <i>parviflora</i>   |
| Mt Gilead Stage 1                                     | <i>Hibbertia puberula</i>                              |
| Indicative extent of fauna underpass disturbance area | <i>Leucopogon exolasius</i>                            |
| 5km buffer  | <i>Marsdenia viridiflora</i> subsp. <i>viridiflora</i> |
| <b>ELA (2015/2017)</b>                                | <i>Melaleuca deanei</i>                                |
| <i>Pomaderris brunnea</i>                             | <i>Pimelea spicata</i>                                 |
| <b>BioNet Atlas (DPE 2022)</b>                        | <i>Pomaderris brunnea</i>                              |
| <i>Acacia bynoeana</i>                                | <i>Pultenaea pedunculata</i>                           |
| <i>Acacia pubescens</i>                               | <i>Syzygium paniculatum</i>                            |
| <i>Eucalyptus benthamii</i>                           |  |



Datum/Projection:  
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Figure 6: Threatened flora species recorded within 5 km of study area (Source BioNet 2022)



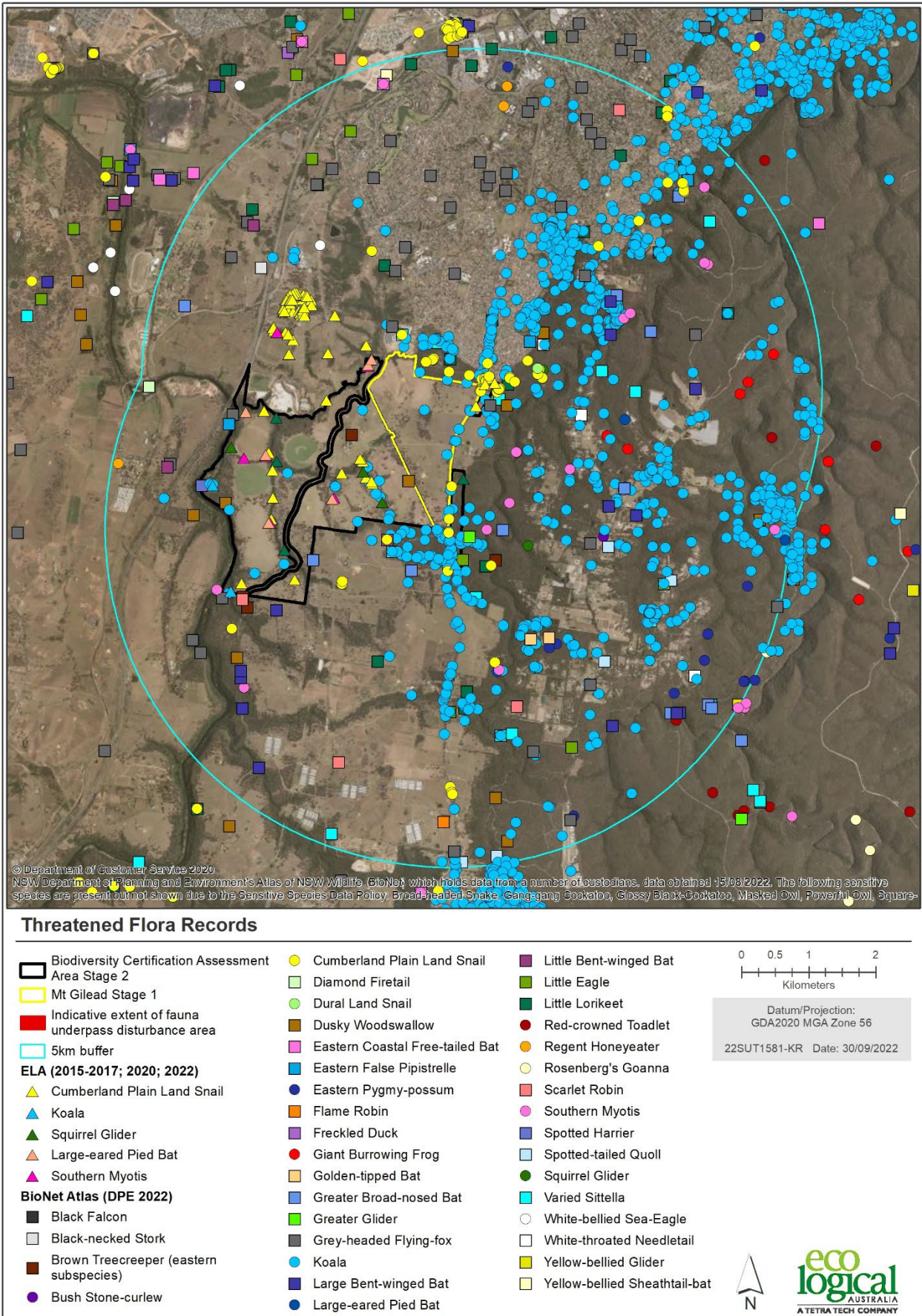


Figure 7: Threatened fauna species recorded within 5 km of study area (Source BioNet 2022)



# Attachment 1 – Likelihood Table

The table below lists the threatened species known or considered likely to occur within or adjacent to the study area based on NSW BioNet and EPBC Act Protected Matters Search (PMST), BAM-C Tool on 15 October 2022 and the results of previous surveys undertaken in the general area by ELA (2014, 2018a, b and c, 2019, 2020 & 2022) and by WSP for the Appin Road Upgrade REF (WSP 2018).

## Threatened flora

Scientific name	Common name	TSC Act	EPBC Act	Source of Record	Habitat association	Likelihood	Survey Result and need for '5 part test'
<i>Acacia bynoeana</i>	Bynoe's Wattle	E	V	NSW Wildlife Atlas & PMST Search	<i>Acacia bynoeana</i> is found in central eastern NSW, from the Hunter District (Morisset) south to the Southern Highlands and west to the Blue Mountains, and has recently been found in the Colymea and Parma Creek areas west of Nowra. It is found in heath and dry sclerophyll forest, typically on a sand or sandy clay substrate, often with ironstone gravels (OEH 2015d).	Potential, recorded approximately 3km south east of study area.  Survey required	Not recorded and unlikely to occur given extent of surveys.
<i>Acacia pubescens</i>	Downy Wattle	V	V	NSW Wildlife Atlas & PMST Search	<i>Acacia pubescens</i> occurs on the NSW Central Coast in Western Sydney, mainly in the Bankstown-Fairfield-Rookwood area and the Pitt Town area, with outliers occurring at Barden Ridge, Oakdale and Mountain Lagoon. It is associated with Cumberland Plains Woodlands, Shale / Gravel Forest and Shale / Sandstone Transition Forest growing on clay soils, often with ironstone gravel (OEH 2015d).	Potential as suitable habitat present, no nearby records	Not recorded and unlikely to occur given extent of surveys.
<i>Allocasuarina glareicola</i>		-	E	PMST Search	<i>Allocasuarina glareicola</i> is primarily restricted to the Richmond district on the north-west Cumberland Plain, with an outlier population found at Voyager Point. It grows in Castlereagh woodland on lateritic soil (OEH 2015d).	Unlikely	No. Marginal habitat present and outside of known range.

Scientific name	Common name	TSC Act	EPBC Act	Source of Record	Habitat association	Likelihood	Survey Result and need for '5 part test'
<i>Asterolasia elegans</i>		E	E	PMST Search	<i>Asterolasia elegans</i> is restricted to a few localities on the NSW Central Coast north of Sydney, in the Baulkham Hills, Hawkesbury and Hornsby LGAs. It is found in sheltered forests on mid- to lower slopes and valleys, in or adjacent to gullies (OEH 2015d).	Unlikely	No. No suitable habitat present and outside of known range.
<i>Caladenia tessellata</i>	Thick Lip Spider Orchid	E	V	PMST Search	<i>Caladenia tessellata</i> occurs in grassy sclerophyll woodland, often growing in well-structured clay loams or sandy soils south from Swansea, usually in sheltered moist places and in areas of increased sunlight. It flowers from September to November (OEH 2015d).	Unlikely	No. No suitable habitat present and outside of known range.
<i>Cryptostylis hunteriana</i>	Leafless Tongue Orchid	V	V	PMST Search	<i>Cryptostylis hunteriana</i> is known from a range of vegetation communities including swamp-heath and woodland. The larger populations typically occur in woodland dominated by Scribbly Gum ( <i>Eucalyptus sclerophylla</i> ), Silvertop Ash ( <i>E. sieberi</i> ), Red Bloodwood ( <i>Corymbia gummifera</i> ) and Black Sheoak ( <i>Allocasuarina littoralis</i> ); where it appears to prefer open areas in the understorey of this community and is often found in association with the Large Tongue Orchid ( <i>C. subulata</i> ) and the Tartan Tongue Orchid ( <i>C. erecta</i> ). Flowers between November and February, although may not flower regularly (OEH 2015d).	Unlikely	No. No suitable habitat present and outside of known range.
<i>Cynanchum elegans</i>	White-flowered Wax Plant	E	E	PMST Search	<i>Cynanchum elegans</i> is a climber or twiner with a variable form, and flowers between August and May, peaking in November. It occurs in dry rainforest gullies, scrub and scree slopes, and prefers the ecotone between dry subtropical rainforest and sclerophyll woodland/forest. The species has also been found in littoral rainforest; <i>Leptospermum laevigatum</i> – <i>Banksia integrifolia</i> subsp. <i>integrifolia</i> coastal scrub; <i>Eucalyptus</i>	Potential, survey required	Not recorded

Scientific name	Common name	TSC Act	EPBC Act	Source of Record	Habitat association	Likelihood	Survey Result and need for '5 part test'
					<i>tereticornis</i> open forest/ woodland; <i>Corymbia maculata</i> open forest/woodland; and <i>Melaleuca armillaris</i> scrub to open scrub (OEH 2015d).		
<i>Dillwynia tenuifolia</i>		V		Biobanking Tool	The core distribution is the Cumberland Plain from Windsor and Penrith east to Dean Park near Colebee. Other populations in western Sydney are recorded from Voyager Point and Kemps Creek in the Liverpool LGA, Luddenham in the Penrith LGA and South Maroota in the Baulkham Hills Shire. In western Sydney, may be locally abundant particularly within scrubby/dry heath areas within Castlereagh Ironbark Forest and Shale Gravel Transition Forest on tertiary alluvium or laterised clays (OEH 2015d).	Potential, survey required	Not recorded.
<i>Epacris purpurascens</i> var. <i>purpurascens</i>		V		Biobanking Tool	Found in a range of habitat types, most of which have a strong shale soil influence (OEH 2015d).	Potential, survey required	Not recorded.
<i>Genoplesium baueri</i>	Bauer's Midge Orchid	E	E	PMST Search	Recorded from locations between Nowra and Pittwater. Dry sclerophyll forest and moss gardens over sandstone.	Unlikely	No. No suitable habitat present.
<i>Grevillea juniperina</i> subsp. <i>juniperina</i>	Juniper-leaf Grevillea	V		Biobanking Tool	Endemic to Western Sydney. Grows on reddish clay to sandy soils derived from Wianamatta Shale and Tertiary alluvium (often with shale influence), typically containing lateritic gravels. Recorded from Cumberland Plain Woodland, Castlereagh Ironbark Woodland, Castlereagh Scribbly Gum Woodland and Shale/Gravel Transition Forest (OEH 2015d).	Potential, survey required	Not recorded

Scientific name	Common name	TSC Act	EPBC Act	Source of Record	Habitat association	Likelihood	Survey Result and need for '5 part test'
<i>Grevillea parviflora</i> subsp. <i>parviflora</i>	Small-flower Grevillea	V	V	NSW Wildlife Atlas & PMST Search	<i>Grevillea parviflora</i> subsp. <i>parviflora</i> is sporadically distributed throughout the Sydney Basin mainly around Picton, Appin and Bargo. Separate populations are also known further north from Putty to Wyong and Lake Macquarie and Cessnock and Kurri Kurri. It grows in sandy or light clay soils over thin shales, often with lateritic ironstone gravels. It often occurs in open, slightly disturbed sites such as tracks (OEH 2015d).	Potential, recorded 2km east of subject site, survey required	Not recorded
<i>Haloragis exalata</i> subsp. <i>exalata</i>	Wingless Raspwort	V	V	PMST Search	Square Raspwort occurs in 4 widely scattered localities in eastern NSW. It is disjunctly distributed in the Central Coast, South Coast and North Western Slopes botanical subdivisions of NSW. It appears to require protected and shaded damp situations in riparian habitats (OEH 2015d).	Unlikely	No. No suitable habitat present.
<i>Leucopogon exolasius</i>	Woronora Beard-heath	V	V	NSW Wildlife Atlas & PMST Search	<i>Leucopogon exolasius</i> is found along the upper Georges River area and in Heathcote National Park. It is associated with Sydney Sandstone Gully Forest on rocky hillsides and creek banks (OEH 2015d).	Unlikely	No. No suitable habitat present.
<i>Melaleuca deanei</i>	Deane's Paperbark	V	V	NSW Wildlife Atlas & PMST Search	Found in heath on sandstone, and also associated with woodland on broad ridge tops and slopes on sandy loam and lateritic soils (OEH 2015d).	Unlikely	No. No suitable habitat present. Not recorded by previous ELA survey within locality.

Scientific name	Common name	TSC Act	EPBC Act	Source of Record	Habitat association	Likelihood	Survey Result and need for '5 part test'
<i>Pelargonium sp. striatellum</i>	Omeo's Stork's Bill	E	E	PMST Search	The species is known to occur in habitat usually located just above the high water level of irregularly inundated or ephemeral lakes. During dry periods, the species is known to colonise exposed lake beds. It is not known if the species' rhizomes and/or soil seedbank persist through prolonged inundation or drought (OEH 2015d).	Unlikely	No. No suitable habitat present.
<i>Persoonia bargoensis</i>	Bargo Geebung	E	V	PMST Search	Associated with woodland to dry sclerophyll forest, on sandstone and clayey laterite on heavier, well-drained, loamy, gravelly soils of the Hawkesbury Sandstone and Wianamatta Shale in the catchments of the Cataract, Cordeaux and Bargo Rivers (OEH 2015d).	Unlikely	No. Marginal habitat present. Not recorded by previous ELA survey within locality.
<i>Persoonia hirsuta</i>	Hairy Geebung	E	E	NSW Wildlife Atlas & PMST Search	<i>Persoonia hirsuta</i> occurs from Singleton in the north, south to Bargo and the Blue Mountains to the west. It grows in dry sclerophyll eucalypt woodland and forest on sandstone (OEH 2015d).	Potential, recorded 2-3 km southeast of study area, survey required	Not recorded
<i>Persoonia nutans</i>	Nodding Geebung	E	E	PMST Search	Associated with dry woodland, Castlereagh Scribbly Gum Woodland, Agnes Banks Woodland and sandy soils associated with tertiary alluvium, occasionally poorly drained. Endemic to the Western Sydney (OEH 2015d).	Unlikely	No. No suitable habitat present. Not recorded by previous ELA survey within locality.



Scientific name	Common name	TSC Act	EPBC Act	Source of Record	Habitat association	Likelihood	Survey Result and need for '5 part test'
<i>Pimelea curviflora</i> var. <i>curviflora</i>		V	V	PMST Search	<i>Pimelea curviflora</i> var. <i>curviflora</i> is confined to the coastal area of Sydney between northern Sydney in the south and Maroota in the north-west. It grows on shaley/lateritic soils over sandstone and shale/sandstone transition soils on ridgetops and upper slopes amongst woodlands (OEH 2015d).	Unlikely	No. Marginal habitat present. Not recorded by previous ELA survey within locality.
<i>Pimelea spicata</i>	Spiked Rice-flower	E	E	PMST Search	In western Sydney, <i>Pimelea spicata</i> occurs on an undulating topography of well structured clay soils, derived from Wianamatta shale. It is associated with Cumberland Plains Woodland (CPW), in open woodland and grassland often in moist depressions or near creek lines. Has been located in disturbed areas that would have previously supported CPW (OEH 2015d).	Potential recorded east of Appin Rd (north of Glen Lorne), 2019. Survey required.	Not recorded and unlikely to occur given condition of study area and extent of surveys
<i>Pomaderris brunnea</i>	Rufous Pomaderris	V	V	NSW Wildlife Atlas & PMST Search	<i>Pomaderris brunnea</i> occurs in a limited area around the Colo, Nepean and Hawkesbury Rivers, including the Bargo area and near Camden. It also occurs near Walcha on the New England tablelands and in far eastern Gippsland in Victoria It grows in moist woodland or forest on clay or alluvial soils of floodplains and creek lines (OEH 2015d).	Potential, recorded nearby on Mt Gilead and east of Browns Bush, survey required	Not recorded in study area but recorded near by.
<i>Pterostylis saxicola</i>	Sydney Plains Greenhood	E	E	PMST Search	Most commonly found growing in small pockets of shallow soil in depressions on sandstone rock shelves above cliff lines. The vegetation communities above the shelves where <i>Pterostylis saxicola</i> occurs are sclerophyll forest or woodland on shale/sandstone transition soils or shale soils. Restricted to	Unlikely as micro habitat (rock shelves) not present. Recorded	Not recorded

Scientific name	Common name	TSC Act	EPBC Act	Source of Record	Habitat association	Likelihood	Survey Result and need for '5 part test'
					western Sydney between Freemans Reach in the north and Picton in the south. There are very few known populations and they are all very small and isolated (OEH 2015d).	north of study area at Kentlyn and Macquarie fields and west of Gilead at Menangle 2020 survey required	
<i>Pultenaea aristata</i>	Prickly Bush-pea	V	V	PMST Search	Dry sclerophyll woodland or wet heath on sandstone. Restricted to the Woronora Plateau.	Unlikely	No. Marginal habitat present and outside of known range.
<i>Pultenaea pedunculata</i>	Matted Bush-pea	E	-	NSW Wildlife Atlas & PMST Search	In NSW, <i>Pultenaea pedunculata</i> is known from three disjunct populations, in the Cumberland Plains in Sydney, the coast between Tathra and Bermagui and the Windellama area south of Goulburn. It grows in woodland vegetation but plants have also been found on road batters and coastal cliffs. It is largely confined to loamy soils in dry gullies in populations in the Windellama area (OEH 2015d).	Likely, recorded south of Mt Gilead, survey required	Not recorded
<i>Thesium australe</i>	Austral Toadflax	V	V	PMST Search	Occurs in grassland on coastal headlands or grassland and grassy woodland away from the coast (OEH 2015d).	Unlikely	No. No suitable habitat present and outside known range.

## Threatened fauna

Scientific name	Common name	TSC Act	EPBC Act	Source of Record	Habitat association	Likelihood	Survey result and need for '5 part test'
<i>Meridolum corneovirens</i>	Cumberland Plain Land Snail	E	-	NSW Wildlife Atlas, previous surveys	Associated with open eucalypt forests, particularly Cumberland Plain Woodland. Found under fallen logs, debris and in bark and leaf litter around the trunk of gum trees or burrowing in loose soil around clumps of grass. Urban waste may also form suitable habitat (OEH 2015d).	Potential. Known from records in adjacent Noorumba Reserve.	Not recorded in Impact area. Pre-cautionary 5 - part test undertaken re potential habitat <b>(Attachment 3)</b>
<i>Heleioporus australiacus</i>	Giant Burrowing Frog	V	V	NSW Wildlife Atlas & PMST Search	Forages in woodlands, wet heath, dry and wet sclerophyll forest. Associated with semi-permanent to ephemeral sand or rock based streams, where the soil is soft and sandy so that burrows can be constructed (OEH 2015d).	Unlikely	No. No suitable habitat present.
<i>Litoria aurea</i>	Green and Golden Bell Frog	E	V	NSW Wildlife Atlas & PMST Search	This species has been observed utilising a variety of natural and man-made waterbodies such as coastal swamps, marshes, dune swales, lagoons, lakes, other estuary wetlands, riverine floodplain wetlands and billabongs, stormwater detention basins, farm dams, bunded areas,	Unlikely	No. No suitable habitat present.

Scientific name	Common name	TSC Act	EPBC Act	Source of Record	Habitat association	Likelihood	Survey result and need for '5 part test'
					<p>drains, ditches and any other structure capable of storing water. Preferable habitat for this species includes attributes such as shallow, still or slow flowing, permanent and/or widely fluctuating water bodies that are unpolluted and without heavy shading. Large permanent swamps and ponds exhibiting well-established fringing vegetation (especially bulrushes–<i>Typha</i> sp. and spikerushes–<i>Eleocharis</i> sp.) adjacent to open grassland areas for foraging are preferable. Ponds that are typically inhabited tend to be free from predatory fish such as Mosquito Fish (<i>Gambusia holbrooki</i>) (OEH 2015d).</p> <p>Recorded at Birwiri Creek, 7km to north of BCAA, in 2015</p>		
<i>Litoria littlejohnii</i>	Littlejohn's Tree Frog	V	V	PMST Search	Littlejohn's Tree Frog occurs along permanent rocky streams with thick fringing vegetation associated with eucalypt woodlands and heaths among sandstone outcrops. It appears to be restricted to sandstone	Unlikely	No. No suitable habitat present.

Scientific name	Common name	TSC Act	EPBC Act	Source of Record	Habitat association	Likelihood	Survey result and need for '5 part test'
					woodland and heath communities at mid to high altitude (OEH 2015d).		
<i>Litoria raniformis</i>	Southern Bell Frog	E	V	PMST Search	Relatively still or slow-flowing sites such as billabongs, ponds, lakes or farm dams, especially where Typha sp., Eleocharis sp. and Phragmites sp. (Bulrushes) are present. This species is common in lignum shrublands, black box and River Red Gum woodlands, irrigation channels and at the periphery of rivers in the southern parts of NSW. This species occurs in vegetation types such as open grassland, open forest and ephemeral and permanent non-saline marshes and swamps. Open grassland and ephemeral permanent non-saline marshes and swamps have also been associated with this species (OEH 2015d).	Unlikely	No. No suitable habitat present.
<i>Mixophyes balbus</i>	Stuttering Frog	E	V	PMST Search	Rainforest and wet, tall open forest in the foothills and escarpment on the eastern side of the Great Dividing Range. Outside the breeding season adults live in deep leaf litter and thick understorey vegetation on the forest	Unlikely	No. No suitable habitat present.



Scientific name	Common name	TSC Act	EPBC Act	Source of Record	Habitat association	Likelihood	Survey result and need for '5 part test'
					floor. Breed in streams during summer after heavy rain.		
<i>Pseudophryne australis</i>	Red-crowned Toadlet	V		NSW Wildlife Atlas	Occurs in open forests, mostly on Hawkesbury and Narrabeen Sandstones. Inhabits periodically wet drainage lines below sandstone ridges that often have shale lenses or cappings (OEH 2015d).	Unlikely	No. No suitable habitat present.
<i>Hoplocephalus bungaroides</i>	Broad-headed Snake	E	V	NSW Wildlife Atlas & PMST Search	Typical sites consist of exposed sandstone outcrops and benching where the vegetation is predominantly woodland, open woodland and/or heath on Triassic sandstone of the Sydney Basin. They utilise rock crevices and exfoliating sheets of weathered sandstone during the cooler months and tree hollows during summer (OEH 2015d).	Unlikely	No. No suitable habitat present.
<i>Varanus rosenbergi</i>	Rosenberg's Goanna	V	-	NSW Wildlife Atlas	Associated with Sydney sandstone woodland and heath land. Rocks, hollow logs and burrows are utilised for shelter (OEH 2015d).	Potential	Not observed or recorded by previous ELA survey within study area.

Scientific name	Common name	TSC Act	EPBC Act	Source of Record	Habitat association	Likelihood	Survey result and need for '5 part test'
<i>Anthochaera phrygia</i>	Regent Honeyeater	E	CE & M	NSW Wildlife Atlas & PMST Search	Associated with temperate eucalypt woodland and open forest including forest edges, wooded farmland and urban areas with mature eucalypts, and riparian forests of River Oak ( <i>Casuarina cunninghamiana</i> ). Areas containing Swamp Mahogany ( <i>Eucalyptus robusta</i> ) in coastal areas have been observed to be utilised. The Regent Honeyeater primarily feeds on nectar from box and ironbark eucalypts and occasionally from banksias and mistletoes. As such it is reliant on locally abundant nectar sources with different flowering times to provide reliable supply of nectar (OEH 2015d).	Potential foraging habitat	Marginal habitat present. Not recorded by previous ELA survey within locality. Likely occasional visitor Pre-cautionary 5-part test undertaken ( <b>Attachment 3</b> )
<i>Artamus cyanopterus</i>	Dusky Woodswallow	V	-	NSW Wildlife Atlas, previous survey	Prefers dry, open eucalypt forests and woodlands with an open to spare understory. Widespread in eastern, southern and western Australia. Species occurs throughout most of NSW with breeding activity mainly on the western slopes of the Great Dividing Range.	Likely, previously recorded in locality (Biolink 2018)	Previously recorded in locality. 5-part test undertaken ( <b>Attachment 3</b> ).
<i>Botaurus poiciloptilus</i>	Australasian Bittern	V	-	PMST Search	Terrestrial wetlands with tall dense vegetation, occasionally estuarine	Unlikely	No. No suitable

Scientific name	Common name	TSC Act	EPBC Act	Source of Record	Habitat association	Likelihood	Survey result and need for '5 part test'
					habitats. Reedbeds, swamps, streams, estuaries (OEH 2015d).		habitat present. Not recorded by previous ELA survey within study area.
<i>Burhinus grallarius</i>	Bush Stone-curlew	E	-	NSW Wildlife Atlas	Associated with dry open woodland with grassy areas, dune scrubs, in savanna areas, the fringes of mangroves, golf courses and open forest / farmland. Forages in areas with fallen timber, leaf litter, little undergrowth and where the grass is short and patchy. Is thought to require large tracts of habitat to support breeding, in which there is a preference for relatively undisturbed in lightly disturbed (OEH 2015d).	Unlikely	No. No suitable habitat present. Not recorded by previous ELA survey within study area.
<i>Calidris ferruginea</i>	Curlew Sandpiper	E	CE, M	PMST Search	Littoral and estuarine habitats, including intertidal mudflats, non-tidal swamps, lakes and lagoons on the coast and sometimes inland.	Unlikely	No. No suitable habitat present. Not recorded by previous ELA survey within study area.

Scientific name	Common name	TSC Act	EPBC Act	Source of Record	Habitat association	Likelihood	Survey result and need for '5 part test'
<i>Callocephalon fimbriatum</i>	Gang-gang Cockatoo	V	E	NSW Wildlife Atlas	During summer in dense, tall, wet forests of mountains and gullies, alpine woodlands. In winter they occur at lower altitudes in drier more open forests and woodlands, particularly box-ironbark assemblages. They sometimes inhabit woodland, farms and suburbs in autumn/winter (OEH 2015d).	Potential foraging habitat only. Recorded breeding at St Helens Park 2020 and 2021	Previously recorded in locality. 5-part test undertaken ( <b>Attachment 3</b> ). EPBC Assessment undertaken ( <b>Attachment 4</b> )
<i>Calyptorhynchus lathami</i>	Glossy Black-Cockatoo	V	V	NSW Wildlife Atlas	Associated with a variety of forest types containing Allocasuarina species, usually reflecting the poor nutrient status of underlying soils. Intact drier forest types with less rugged landscapes are preferred. Nests in large trees with large hollows (OEH 2015d).	Potential foraging habitat.	Previously recorded in locality. 5-part test undertaken ( <b>Attachment 3</b> ). EPBC Assessment undertaken ( <b>Attachment 4</b> )
<i>Circus assimillilis</i>	Spotted Harrier	V		NSW Wildlife Atlas	Grassy open woodland, inland riparian woodland, grassland, shrub steppe, agricultural land and edges of inland wetlands.	Unlikely	No. Marginal suitable habitat. Not

Scientific name	Common name	TSC Act	EPBC Act	Source of Record	Habitat association	Likelihood	Survey result and need for '5 part test'
							recorded by previous ELA survey within study area.
<i>Climacteris picumnus victoriae</i>	Brown Treecreeper (eastern subspecies)	V	-	NSW Wildlife Atlas	Distributed through central NSW on the western side of the Great Dividing Range and sparsely scattered to the east of the Divide in drier areas such as the Cumberland Plain of Western Sydney, and in parts of the Hunter, Clarence, Richmond and Snowy River valleys. The Brown Treecreeper occupies eucalypt woodlands, particularly open woodland lacking a dense understorey. It is sedentary and nests in tree hollows within permanent territories (OEH 2015d).	Potential	Previously recorded in locality. 5-part test undertaken ( <b>Attachment 3</b> ).
<i>Daphoenositta chrysoptera</i>	Varied Sittella	V	-	NSW Wildlife Atlas and previous survey	Distribution includes most of mainland Australia except deserts and open grasslands. Prefers eucalypt forests and woodlands with rough-barked species, or mature smooth-barked gums with dead branches, mallee and Acacia woodland. Feeds on arthropods from bark, dead branches, or small branches and twigs (OEH 2015d).	Likely, recorded in broader Gilead study area (Biolink 2018)	Previously recorded in locality. 5 Part test undertaken.



Scientific name	Common name	TSC Act	EPBC Act	Source of Record	Habitat association	Likelihood	Survey result and need for '5 part test'
<i>Dasyornis brachypterus</i>	Eastern Bristlebird	E	E	PMST Search	Habitat is characterised by dense, low vegetation and includes sedgeland, heathland, swampland, shrubland, sclerophyll forest and woodland, and rainforest, as well as open woodland with a heathy understorey. In northern NSW occurs in open forest with tussocky grass understorey. All of these vegetation types are fire prone, aside from the rainforest habitat as utilised by the northern population as fire refuge. Age of habitat since fires (fire-age) is of paramount importance to this species; Illawarra and southern populations reach maximum densities in habitat that has not been burnt for at least 15 years; however, in the northern NSW population a lack of fire in grassy forest may be detrimental as grassy tussock nesting habitat becomes unsuitable after long periods without fire; northern NSW birds are usually found in habitats burnt five to 10 years previously (OEH 2015d).	Unlikely	No. No suitable habitat present. Not recorded by previous ELA survey within study area.
<i>Ephippiorhynchus asiaticus</i>	Black-necked Stork	E	-	NSW Wildlife Atlas	Associated with tropical and warm temperate terrestrial wetlands, estuarine and littoral habitats, and	Unlikely	No. No suitable

Scientific name	Common name	TSC Act	EPBC Act	Source of Record	Habitat association	Likelihood	Survey result and need for '5 part test'
					occasionally woodlands and grasslands floodplains. Forages in fresh or saline waters up to 0.5m deep, mainly in open fresh waters, extensive sheets of shallow water over grasslands or sedgeland, mangroves, mudflats, shallow swamps with short emergent vegetation and permanent billabongs and pools on floodplains (OEH 2015d).		habitat present.
<i>Falco subnider</i>	Black Falcon	V		NSW Wildlife Atlas	Woodland, shrubland and grassland, especially riparian woodland and agricultural land. Often associated with streams or wetlands.	Unlikely	No. Marginal suitable habitat.
<i>Grantiella picta</i>	Painted Honeyeater	V	V	PMST Search	Widely distributed in NSW, predominantly on the inland side of the Great Dividing Range but avoiding arid areas. Boree, Brigalow and Box-Gum Woodlands and Box-Ironbark Forests.	Unlikely	No. No suitable habitat present.
<i>Glossopsitta pusilla</i>	Little Lorikeet	V	-	NSW Wildlife Atlas	In New South Wales Little Lorikeets are distributed in forests and woodlands from the coast to the western slopes of the Great Dividing Range, extending westwards to the vicinity of Albury, Parkes, Dubbo and	Recorded in broader Gilead study area by ELA 2014.	5-part test undertaken ( <b>Attachment 3</b> )

Scientific name	Common name	TSC Act	EPBC Act	Source of Record	Habitat association	Likelihood	Survey result and need for '5 part test'
					Narrabri. Little Lorikeets mostly occur in dry, open eucalypt forests and woodlands. They have been recorded from both old-growth and logged forests in the eastern part of their range, and in remnant woodland patches and roadside vegetation on the western slopes. They feed primarily on nectar and pollen in the tree canopy, particularly on profusely-flowering eucalypts, but also on a variety of other species including melaleucas and mistletoes (OEH 2015d).		
<i>Haliaeetus leucogaster</i>	White-bellied Sea Eagle	V	M	NSW Wildlife Atlas & PMST Search	Forages over large open fresh or saline waterbodies, coastal seas and open terrestrial areas. Breeding habitat consists of tall trees, mangroves, cliffs, rocky outcrops, silts, caves and crevices and is located along the coast or major rivers. Breeding habitat is usually in or close to water, but may occur up to a kilometre away.	Potential	No. Marginal habitat present. Not recorded by previous ELA survey within study area. No nests recorded
<i>Hieraaetus morphnoides</i>	Little Eagle	V	-	NSW Wildlife Atlas	Utilises open eucalypt, sheoak and acacia forest, woodland or open woodland. Uses tall trees for nesting, with a large stick nest being built.	Potential	Suitable foraging habitat

Scientific name	Common name	TSC Act	EPBC Act	Source of Record	Habitat association	Likelihood	Survey result and need for '5 part test'
					Lays eggs in spring, and young fledge in early summer. Preys on birds, reptiles and mammals, and occasionally feeds on large insects or carrion (OEH 2015d).		present. 5-part test undertaken ( <b>Attachment 3</b> ).
<i>Lathamus discolor</i>	Swift Parrot	CE	CE & M	NSW Wildlife Atlas & PMST Search	Breeds in Tasmania between September and January. Migrates to mainland in autumn, where it forages on profuse flowering Eucalypts. Hence, in this region, autumn and winter flowering eucalypts are important for this species. Favoured feed trees include winter flowering species such as Swamp Mahogany ( <i>Eucalyptus robusta</i> ), Spotted Gum ( <i>Corymbia maculata</i> ), Red Bloodwood ( <i>C. gummifera</i> ), Mugga Ironbark ( <i>E. sideroxylon</i> ), and White Box ( <i>E. albens</i> ) (OEH 2015d).	Potential, recorded foraging in Browns Bush 2018. foraging habitat present	Previously recorded in locality Suitable habitat present. 5-part test undertaken ( <b>Attachment 3</b> ). EPBC Assessment undertaken ( <b>Attachment 4</b> )
<i>Lophoictinia isura</i>	Square-tailed Kite	V	-	NSW Wildlife Atlas	Found in a variety of timbered habitats including dry woodlands and open forests. Shows a particular preference for timbered watercourses (OEH 2015d).	Potential	Suitable habitat present. No nest observed. 5-part test undertaken

Scientific name	Common name	TSC Act	EPBC Act	Source of Record	Habitat association	Likelihood	Survey result and need for '5 part test'
							<b>(Attachment 3).</b>
<i>Ninox strenua</i>	Powerful Owl	V	-	NSW Wildlife Atlas	The Powerful Owl is associated with a wide range of wet and dry forest types with a high density of prey, such as arboreal mammals, large birds and flying foxes. Large trees with hollows at least 0.5m deep are required for shelter and breeding (OEH 2015d).	Potential foraging habitat present	Previously recorded in locality. No suitable breeding hollows present. Suitable foraging habitat present. 5-part test undertaken <b>(Attachment 3).</b>
<i>Petroica boodang</i>	Scarlet Robin	V	-	NSW Wildlife Atlas	Occurs from the coast to the inland slopes in NSW. After breeding (July-Jan), some disperse to the lower valleys and plains of the tablelands and slopes. Primarily resides in dry eucalypt forests and woodlands, with usually open and grassy understorey, with scattered shrubs. Abundant logs and fallen timber are important habitat components. In autumn and winter many Scarlet Robins live in open	Potential	No. Marginal habitat present. Not recorded by previous ELA survey within locality. 5-part test undertaken

Scientific name	Common name	TSC Act	EPBC Act	Source of Record	Habitat association	Likelihood	Survey result and need for '5 part test'
					grassy woodlands, and grasslands or grazed paddocks with scattered trees, and may join mixed flocks of other small insectivorous birds (OEH 2015d).		<b>(Attachment 3).</b>
<i>Rostratula australis</i>	Painted Snipe (Australian subspecies)	E	V	NSW Wildlife Atlas & PMST Search	Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber. Nests on the ground amongst tall vegetation, such as grasses, tussocks or reeds. Breeding is often in response to local conditions; generally occurs from September to December. Forages nocturnally on mud-flats and in shallow water. Feeds on worms, molluscs, insects and some plant-matter (OEH 2015d).	Unlikely	No. No suitable habitat present. Not recorded by previous ELA survey with study area.
<i>Stagonopleura guttata</i>	Diamond Firetail	V	-	NSW Wildlife Atlas	Typically found in grassy eucalypt woodlands, but also occurs in open forest, mallee, Natural Temperate Grassland, and in secondary grassland derived from other communities. It is often found in riparian areas and sometimes in lightly wooded farmland. Appears to be sedentary, though some	Potential	No. Marginal habitat present. Not recorded by previous ELA survey within locality. 5-part test undertaken



Scientific name	Common name	TSC Act	EPBC Act	Source of Record	Habitat association	Likelihood	Survey result and need for '5 part test'
					populations move locally, especially those in the south (OEH 2015d).		<b>(Attachment 3)</b>
<i>Tyto novaehollandiae</i>	Masked Owl	V	-	NSW Wildlife Atlas	Lives in dry eucalypt forests and woodlands from sea level to 1100 m (OEH 2015d).	Potential	No suitable breeding hollows present. Suitable foraging habitat present. 5-part test undertaken <b>(Attachment 3)</b> .
<i>Cercartetus nanus</i>	Eastern Pygmy-possum	V	-	NSW Wildlife Atlas	Found in wet and dry eucalypt forest, subalpine woodland, coastal banksia woodland and wet heath. Pygmy-Possums feed mostly on the pollen and nectar from banksias, eucalypts and understorey plants and will also eat insects, seeds and fruit. Small tree hollows are favoured as day nesting sites, but nests have also been found under bark, in old birds nests and in the branch forks of tea-trees (OEH 2015d).	Unlikely, not recorded in previous surveys of study area	No. No suitable habitat present.

Scientific name	Common name	TSC Act	EPBC Act	Source of Record	Habitat association	Likelihood	Survey result and need for '5 part test'
<i>Dasyurus maculatus</i> <i>Dasyurus maculatus maculatus</i>	Spotted-tailed Quoll Spotted-tailed Quoll (SE mainland population)	V	E	NSW Wildlife Atlas & PMST Search	The Spotted-tailed Quoll inhabits a range of forest communities including wet and dry sclerophyll forests, coastal heathlands and rainforests, more frequently recorded near the ecotones of closed and open forest. Individual animals use hollow-bearing trees, fallen logs, small caves, rock crevices, boulder fields and rocky-cliff faces as den sites. Maternal den sites are logs with cryptic entrances; rock outcrops; windrows; burrows (OEH 2015d).	Potential	Previously recorded in locality. Not recorded by previous ELA survey within study area but may occasionally use the study area EPBC Assessment undertaken ( <b>Attachment 4</b> ).
<i>Isodon obesulus</i>	Southern Brown Bandicoot	E	E	PMST Search	This species is associated with heath, coastal scrub, heathy forests, shrubland and woodland on well drained soils. This species is thought to display a preference for newly regenerating heathland and other areas prone to fire (OEH 2015d).	Potential	Previously recorded in locality. Not recorded by previous ELA survey within study area
<i>Petauroides volans</i>	Greater Glider	-	E	NSW Wildlife Atlas & PMST Search	This species is a nocturnal arboreal marsupial, predominantly solitary and largely restricted to eucalypt forest and woodlands of eastern Australia. It	Potential	Previously recorded in locality.

Scientific name	Common name	TSC Act	EPBC Act	Source of Record	Habitat association	Likelihood	Survey result and need for '5 part test'
					is typically found in highest abundance in taller, montane, moist eucalypt forest on fertile soils with relatively old trees and abundant hollows, but also occurs in drier habitats.		Not recorded by previous ELA survey within study area. EPBC Assessment undertaken ( <b>Attachment 4</b> )
<i>Petaurus norfolcensis</i>	Squirrel Glider	V	-	NSW Wildlife Atlas	Associated with dry hardwood forest and woodlands. Habitats typically include gum barked and high nectar producing species, including winter flower species. The presence of hollow bearing eucalypts is a critical habitat value (OEH 2015d).	Potential. Recorded by ELA (2016) less than 1 km to the west	Previously recorded in locality. 5-part test undertaken ( <b>Attachment 3</b> ).
<i>Petrogale penicillata</i>	Brush-tailed Rock-wallaby	E	V	PMST Search	Rocky areas in a variety of habitats, typically north facing sites with numerous ledges, caves and crevices (OEH 2015d).	Unlikely	No. No suitable habitat present.
<i>Phascolarctos cinereus</i>	Koala	E	E	NSW Wildlife Atlas & PMST Search	Associated with both wet and dry Eucalypt forest and woodland that contains a canopy cover of approximately 10 to 70%, with acceptable Eucalypt food trees. Some preferred Eucalyptus species are:	Known adjacent to site in Noorumba Reserve	Recorded in Noorumba Reserve, preferred browse

Scientific name	Common name	TSC Act	EPBC Act	Source of Record	Habitat association	Likelihood	Survey result and need for '5 part test'
					<i>Eucalyptus tereticornis</i> , <i>E. punctata</i> , <i>E. cypellocarpa</i> , <i>E. viminalis</i> (OEH 2015d)		species present. 5-part test and SIC undertaken ( <b>Attachment 3</b> ). EPBC Assessment undertaken ( <b>Attachment 4</b> )
<i>Pseudomys novaehollandiae</i>	New Holland Mouse	-	✓	PMST Search	A small burrowing native rodent with a fragmented distribution across Tasmania, Victoria, New South Wales and Queensland. Inhabits open heathlands, open woodlands with a heathland understorey and vegetated sand dunes. A social animal, living predominantly in burrows shared with other individuals. The home range of the New Holland Mouse ranges from 0.44 ha to 1.4 ha and the species peaks in abundance during early to mid stages of vegetation succession typically induced by fire (OEH 2015d).	Unlikely	No. No suitable habitat present.

Scientific name	Common name	TSC Act	EPBC Act	Source of Record	Habitat association	Likelihood	Survey result and need for '5 part test'
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	V	V	NSW Wildlife Atlas & PMST Search	The Large-eared Pied Bat has been recorded in a variety of habitats, including dry sclerophyll forests, woodland, sub-alpine woodland, edges of rainforests and wet sclerophyll forests. This species roosts in caves, rock overhangs and disused mine shafts and as such is usually associated with rock outcrops and cliff faces. Found in well-timbered areas containing gullies (OEH 2015d).	Likely. Recorded by ELA (2014) on adjacent MDP lands.	Foraging habitat present, no breeding habitat 5-part test undertaken ( <b>Attachment 3</b> ). EPBC Assessment undertaken ( <b>Attachment 4</b> )
<i>Falsistrellus tasmaniensis</i>	Eastern False Pipistrelle	V	-	NSW Wildlife Atlas	Prefers moist habitats with trees taller than 20m. Roosts in tree hollows but has also been found roosting in buildings or under loose bark (OEH 2015d).	Likely. Recorded by ELA (2014) on adjacent MDP lands.	5-part test undertaken ( <b>Attachment 3</b> ).
<i>Miniopterus australis</i>	Little Bentwing Bat	V	-	NSW Wildlife Atlas	East coast and ranges of Australia from Cape York in Queensland to Wollongong in NSW. Moist eucalypt forest, rainforest, vine thicket, wet and dry sclerophyll forest, Melaleuca swamps, dense coastal forests and banksia scrub (OEH 2015d).	Likely. Recorded by ELA (2014) on adjacent MDP lands.	5-part test undertaken ( <b>Attachment 3</b> ).

Scientific name	Common name	TSC Act	EPBC Act	Source of Record	Habitat association	Likelihood	Survey result and need for '5 part test'
<i>Miniopterus schreibersii oceanensis</i>	Eastern Bent-wing Bat	V	-	NSW Wildlife Atlas	Associated with a range of habitats such as rainforest, wet and dry sclerophyll forest, monsoon forest, open woodland, paperbark forests and open grassland. It forages above and below the tree canopy on small insects. Will utilise caves, old mines, and stormwater channels, under bridges and occasionally buildings for shelter (OEH 2015d).	Likely. Recorded by ELA (2014) on adjacent MDP lands.	5-part test undertaken ( <b>Attachment 3</b> ).
<i>Mormopterus norfolkensis</i>	Eastern Freetail Bat	V	-	NSW Wildlife Atlas	Most records of this species are from dry eucalypt forest and woodland east of the Great Dividing Range. Individuals have, however, been recorded flying low over a rocky river in rainforest and wet sclerophyll forest and foraging in clearings at forest edges. Primarily roosts in hollows or behind loose bark in mature eucalypts, but have been observed roosting in the roof of a hut (OEH 2015d).	Likely. Recorded by ELA (2014) on adjacent MDP lands.	5-part test undertaken ( <b>Attachment 3</b> ).
<i>Myotis macropus</i>	Southern Myotis	V	-	NSW Wildlife Atlas	The Large-footed Myotis is found in the coastal band from the north-west of Australia, across the top-end and south to western Victoria. Will occupy most habitat types such as mangroves, paperbark swamps,	Likely. Recorded by ELA (2014) on adjacent MDP lands.	5-part test undertaken ( <b>Attachment 3</b> ).



Scientific name	Common name	TSC Act	EPBC Act	Source of Record	Habitat association	Likelihood	Survey result and need for '5 part test'
					riverine monsoon forest, rainforest, wet and dry sclerophyll forest, open woodland and River Red Gum woodland, close to water. While roosting (in groups of 10-15) is most commonly associated with caves, this species has been observed to roost in tree hollows, amongst vegetation, in clumps of Pandanus, under bridges, in mines, tunnels and stormwater drains, however with specific roost requirements. Forages over streams and pools catching insects and small fish. In NSW females have one young each year usually in November or December (OEH 2015d)		
<i>Pteropus poliocephalus</i>	Grey-headed Flying-Fox	V	V & M	NSW Wildlife Atlas & PMST Search	Inhabits a wide range of habitats including rainforest, mangroves, paperbark forests, wet and dry sclerophyll forests and cultivated areas. Camps are often located in gullies, typically close to water, in vegetation with a dense canopy (OEH 2015d).	Likely. Recorded by ELA (2014) on adjacent MDP lands.	5-part test undertaken ( <b>Attachment 3</b> ). EPBC Assessment undertaken ( <b>Attachment 4</b> )

Scientific name	Common name	TSC Act	EPBC Act	Source of Record	Habitat association	Likelihood	Survey result and need for '5 part test'
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheathtail Bat	V		Previous surveys (ELA 2014)	Found in almost all habitats, from wet and dry sclerophyll forest, open woodland, open country, mallee, rainforests, heathland and waterbodies. Roosts in tree hollows; may also use caves; has also been recorded in a tree hollow in a paddock and in abandoned sugar glider nests. The Yellow-bellied Sheathtail-bat is dependent on suitable hollow-bearing trees to provide roost sites, which may be a limiting factor on populations in cleared or fragmented habitats (OEH 2015d).	Likely. Recorded by ELA (2014) on adjacent MDP lands.	5-part test undertaken ( <b>Attachment 3</b> ).
<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat	V		NSW Wildlife Atlas	Associated with moist gullies in mature coastal forest, or rainforest, east of the Great Dividing Range, tending to be more frequently located in more productive forests. Within denser vegetation types use is made of natural and man-made openings such as roads, creeks and small rivers, where it hawks backwards and forwards for prey (OEH 2015d).	Likely. Recorded by ELA (2014) on adjacent MDP lands.	5-part test undertaken ( <b>Attachment 3</b> ).

# Attachment 2 - General site photos showing structure and condition of vegetation

**Glen Lorne Northern Underpass**



**Young regrowth Cumberland Plain Woodland**



**Exotic pasture grass under existing powerline corridor**



**Browns Bush Southern Underpass**



Intact, regrowth Shale Sandstone Transition Forest



Existing, highly modified Powerline Easement which underpass will intersect





Rubbish dumping at location of proposed underpass

# Attachment 3 – BC Act Assessment of Significance

The Assessment of Significance (five-part test) is applied to species, populations and ecological communities listed on Schedules 1 and 2 of the BC Act and Schedules 4, 4A and 5 of the Fisheries Management Act. The assessment sets out 5 factors, which when considered, allow proponents to undertake a qualitative analysis of the likely impacts of an action and to determine whether further assessment is required via a Species Impact Statement (SIS) or Biodiversity Assessment Report (BDAR). All factors must be considered and an overall conclusion made based on all factors in combination. An SIS is required if, through application of the 5-part test, an action is considered likely to have a significant impact on a threatened species, populations or ecological communities.

The assessment of significance was undertaken for the following communities and threatened species:

## Threatened ecological communities:

- Cumberland Plain Woodland (CPW)
- Shale Sandstone Transition Forest (SSTF)

## Fauna:

- *Phascolarctos cinereus* (Koala)
- *Meridolum corneovirens* (Cumberland Plain Land Snail)
- *Petaurus norfolcensis* (Squirrel Glider)
- Woodland bird group
  - *Artanus cyanopterus* (Dusky Wood Swallow)
  - *Climacteris picumnus victoriae* (Brown Treecreeper)
  - *Daphoenositta chrysoptera* (Varied Sittella)
  - *Melanodryas cucullata* ssp. *cucullata* (Hooded Robin)
  - *Stagonopleura guttata* (Diamond Firetail)
- Blossom Nomads
  - *Anthochaera phrygia* (Regent Honeyeater)
  - *Glossopsitta pusilla* (Little Lorikeet)
  - *Lathamus discolor* (Swift Parrot)
  - *Pteropus poliocephalus* (Grey-headed Flying-fox)
- Large forest owls and Cockatoos
  - *Callocephalon fimbriatum* (Gang-gang Cockatoo)
  - *Calyptorhynchus lathami* (Glossy Black Cockatoo)
  - *Ninox strenua* (Powerful Owl)
  - *Tyto novaehollandiae* (Masked Owl)
- Microchiropteran bats
  - *Chalinolobus dwyeri* (Large-eared Pied Bat)
  - *Falsistrellus tasmaniensis* (Eastern False Pipistrelle)
  - *Miniopterus australis* (Little Bentwing-bat)



- *Miniopterus schreibersii oceanensis* (Eastern Bentwing-bat)
  - *Myotis macropus* (Large-footed Myotis)
  - *Mormopterus norfolkensis* (Eastern Freetail-bat)
  - *Scoteanax rueppellii* (Greater Broad-nosed Bat)
  - *Saccolaimus flaviventris* (Yellow-bellied Sheathtail-bat)
- Raptors
    - *Hieraaetus morphnoides* (Little Eagle)
    - *Lophoictinia isura* (Square-tailed Kite)

### ***Cumberland Plain Woodland (CPW)***

Cumberland Plain Woodland (CPW) is listed as a Critically Endangered Ecological Community on Schedule 2 of the BC Act. CPW occurs on soils derived from Wianamatta Shale, and throughout the driest part of the Sydney Basin.

The subject site was assessed as comprising Cumberland Plains Woodland in a degraded state (regrowth trees and pasture improved/grazed understorey (Refer to photos in Attachment 3)). The proposal will directly (and indirectly) impact up to 0.12 ha of CPW during the construction of the underpass (which will be revegetated with CPW species following construction). The trees range in size from a few metres tall (with limited foraging value to 10 - 15m tall, none of which have been assessed to have hollows that may provide breeding sites for threatened fauna.

- a. in the case of a threatened species, whether the proposed action or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at the risk of extinction.**

Not applicable for CPW.

- b. in the case of an endangered ecological community or critically endangered ecological community, whether the proposed action or activity action :**
- i. is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or**

The local occurrence of CPW extends outside of the impact area to the adjacent proposed Browns Bush BSA site and Georges River Koala National Park and Noorumba Reserve where over 100 ha of CPW in an intact condition state will be permanently protected and managed.

The loss of up to 0.12ha of CPW in regrowth condition that is the subject of this assessment will not have an adverse effect on the extent of the community such that its local occurrence is placed at risk of extinction.

- ii. is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.**

The loss of up to 0.12 ha of CPW from a degraded patch of CPW is unlikely to substantially and adversely modify the composition of the CPW such that it's local occurrence is likely to be placed at risk of extinction.

- c. in relation to the habitat of a threatened species or ecological community:**
- i. the extent to which habitat is likely to be removed or modified as a result of the action proposed development tor activity, and**

The proposed development will impact up to 0.12 ha of CPW, and will be revegetated once construction of the underpass is complete.

- ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and**

The proposed activity will not result in the remaining patch of CPW in the study area becoming fragmented or isolated from other areas.

- iii. the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality,**

The patch of CPW from which the up to 0.12ha is an important area of habitat for CPW within the locality as it forms part of a larger, connected remnant of the community.

**d. whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)**

The study area is not a declared area of outstanding biodiversity value.

**e. whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.**

The proposed development constitutes a key threatening process of relevance to CPW i.e. clearing of native vegetation. The proposed development would result in the clearing of up to 0.12ha of CPW.

### **Conclusions**

The proposed development is highly unlikely to result in a significant impact to CPW. Consequently, a Species Impact Statement is not required for the proposed development with respect to this CEEC.

### ***Shale/Sandstone Transition Forest***

Shale/Sandstone Transition Forest is a critically endangered ecological community (CEEC) under the TSC Act. This community occurs on the edges of the Cumberland Plain where the clay soils from the shale rock intergrade with the soils from the sandstone. Prior to European settlement, SSTF was represented throughout western Sydney. Less than 22.6 % of its original extent remains today (OEH 2014). Presently, this community occurs in the Hawkesbury, Baulkham Hills, Bankstown, Blue Mountains, Liverpool, Parramatta, Penrith, Campbelltown and Wollondilly LGA (NSW SC 2011).

Field survey confirmed the presence of this CEEC at both the northern and southern underpass locations. The proposed works will impact up to 0.5 ha of SSTF in good/intact condition and 0.04 ha as derived native grassland (all of which will be revegetated after construction is completed).

**a. in the case of a threatened species, whether the proposed action or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at the risk of extinction.**

Not applicable for SSTF.

**b. in the case of an endangered ecological community or critically endangered ecological community whether the proposed action or activity action:**

**i. is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or**

The proposal is unlikely to adversely impact on this ecological community to an extent that it will be placed at risk of becoming extinct. The proposed action would involve removal of 0.05 ha of SSTF in good condition within a larger patch of > 50 ha of the ecological community in a proposed BSA site and which extends further within the surrounding landscape and a 0.04 ha of DNG SSTF. Vegetation to be impacted has undergone previous disturbance and is the most disturbed portion of the study area (refers to photos in Attachment 3), adjacent to the existing powerline easement and road reserve. This area appears to have been selectively cleared in the past, with an open to sparse canopy present and cut stumps observed. This area also contains unauthorised rubbish dumping and appears to have been more recently burnt than the surrounding less disturbed areas of SSTF. While

the proposed action would involve temporarily clearing a small, disturbed area of the ecological community, given this area is less than 1% of the contiguous patch and is located in an area which has previously been disturbed, the proposed works are unlikely to have an adverse effect on the extent of the community such that its local occurrence would be placed at risk.

**ii. is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.**

The proposal will result in the clearing of approximately 0.09 ha of SSTF. Vegetation to be cleared has undergone previous disturbance and is the most disturbed portion of the study area, adjacent to the existing powerline easement and a previously grazed paddock. Additionally, this area appears to have been selectively cleared in the past, with an open to sparse canopy present and cut stumps observed. Therefore it is considered unlikely that the proposal would result in substantial and adverse modifications to such an extent to place this community at risk of extinction.

**c. in relation to the habitat of a threatened species, population or ecological community:**

**i. the extent to which habitat is likely to be removed or modified as a result of the action proposed, and**

The proposed works will result in the removal of 0.09 ha of modified SSTF vegetation. The habitat that has been identified for removal has previously been disturbed and was regarded as being in relatively poor condition, particularly compared to the less disturbed vegetation within the surrounding study area and landscape.

**ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and**

The vegetation to be removed is relatively small compared with the remaining extent of this community within the study area and surrounding landscape. It is located on the edge of a larger area of less disturbed SSTF, adjacent to the existing powerline easement. Therefore, it is expected that the proposed will not fragment or isolate areas of this ecological community.

**iii. the importance of the habitat to be removed, modified, fragmented or isolated to the long term survival of the species, population or ecological community in the locality.**

The proposed removal of vegetation is unlikely to impact upon the long term survival of this ecological community in the locality. The vegetation that will be removed is minimal in comparison with that remaining unaffected in the study area and surrounding landscape. As previously mentioned, the vegetation identified for removal is the most disturbed portion of the wider study area.

**d. whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly) (either directly or indirectly),**

The study area is not a declared area of outstanding biodiversity value

**e. whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process**

A number of Key Threatening Processes (KTP) are relevant to this proposal with respect to SSTF. These include:

- clearing of native vegetation
- invasion of native plant communities by exotic perennial grasses
- removal of dead wood and dead trees.

Vegetation to be cleared has undergone previous disturbance and is the most disturbed portion of the study area, adjacent to the existing powerline easement. This area appears to have been selectively cleared in the past, with an open to sparse canopy present and cut stumps observed. This area also contains unauthorised rubbish dumping and appears to have been more recently burnt than the surrounding less disturbed areas of SSTF. Therefore it is considered unlikely that the proposal would significantly exacerbate this KTP.

The invasion of exotic weeds, plant pathogens and detrimental fungi is relevant to the proposed works. However, mitigation measures are discussed in this report and are encouraged to be implemented to prevent the spread of weeds, pathogens and fungi into the study site and adjoining habitats.

## **Conclusion**

The proposed development is unlikely to significantly impact upon SSTF given that:

- the area to be removed is relatively small in size (approximately 0.09 ha)
- the vegetation has previously been extensively disturbed
- the proposal will not further fragment or isolate this ecological community from other patches of SSTF.

On the basis of the above considerations, it is unlikely that the proposed development will result in a significant effect on SSTF



***Phascolarctos cinereus (Koala)***

Koalas have previously been recorded using habitats within the broader locality (Biolink 2018) and parts of the study area (ELA 2014, 2018 a, b and c, 2019 and 2022) and **Figure 9**, and may utilise the trees within the subject site from time to time for foraging and resting. The northern impact area comprises regrowth Forest Red Gum, a Koala Food Tree in the Campbelltown LGA whilst the southern impact area is largely Broad and Narrow-leaved Ironbark (which are not Koala Feed Trees). It is likely that Koala will browse and/or rest/shelter in the trees at various points in time as they use the broader resources in the area.

- a. in the case of a threatened species, whether the proposed action or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at the risk of extinction**

The proposed works will result in the temporary removal of up 0.12 ha of regrowth CPW and 0.05 ha of SSTF with some 200+ ha of Koala habitat proposed for permanent protection to the East of Appin Rd (Browns Bush BSA site and proposed Georges River Koala National Park (DPE 2022)). It is highly unlikely that this small loss of habitat would have an adverse effect on the life-cycle of the Koala such that a viable local population is likely to be placed at the risk of extinction. Indeed the proposed activity is designed to mitigate a major threat to Koala, that being road mortality on Appin Rd (by koala exclusion fencing) and to provide a safe passage between important habitat areas between the Georges and Nepean Rivers (fauna underpasses). This expected improved connectivity, and reduced mortality of Koala on Appin Rd will lead to a more viable and genetically diverse local Koala population. The REF provides documentation of the verified use of the proposed underpasses structures by Koalas under similar 4 and 6 lane roads (design, length of tunnels) and the sequencing of fencing to avoid/minimise any impacts during road construction.

- b. in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:**
- i. is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or**
  - ii. is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.**

Not applicable. The Koala is not an endangered ecological community.

- c. in relation to the habitat of a threatened species, population or ecological community:**
- i. the extent to which habitat is likely to be removed or modified as a result of the action proposed, and**

The proposed works will result in the removal of up to 0.22 ha of potential foraging and shelter habitat.

- ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and**

The temporary loss of up to 0.22 ha of foraging habitat will not result in the remaining patches of Koala habitat on the east side of Appin Road becoming fragmented or isolated from other areas. The proposed action is proposed to improve connectivity between protected habitat areas on the eastern and western side of Appin Road, and are located at identified/recommended strategically important corridors (BioLink 2018; NSW Chief Scientist 2020, 2021a & 2021b) and provide a safe passage for this connectivity.

- iii. **the importance of the habitat to be removed, modified, fragmented or isolated to the long term survival of the species, population or ecological community in the locality,**

The patch of Koala habitat from which the up to 0.22 ha will be temporarily removed is not considered to be an important area of habitat for Koala within the study area given its regrowth state and the higher quality habitat in the immediate vicinity of the impact area.

- d. **whether the action proposed is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)**

No areas of outstanding biodiversity value have been declared for the Koala.

- e. **whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.**

The proposed works constitute one key threatening processes of relevance to the Koala, namely Clearing of Native Vegetation, which would result in a very small loss of foraging habitat. It is considered unlikely that the proposal would significantly exacerbate this key threatening processes at this location.

### **Conclusion**

The Appin Road Upgrade project, as amended by this addendum REF (to include fauna underpasses and Koala exclusion fencing), is unlikely to result in a 'significant effect' on the Koala or local Koala population. The proposed activity is designed to mitigate a major threat to Koala, that being road mortality on Appin Rd and improving connectivity between areas of important habitat by providing safe passage for east-west and west-east movement of Koalas, with Koala exclusion fencing, between the Georges and Nepean Rivers.

***Meridolum corneovirens (Cumberland Plain Land Snail)***

*Meridolum corneovirens* (Cumberland Plain Land Snail; CPLS) is listed as endangered under the BC Act.

Current knowledge suggests that CPLS is restricted to the Cumberland Plain and Castlereagh Woodlands of Western Sydney and also along the fringes of River-flat Eucalypt Forest, especially where it meets Cumberland Plain Woodland. It is currently known from well over 100 locations in western Sydney with 1,166 records in BioNet. However, most of these populations are scattered throughout the region and are often small and isolated (OEH 2012). There are numerous records of this species within 5 km of the study area (Figure 4). Cumberland Plain Land Snail typically occurs under logs and other debris, amongst leaf and bark accumulations and sometimes under grass clumps. Where possible it will burrow into loose soil (OEH 2012).

CPLS has previously been recorded adjacent to the proposed impact area (ELA 2022) and in the Noorumba Bushland Reserve (ELA 2018c and **Figure 9**). There is limited suitable habitat for this species in the impact area due to the lack of leaf litter, logs and coarse woody debris in this modified area that has been subject to regular slashing of a powerline management corridor.

- a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.**

The proposed works will result in the removal of a small area (up to 0.22 ha) of potential habitat for this species. As the species was not recorded it is unlikely that the proposal would place a local viable population at risk of extinction.

- b) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:**
- i. is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or**
  - ii. is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.**

Not applicable. The CPLS is not an endangered ecological community.

- c. in relation to the habitat of a threatened species, population or ecological community:**
- i. the extent to which habitat is likely to be removed or modified as a result of the action proposed, and**

The proposal will remove a small area (up to 0.22 ha) from a much larger patch of occupied habitat that will be permanently protected and managed for conservation (Browns Bush BSA site, ELA 2022).

- ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and**

The location of the vegetation/habitat to be impacted is on the edge of an existing road and surrounded by larger patches of more suitable habitat. It is considered unlikely that the proposed works will result in an area of habitat becoming fragmented or isolated from other areas of habitat.

- iii. the importance of the habitat to be removed, modified, fragmented or isolated to the long term survival of the species, population or ecological community in the locality,**

The proposal will temporarily remove up to 0.22 ha of potential habitat for CPLS. This represents a very small amount of potential habitat, compared with the extent of habitat remaining within the locality which is protected and managed for conservation.

It is considered unlikely that the habitat to be removed would be considered important to the long-term survival of the species within the locality.

**d. whether the action proposed is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly).**

No areas of outstanding biodiversity value have been declared for this species.

**e. whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.**

The proposed works constitutes one key threatening processes of relevance to CPLS, Clearing of Native Vegetation, which would result in the loss of a very small area of potential habitat. Therefore it is unlikely that the proposal would exacerbate any key threatening processes.

**Conclusion**

The proposed works are unlikely to impose a significant impact on the CPLS given that:

- the species was not recorded within the proposed impact areas.
- a very small area of the potential habitat for this species would be removed
- no areas of potential habitat would become further isolated as a consequence of the proposal
- potential habitat would remain for this species within the study area and wider landscape

Consequently a Species Impact Statement (SIS) is not required for this species.

***Petaurus norfolcensis (Squirrel Glider)***

*Petaurus norfolcensis* (Squirrel Glider) is a vulnerable species listed under the BC Act. It is sparsely distributed along the east coast and immediate inland districts from western Victoria to north Queensland, where it occurs in dry sclerophyll forest and woodland (DECC 2005). Suitable habitat for this species requires abundant hollow-bearing trees and a mix of eucalypts including some smooth barked and winter flowering species (NPWS 1999).

Squirrel Gliders are nocturnal and dependent upon hollows for shelter. They feed on nectar, pollen, flowers, acacia gum and insects, but may also eat sap from feeding scars from other species of Glider (NPWS 1999). Mean home range for this species is 3-9 ha in coastal habitats and 3-4 ha in productive inland habitat fragments (NSW Scientific Committee 2008).

The species has been recorded from the Mt Gilead Biocertification Assessment Area within structural diverse riparian vegetation with abundant hollows and within the proposed Browns Bush BSA site (ELA 2022) although there are relatively few HBTs in the Browns Bush area and the existing vegetation is largely regrowth woodland.

**a. in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction**

Factors likely to have an adverse effect on the life cycle of the Squirrel Glider would include a substantial loss and/or fragmentation of foraging habitat, loss of hollows and increased presence of foxes and cats.

The proposed works will result in the removal of up to 0.22 ha of regrowth habitat that does not contain any hollows suitable for breeding. Given the area of the proposed Browns Bush BSA site (28 ha) and the Georges River National Park (DPE 2022) this is unlikely to adversely effect the life cycle of a viable local population.

**b. in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:**

- i. is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or**
- ii. is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction**

Not applicable. The Squirrel Glider is not an endangered ecological community.

**c. in relation to the habitat of a threatened species, population or ecological community:**

- i. the extent to which habitat is likely to be removed or modified as a result of the action proposed, and**

The proposed works will result in the temporary removal of up to 0.22 ha of foraging habitat within an contiguous patch of forest/woodland area in excess of 200 ha.

- ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and**

The proposed works will not result in the fragmentation or isolation of areas of habitat from other areas of habitat for the Squirrel Glider.

- iii. the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality**

The proposal will temporarily remove up to 0.22 ha of foraging habitat. This represents a very small amount of potential habitat, compared with the extent of habitat remaining adjacent to the impact areas that is proposed for in perpetuity conservation management (ELA 2022; DPE 2022).

**e. whether the action proposed is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)**

No areas of outstanding biodiversity value have been declared for this species

**d. The action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.**

The proposed works constitutes one key threatening processes of relevance to the Squirrel Glider, namely Clearing of Native Vegetation, which would result in a very small loss of potential foraging habitat. It is unlikely that the proposal would exacerbate any key threatening processes.

### **Conclusions**

The proposal is unlikely to impose a significant effect on the Squirrel Glider given that:

- a small amount of potential foraging habitat for this species would be removed (and revegetated)
- no areas of potential habitat would become further isolated as a consequence of the proposal
- potential habitat would remain for this species adjacent to the study area and wider landscape

Consequently a Species Impact Statement (SIS) is not required for this species.



### **Large Forest Owls and Cockatoos**

The Powerful and Masked Owl and Gang-gang and Glossy Black Cockatoo have all been recorded in the locality and will likely use resources, breeding sites and foraging areas, in the locality from time to time (**Figure 9**).

Of particular importance for these species is suitable breeding sites comprising large hollows (> 20cm diameter) in the trunks and limbs of tall living or dead trees and extensive areas in which to forage for prey. There are no suitable breeding sites within the proposed impact areas.

- a) in the case of a threatened species, whether the proposed action or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at the risk of extinction.**

Factors likely to have an adverse effect on the life cycle of the Barking Owl, Powerful Owl and Masked Owl would include a substantial loss and/or fragmentation of foraging habitat and loss of suitable nesting and roosting habitat (e.g. large hollow bearing trees).

The loss of up to 0.22 ha of foraging habitat is not a substantial loss of foraging habitat for these species which forage over 100's (owls) and 1'000's (cockatoo's) of hectares. Accordingly it is considered unlikely that the removal of this very small area of potential foraging habitat will significantly disrupt the life cycle of these species such that viable local populations are placed at risk of extinction.

- b) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:**
- (i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or**
  - (ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.**

Not applicable. These species are not listed as endangered ecological communities.

- c) in relation to the habitat of a threatened species, population or ecological community:**
- (i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and**

The proposed works will result in the temporary removal of up to 0.22 ha of potential foraging habitat for these species.

- (ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and**

The loss of up to 0.22 ha of foraging habitat for these highly mobile species will not result in the remaining areas of foraging habitat in the study area becoming fragmented or isolated from other areas.

- (iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long term survival of the species, population or ecological community in the locality,**

The patch of habitat from which the two trees will be impacted is not considered to be an important area of habitat for these species within the study area given its modified state.

- d. whether the action proposed is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)**

No areas of outstanding biodiversity values have been declared for these species.

**e) the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.**

The proposed works constitute one key threatening processes of relevance to these species, 'Clearing of Native Vegetation', which would result in the loss of a very small area (0.22 ha) of potential foraging habitat. However, given the extent of habitat in the locality and that vegetation to be cleared is highly modified, it is unlikely that the proposal would exacerbate any key threatening processes.

**Conclusion**

The proposal is unlikely to constitute a significant effect on the Barking Owl, Powerful Owl, Gang-gang Cockatoo or Glossy Black Cockatoo given that the proposed works:

- the area is not suitable breeding habitat for these species
- would only disturb a very small area of potential foraging habitat within the locality
- would not isolate or fragment any currently connecting areas of habitat
- does not impact larger areas of more suitable potential foraging habitat that are present within the surrounding landscape

Consequently, a Species Impact Statement is not required for the proposal with respect to these species.

### ***Blossom Nomads***

The Little Lorikeet, Grey-headed Flying Fox, Swift Parrot, and Regent Honeyeater, have been recorded (Little Lorikeet, Flying-fox) or may occur (Swift Parrot/Regent Honeyeater) within the study area from time to time (ELA 2018) (**Figure 9**). They have been grouped together for this Assessment of Significance because they have similarities in their foraging behaviours (highly nomadic and move great distances to forage on flowering eucalypts when in season) and accordingly are likely to use foraging resources within the study area intermittently. Consequently predicted impacts are considered to be the same or similar. None of the species have been recorded breeding on the study area.

- a. in the case of a threatened species, whether the proposed action or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at the risk of extinction.**

Impacts likely to have an adverse effect on the lifecycle of these species includes the loss or degradation of significant areas of suitable foraging habitat, in particular, high quality foraging habitat with an abundance of winter flowering species.

The proposed works will result in the temporary removal of a very small area (0.22 ha) of foraging habitat. Therefore, it is considered unlikely that the removal of a small area of foraging habitat will significantly disrupt the life cycle of these species such that viable local populations are placed at risk

- b. in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:**
- i. is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or**
  - ii. is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.**

Not applicable. These species are not listed as endangered ecological communities.

- c. in relation to the habitat of a threatened species, population or ecological community:**
- i. the extent to which habitat is likely to be removed or modified as a result of the action proposed, and**

The proposed works will result in the temporary removal of up to 0.22 ha of potential foraging habitat.

- ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and**

The loss of up to 0.22 ha will not result in the remaining areas of foraging habitat in the study area becoming fragmented or isolated from other areas.

- iii. the importance of the habitat to be removed, modified, fragmented or isolated to the long term survival of the species, population or ecological community in the locality,**

The 0.22 ha to be impacted is not considered to be an important area of habitat for these species in relation to the long-term survival of the species in the locality.

- d. whether the action proposed is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)**

No areas of outstanding biodiversity values have been declared for these species.

**e. whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.**

The proposed works constitute one key threatening processes of relevance to these species, namely 'Clearing of Native Vegetation', which would result in the loss of a very small area of potential foraging habitat. Given the highly mobile nature of this species, that the majority of potential habitat for this species will be conserved within the locality and wider landscape, and that vegetation to be cleared is within the most disturbed portion of the study area, it is unlikely that the proposal would exacerbate any key threatening processes.

**Conclusions**

The proposal is unlikely to constitute a significant impact to these species given that:

- the proposed works would only disturb a very small (0.22 ha) area of potential foraging habitat within the study area
- the proposed works would not isolate or fragment any currently connecting areas of habitat
- larger areas of suitable potential foraging habitat are present within the surrounding landscape.

On the basis of the above considerations, it is unlikely that the proposal will constitute a significant impact on these species.

### **Microchiropteran bats**

For the purpose of this assessment the microchiropteran bat species *Chalinolobus dwyeri* (Large-eared Pied Bat), *Falsistrellus tasmaniensis* (Eastern False Pipistrelle), *Miniopterus schreibersii oceanensis* (Eastern Bentwing-bat), *Mormopterus norfolkensis* (Eastern Freetail-bat), *Myotis macropus* (Southern Myotis), *Saccolaimus flaviventris* (Yellow-bellied Sheath-tail-bat) and *Scoteanax rueppellii* (Greater Broad-nosed Bat) have been assessed together. This is due to the similarities in their habitat associations and biology.

Most species forage along edges of forests, cleared paddocks, tree-lined water courses and above or just below the tree canopy. The Large-footed Myotis forages along streams and pools, feeding on insects and small fish caught by raking their long feet across the water surface.

These species are threatened by a number of processes including loss of trees for foraging and hollow-bearing trees for roosting, disturbance to winter roosting and breeding sites, and application of pesticides in or adjacent to foraging areas (DECC 2005).

These seven microchiropteran bat species have all been recorded foraging within the study area. Collectively, these species are known to roost in tree hollows, under loose bark on trees, in buildings, caves, tunnels, abandoned mines, stormwater drains, culverts and bridges. The impact area has no tree hollows suitable for microchiropteran bats and there is limited loose bark suitable as roosting sites for these species given the young age/size of the trees to be impacted.

- a. in the case of a threatened species, whether the proposed action or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at the risk of extinction**

Factors likely to have an adverse effect on the life cycle of these species would include a substantial loss and/or fragmentation of foraging habitat, including water bodies, and a loss of suitable roosting or breeding habitat.

The proposed works will result in the temporary removal of a very small area of foraging habitat ( 0.22 ha).

There are no man-made structures (such as culverts) in the subject site.

It is considered highly unlikely that the loss of this small area of foraging habitat will significantly disrupt the life cycle of these species such that viable local populations are placed at risk of extinction.

- b. in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:**
- i. is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or**
  - ii. is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction**

Not applicable. These species are not listed as endangered ecological communities.

- c. in relation to the habitat of a threatened species, population or ecological community:**
- i. the extent to which habitat is likely to be removed or modified as a result of the action proposed, and**

The proposed works will result in the removal of a very small area (0.22 ha) of foraging habitat and two trees that may provide suitable roosting sites.

**ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and**

The loss of up to 0.22 ha not result in the remaining areas of foraging habitat in the study area becoming fragmented or isolated from other areas in regards to these highly mobile species.

**iii. the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality**

The habitat to be removed is not considered to be an important area of habitat for these species within the locality given its highly degraded state.

**d. whether the action proposed is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly).**

No areas of outstanding biodiversity values have been declared for these species.

**e. The action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.**

The proposed works constitutes one key threatening processes of relevance to these species, 'Clearing of Native Vegetation', which would result in the loss of a very small area of potential foraging habitat. Given the majority of potential habitat for these species will be conserved within the study area and locality it is unlikely that the proposal would exacerbate any key threatening processes.

**Conclusions**

The proposal is unlikely to impose a significant effect on these microchiropteran bat species given that:

- the proposed works would only disturb a very small area of foraging habitat within the study area and two trees that may contain suitable roosting sites
- no areas of potential habitat would become further isolated as a consequence of the proposal.

Consequently a Species Impact Statement (SIS) is not required for these species.



### ***Threatened diurnal Woodland birds***

Five threatened forest and woodland birds (Dusky Woodswallow, Brown Treecreeper, Varied Sittella, Hooded Robin and Diamond Firetail) have been recorded or are likely to occur within the study area (ELA 2018, Biolink 29018, WSP 2018) (**Figure 9**). They have been grouped together for this Assessment of Significance because they have certain similarities in their foraging and/or roosting behaviours, habitat requirements and consequently predicted impacts are considered to be the same or similar.

- a) in the case of a threatened species, whether the proposed action or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at the risk of extinction.**

Impacts likely to have an adverse effect on the lifecycle of these species includes the loss or degradation of significant areas of forest and woodland habitat.

The proposed works will result in the temporary removal of a very small area (0.22 ha) of habitat. Therefore, it is considered highly unlikely that the removal of a small area of potential foraging habitat will significantly disrupt the life cycle of these species such that viable local populations are placed at risk of extinction.

- b) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:**
- (i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or**
  - (ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.**

Not applicable. These species are not listed as an endangered ecological community.

- c) in relation to the habitat of a threatened species, population or ecological community:**
- (i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and**

The proposed works will result in the temporary removal of up to 0.22 ha with over 200 ha of higher quality habitat being permanently protected within proposed BSA sites and the Georges River Koala National Park.

- (ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and**

The temporary loss of up to 0.22 ha will not result in the remaining areas of woodland bird habitat in the study area becoming fragmented or isolated from other areas.

- (iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long term survival of the species, population or ecological community in the locality,**

The patch of habitat from which the nine trees will be impacted is not considered to be an important area of habitat for woodland birds within the study area given its highly degraded state and the higher quality habitat in the adjacent biobank sites that will be protected and restored.

- d. whether the action proposed is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)**

No areas of outstanding biodiversity values have been declared for these woodland bird species.

**e) the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.**

The proposed works constitutes one key threatening processes of relevance to these 'Clearing of Native Vegetation', which would result in a small loss of potential foraging habitat. Given the mobile nature of these species, that the majority of potential habitat will be conserved within the study area and wider landscape, and that vegetation to be cleared is within a highly disturbed/modified part of the study area, it is unlikely that the proposal would exacerbate any key threatening processes.

**Conclusion**

The proposal is unlikely to constitute a significant impact to any threatened woodland bird species given that:

- the proposed works would remove only a small area of potential foraging habitat relative to the amount available in the wider landscape
- larger areas of suitable foraging and roosting habitat are present within the surrounding landscape
- the proposal would not isolate or fragment any currently connecting areas of habitat.

Consequently, a SIS is not required for the proposal with respect to these species.

## **Raptors**

The following two raptor bird species are regarded as having potential to occur within the study area and consequently have been grouped together for this Assessment of Significance. This is because they have certain similarities in their foraging and/or roosting behaviours, habitat requirements and consequently predicted impacts are considered to be the same or similar. Where obvious differences are apparent between each species, they are discussed separately.

The Little Eagle and Square-tailed Kite are listed as vulnerable under the BC Act. The Square-tailed Kite has previously been recorded within the study area and both species both have been recorded within 5 km of the study area (**Figure 9**). Potential foraging and roosting habitat for these species was identified within the study area although no nests have been recorded despite several years of survey in the locality.

### *Hieraaetus morphnoides* (Little Eagle)

The Little Eagle occupies many habitats including open forest, woodland and scrub communities, as well as open agricultural land (Simpson & Day 2004). Little Eagles are known to nest in canopy trees during spring and early summer, in open woodland or riparian zones, where open areas are available to forage for birds, reptiles and mammals (Morcombe 2004; Marchant & Higgins 1993).

### *Lophoictinia isura* (Square-tailed Kite)

The Square-tailed Kite is a summer breeding migrant to the south-east, including the NSW south coast, arriving in September and leaving by March. This species is found in a variety of timbered habitats including dry woodlands and open forests and shows a particular preference for timbered watercourses. Breeding is from July to February, with nest sites generally located along or near watercourses, in a fork or on large horizontal limbs (DECC 2008e). When foraging, this species typically glides just above the tree canopy in search of prey and, therefore, they are more likely to forage above timbered areas rather than open country.

- a. in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.**

The proposed works will result in the temporary removal of up to 0.22 ha of foraging habitat for these species. No characteristic nests were observed in any of the trees to be removed or nearby that may be affected by noise and other disturbances.

It is considered highly unlikely that the removal of a small area of potential foraging habitat will significantly disrupt the life cycle of these species such that viable local populations are placed at risk of extinction.

- b. in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:**
- i. is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or**
  - ii. is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.**

Not applicable. The Little Eagle and Square-Tailed Kite are not an endangered ecological community.

- c. in relation to the habitat of a threatened species, population or ecological community:**

**i. the extent to which habitat is likely to be removed or modified as a result of the action proposed, and**

The proposed works will result in the temporary removal of a very small area of vegetation (up to 0.22 ha) which represents potential foraging and roosting habitat for the Little Eagle and Square-tailed Kite. Given the highly mobile nature of these species, the proposed removal of potential habitat is minimal when compared to the large areas of undisturbed habitat within the study area and wider landscape.

**ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and**

Given the relatively small amount of vegetation to be impacted (0.22 ha), the highly mobile nature of these species and that the connectivity of the surrounding vegetation would be maintained, as vegetation to be cleared is located on the edge of more continuous vegetation, it is unlikely that an area of habitat will become fragmented or isolated from other area of habitat.

**iii. the importance of the habitat to be removed, modified, fragmented or isolated to the long term survival of the species, population or ecological community in the locality,**

The proposal will remove up to 0.22 ha of potential foraging and roosting habitat for these species. This represents a relatively small amount of potential habitat, compared with potential habitat remaining within the study area and wider landscape, and the highly mobile nature of these species. Additionally, the location of the vegetation to be cleared is within the most disturbed portion of the study area. Therefore, it is unlikely that the habitat to be removed would be considered important to the long-term survival of these highly mobile species within the locality.

**d. whether the action proposed is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)**

No areas of outstanding biodiversity values have been declared for these woodland bird species.

**e. whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.**

The proposed works constitute one key threatening processes of relevance to these species, namely Clearing of Native Vegetation, which would result in a small loss of potential foraging habitat. Given the highly mobile nature of these species, that the majority of potential habitat for these species will be conserved within the study area and wider landscape, and that vegetation to be cleared is within the most disturbed portion of the study area, it is unlikely that the proposal would exacerbate any key threatening processes.

## **Conclusion**

The proposal is unlikely to constitute a significant effect on the Little Eagle or Square-tailed Kite given that the proposed works:

- would only disturb a small area of potential foraging habitat within the study area
- not isolate or fragment any currently connecting areas of habitat
- do not impact larger areas of more suitable potential foraging habitat are present within the surrounding landscape.

Consequently, a Species Impact Statement is not required for the proposal with respect to these species.

# Attachment 4 – EPBC Act MNES

## Assessment of Significance

The EPBC Act Administrative Guidelines on Significance set out ‘Significant Impact Criteria’ that are to be used to assist in determining whether a proposed action is likely to have a significant impact on matters of national environmental significance (MNES). Matters listed under the EPBC Act as being of national environmental significance include:

- Listed threatened species and ecological communities
- Listed migratory species
- Wetlands of International Importance
- The Commonwealth marine environment
- World heritage properties
- National heritage places
- Nuclear actions.

Specific ‘Significant Impact Criteria’ are provided for each matter of national environmental significance except for threatened species and ecological communities in which case separate criteria are provided for species listed as critically endangered, endangered and vulnerable under the EPBC Act. The following MNES were assessed for the proposed action:

### Threatened Ecological Communities:

- Cumberland Plain Woodland (CPW)
- Shale Sandstone Transition Forest (SSTF)

### Fauna:

- *Phascolarctos cinereus* (Koala)
- Greater Glider
- Gang-gang Cockatoo
- Spot-tailed Quoll
- *Lathamus discolor* (Swift Parrot)
- Glossy Black Cockatoo
- *Pteropus poliocephalus* (Grey-headed Flying-fox)
- *Chalinolobus dwyeri* (Large-eared Pied Bat)
- 

### Flora:

- No threatened flora species recorded in or adjacent to impact areas

### Migratory species:

- *Ardea ibis* (Cattle Egret)
- *Merops ornatus* (Rainbow Bee-eater)

### ***Cumberland Plain Woodland (CPW)***

An action is likely to have a significant impact on a critically endangered or endangered ecological community if there is a real chance or possibility that it will:

- **reduce the extent of an ecological community**

The proposed action would involve removal of 0.12 ha of modified/regrowth CPW which occurs within a known larger patch of > 50 ha of the ecological community in the locality, much of which is proposed as a Biodiversity Stewardship Agreement site (BSA) and/or a new National Park (Georges River Koala National Park). The CPW to be removed is highly disturbed regrowth CPW along an existing road and extends into a powerline easement maintenance corridor that is periodically slashed. While the proposed action would involve clearing a small, disturbed area of the ecological community, given the extremely small area involved, the modified nature of the impacted CPW and the fact that it will be revegetated and managed for conservation in a BSA site after the underpass is established the extent to which the action will reduce the extent of the community is considered negligible.

- **fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines**

The proposed action would involve disturbance adjacent to an existing road and powerline easement and would therefore not fragment any currently interconnected areas of the ecological community.

- **adversely affect habitat critical to the survival of an ecological community**

Habitat critical to the survival of the community would include areas necessary for the long-term maintenance of the ecological community. The small and relatively disturbed area within the footprint is not considered critical to the survival of the ecological community particularly in the context of the larger patch of CPW within the study area which would not be impacted.

- **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 proposed action would not involve modification or destruction of abiotic factors necessary for the survival of the ecological community in the study area or broader locality. Erosion and sediment control measures will be established before work begins and maintained in effective working order throughout the duration of the works, and until the site has been stabilised to mitigate potential indirect impacts to soil and run-off by the proposed works.

- **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 proposed action would involve clearing and loss of the community across a very small area (0.12 ha) which forms part of a greater than 50 ha patch of the ecological community. The proposed action would not have any impacts such as altered species composition or loss of functionally important species outside of the subject site and will be restored to CPW as part of the management of the BSA site.

Weed species currently occur within the action area. Mitigation measures recommended to prevent further weed invasion and/or spread have been included in the REF. They include washing down machinery before conducting works to limit weed spread or introduction of weed species.



- **cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to:**
  - **assisting invasive species, that are harmful to the listed ecological community, to become established, or**
  - **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**

The proposed action would involve clearing and loss of the community across a very small area (0.12 ha) which forms part of a greater than 50 ha patch of the ecological community. The proposed works are unlikely to assist invasive species becoming established as the subject site is already vulnerable to weed invasion, due to its location adjacent to the powerline easement and road. Once registered as a BSA site, the prevalence of invasive weeds will be reduced by annual conservation management.

- **interfere with the recovery of an ecological community.**

The proposed action would involve clearing and loss of the community across a very small area (0.12 ha) which forms part of a greater than 50 ha patch of the ecological community and will be restored on completion of works. Given the relatively small scale of the impacts and that no impacts are proposed to adjacent areas of CPW within the study area, the proposed action is considered unlikely to interfere with the recovery of the ecological community.

### ***Conclusion***

The proposed action is unlikely to have a significant impact on the listed ecological community, CPW.

### ***Shale Sandstone Transition Forest (SSTF)***

An action is likely to have a significant impact on a critically endangered or endangered ecological community if there is a real chance or possibility that it will:

- **reduce the extent of an ecological community**

The proposed action would involve removal of 0.05 ha of disturbed, regrowth SSTF which occurs within a known larger patch of > 100 ha of the ecological community in the locality, much of which is proposed as a Biodiversity Stewardship Agreement site (BSA) and/or a new National Park (Georges River Koala National Park). The SSTF to be removed is disturbed, regrowth SSTF along an existing road and extends into a powerline easement maintenance corridor that is periodically slashed. While the proposed action would involve clearing a small, disturbed area of the ecological community, given the extremely small area involved, the modified nature of the impacted SSTF and the fact that it will be revegetated and managed for conservation in a BSA site after the underpass is established the extent to which the action will reduce the extent of the community is considered negligible.

- **fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines**

The proposed action would involve disturbance adjacent to an existing road and powerline easement and would therefore not fragment any currently interconnected areas of the ecological community.

- **adversely affect habitat critical to the survival of an ecological community**

Habitat critical to the survival of the community would include areas necessary for the long-term maintenance of the ecological community. The small and relatively disturbed area within the footprint is not considered critical to the survival of the ecological community particularly in the context of the larger patch of SSTF within the study area which would not be impacted.

- **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 proposed action would not involve modification or destruction of abiotic factors necessary for the survival of the ecological community in the study area or broader locality. Erosion and sediment control measures will be established before work begins and maintained in effective working order throughout the duration of the works, and until the site has been stabilised to mitigate potential indirect impacts to soil and run-off by the proposed works.

- **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 proposed action would involve clearing and loss of the community across a very small area (0.05 ha) which forms part of a greater than 100 ha patch of the ecological community. The proposed action would not have any impacts such as altered species composition or loss of functionally important species outside of the subject site and will be restored to SSTF as part of the management of the BSA site.

Weed species currently occur within the action area. Mitigation measures recommended to prevent further weed invasion and/or spread have been included in the REF. They include washing down machinery before conducting works to limit weed spread or introduction of weed species.

- **cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to:**
  - **assisting invasive species, that are harmful to the listed ecological community, to become established, or**
  - **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**

The proposed action would involve clearing and loss of the community across a very small area (0.05 ha) which forms part of a greater than 100 ha patch of the ecological community. The proposed works are unlikely to assist invasive species becoming established as the subject site is already vulnerable to weed invasion, due to its location adjacent to the powerline easement and road. Once registered as a BSA site, the prevalence of invasive weeds will be reduced by annual conservation management.

- **interfere with the recovery of an ecological community.**

The proposed action would involve clearing and loss of the community across a very small area (0.05 ha) which forms part of a greater than 100 ha patch of the ecological community and will be restored on completion of works. Given the relatively small scale of the impacts and that no impacts are proposed to adjacent areas of SSTF within the study area, the proposed action is considered unlikely to interfere with the recovery of the ecological community.

### ***Conclusion***

The proposed action is unlikely to have a significant impact on the listed ecological community, SSTF.

***Phascolarctos cinereus (Koala)***

The Koala is listed as endangered under the EPBC Act. It has been recorded using habitat areas within the study area.

**Criterion a: lead to a long-term decrease in the size of a population of a species**

The proposed works will result in the temporary removal of a very small area of native vegetation (approximately 0.21 ha), that comprises Koala habitat, approximately 50% of which does not include any preferred browse species. Given the average size of the local population's home range is 35 ha, this is a small proportion of one individual's habitat requirements and accordingly, on its own, is highly unlikely to lead to a long-term decrease in the size of the local population. The impact area is part of a much larger (> 250ha) patch of Koala habitat in the locality, most of which is proposed as a Biodiversity Stewardship Agreement site (BSA) and/or a new National Park (Georges River Koala National Park).

**Criterion b: reduce the area of occupancy of the species**

The proposed works will result in the temporary removal of a very small area of Koala habitat (approximately 0.21 ha). As the area will be restored and is part of a much larger contiguous patch of habitat used by Koalas, the temporary loss of this area is highly unlikely to have any long-term impacts on the area of occupancy of the local population.

**Criterion c: fragment an existing population into two or more populations**

The proposed works will result in the removal of a small area of vegetation (approximately 0.21 ha) which represents foraging and movement habitat for the local Koala population. The proposed works are unlikely to result in the fragmentation or isolation of areas of potential Koala habitat and will enhance movement between to the Georges and Nepean River corridors) that have been recognised as being of strategic importance to the local Koala population. The proposed fencing is not expected to present a barrier to Koala movement due to the likely efficacy of the underpasses.

**Criterion d: adversely affect habitat critical to the survival of the species**

The impact area includes a number of 'factors' listed in the Conservation Advice (DCCEEW 2022) that are considered 'habitat critical to the survival of the species', including habitat that is used for essential life cycle requirements (foraging, sheltering, dispersal), is used by an important population, assists in maintaining genetic diversity, used as a corridor). Whilst the proposed action will temporarily adversely affect this habitat, it will have longer term benefits in terms of enhancing connectivity and reducing mortality thereby allowing the local population to disperse and maintain genetic diversity.

**Criterion e: disrupt the breeding cycle of a population**

As the proposed works will involve the temporary removal of a very small amount of foraging and movement habitat, that is within a larger area of habitat which will not become fragmented or isolated, it is unlikely the proposed work would disrupt the breeding cycle of the local population.

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

The proposed works will result in the temporary removal of a very small area of native vegetation (approximately 0.21 ha). Given the average size of the local population's home range is 35 ha, this is a small proportion of one individual's habitat requirements and accordingly, on its own, is highly unlikely to remove or isolate the availability or quality of habitat 'to the extent that the species' is likely to decline.

**Criterion g: result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered species' habitat**

The proposed works are unlikely to assist invasive species becoming established as the subject site is already vulnerable to weed invasion, due to its location adjacent to the powerline easement and road. Once registered as a BSA site, the prevalence of invasive weeds will be reduced by annual conservation management.

**Criterion h: introduce disease that may cause the species to decline; or**

The proposed works would be unlikely to introduce a disease that may cause this species to decline.

**Criterion i: interfere substantially with the recovery of the species**

One of the primary objectives of the National Koala Recovery Plan (DAWE 2022) is to stabilise the area of occupancy and population size of declining populations. The proposed action does not interfere with this objective as its primary purpose is to mitigate road mortality by providing a koala exclusion fence along Appin Road (a known road mortality hot spot) and enhance the connectivity between important habitat areas between the Georges and Nepean Rivers to allow safe passage and dispersal of an expanding local Koala population.

**Conclusion:** The Appin Road Upgrade project, as amended by this addendum REF (to include fauna underpasses and Koala exclusion fencing), is unlikely to result in a 'significant effect' on the Koala or local Koala population. The proposed activity is designed to mitigate a major threat to Koala, that being road mortality on Appin Rd and improving connectivity between areas of important habitat by providing safe passage for east-west and west-east movement of Koalas, with Koala exclusion fencing, between the Georges and Nepean Rivers.

### ***Petauroides volans* (Greater Glider)**

The Greater Glider is listed as endangered under the EPBC Act. It has not been recorded in the study area but has been recorded nearby and may use the study area from time to time. There are no large hollow bearing trees, that would provide potential denning sites for the species that will be impacted.

#### **Criterion a: lead to a long-term decrease in the size of a population of a species**

The proposed works will result in the temporary removal of a very small area of native vegetation (approximately 0.21 ha), that comprises potential foraging habitat for the Greater Glider. There are no large hollow bearing trees, that would be impacted. Given the average home range size of the Greater Glider in low fertility sites in open woodland (such as CPW and SSTF) are around 20 ha (DCEEW 2022), this is a small proportion of one individual's habitat requirements and accordingly, on its own, is highly unlikely to lead to a long-term decrease in the size of the local population. The impact area is part of a much larger (> 250ha) patch of habitat in the locality, most of which is proposed as a Biodiversity Stewardship Agreement site (BSA) and/or a new National Park (Georges River Koala National Park).

#### **Criterion b: reduce the area of occupancy of the species**

The proposed works will result in the temporary removal of a very small area of habitat (approximately 0.21 ha). As the area will be restored and is part of a much larger contiguous patch of habitat used by Greater Gliders to the east in the Georges River corridor, the temporary loss of this area is highly unlikely to have any long-term impacts on the area of occupancy of the local population.

#### **Criterion c: fragment an existing population into two or more populations**

The proposed works will result in the removal of a small area of vegetation (approximately 0.21 ha) which represents potential foraging and movement habitat for the local Greater Glider population. The proposed works are unlikely to result in the fragmentation or isolation of areas of potential Greater Glider habitat as the proposed works are located on the edge of an existing vegetation remnant and as such the connectivity of the surrounding vegetation would be maintained and will not prevent Greater Gliders, if present, moving freely within the greater landscape.

#### **Criterion d: adversely affect habitat critical to the survival of the species**

The Conservation Advice for the Greater Glider (DCEEW 2022) states that 'habitat critical to the survival of the species', includes large contiguous areas of habitat (Yes), smaller or fragmented patches connected to larger patches (Yes), cool microclimate forest in protected gullies, southern slopes (No), areas identified as refuges under climate change scenarios or post fire refuges (No). Given the very small area to be impacted, and there being no evidence of any Greater Gliders in the study area, it is considered that habitat critical to the survival of the species is unlikely to be adversely affected.

#### **Criterion e: disrupt the breeding cycle of a population**

As the proposed works will involve the temporary removal of a very small amount of potential foraging and movement habitat, that is within a larger area of habitat (part of which is occupied by the species) which will not become fragmented or isolated, it is unlikely the proposed work would disrupt the breeding cycle of the local population.

#### **Criterion f: modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline**



The proposed works will result in the temporary removal of a very small area of native vegetation (approximately 0.21 ha). Given the average size of the local population's home range is around 20 ha, this is a small proportion of one individual's habitat requirements and accordingly, on its own, is highly unlikely to remove or isolate the availability or quality of habitat 'to the extent that the species' is likely to decline.

**Criterion g: result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered species' habitat**

The proposed works are unlikely to assist invasive species becoming established as the subject site is already vulnerable to weed invasion, due to its location adjacent to the powerline easement and road. Once registered as a BSA site, the prevalence of invasive weeds will be reduced by annual conservation management.

**Criterion h: introduce disease that may cause the species to decline; or**

The proposed works would be unlikely to introduce a disease that may cause this species to decline.

**Criterion i: interfere substantially with the recovery of the species**

DCCEEW (2022) states that the primary conservation objective for the species is that its population size and the extent and quality of habitat and connectivity required to maintain the population is increased. The proposed action is unlikely to affect meeting this objective.

**Conclusion:** The proposed action is unlikely to have a significant impact on the endangered species, Greater Glider.

### ***Callocephalon fimbriatum* (Gang-gang Cockatoo)**

The Gang-gang Cockatoo is listed as endangered under the EPBC Act. It is an altitudinal migrant, occupying mature, wet sclerophyll forest at higher altitudes in summer and moving to lower altitude, coastal woodlands in winter where it breeds. It has been recorded in the study area foraging and breeding approximately 5-10 km north in St Helens Park. There are no large hollow bearing trees, that would provide potential breeding sites for the species that will be impacted.

#### **Criterion a: lead to a long-term decrease in the size of a population of a species**

The proposed works will result in the temporary removal of a very small area of native vegetation (approximately 0.21 ha), that comprises potential foraging habitat for the Gang-gang Cockatoo. There are no large hollow bearing trees, that would be impacted. Given the species high mobility and wide-ranging foraging behaviour, this is highly unlikely to lead to a long-term decrease in the size of the population. The impact area is part of a much larger (> 250ha) patch of habitat in the locality, most of which is proposed as a Biodiversity Stewardship Agreement site (BSA) and/or a new National Park (Georges River Koala National Park).

#### **Criterion b: reduce the area of occupancy of the species**

The proposed works will result in the temporary removal of a very small area of foraging habitat (approximately 0.21 ha). As the area will be restored and is part of a much larger contiguous patch of habitat, the temporary loss of this area is highly unlikely to have any long-term impacts on the area of occupancy of the population.

#### **Criterion c: fragment an existing population into two or more populations**

The proposed works will result in the removal of a small area of vegetation (approximately 0.21 ha) which represents potential foraging habitat for the Gang-gang Cockatoo. As the species is highly mobile, the proposed works are unlikely to result in the fragmentation or isolation of populations of Gang-gang Cockatoos.

#### **Criterion d: adversely affect habitat critical to the survival of the species**

The Conservation Advice for the Gang-gang Cockatoo (DCCEEW 2022) states that 'habitat critical to the survival of the species', includes all foraging habitat during the breeding and non-breeding season.

Given the very small area to be impacted, it is considered that habitat critical to the survival of the species is unlikely to be adversely affected by the action.

#### **Criterion e: disrupt the breeding cycle of a population**

The proposed works will not impact any potential breeding habitat for the Gang-gang Cockatoo.

#### **Criterion f: modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline**

The proposed works will result in the temporary removal of a very small area of native vegetation (approximately 0.21 ha). It is highly unlikely to remove or isolate the availability or quality of habitat 'to the extent that the species' is likely to decline.

#### **Criterion g: result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered species' habitat**

The proposed works are unlikely to assist invasive species becoming established as the subject site is already vulnerable to weed invasion, due to its location adjacent to the powerline easement and road. Once registered as a BSA site, the prevalence of invasive weeds will be reduced by annual conservation management.

**Criterion h: introduce disease that may cause the species to decline; or**

The proposed works would be unlikely to introduce a disease that may cause this species to decline.

**Criterion i: interfere substantially with the recovery of the species**

DCCEEW (2022) states that the primary conservation objective for the species is to prevent further declines and support increases in the population size of the Gang-gang Cockatoo. The proposed action is unlikely to affect meeting this objective.

**Conclusion:** The proposed action is unlikely to have a significant impact on the endangered species, Gang-gang Cockatoo.

### ***Dasyurus maculatus* (Spot-tailed Quoll)**

The Spot-tailed Quoll is listed as endangered under the EPBC Act. It has not been recorded in the study area but has been recorded in the extensive areas of bushland to the east of the study area (Sydney Water Catchment areas, Dharawal National Park, Holsworthy Military area). Spot-tailed Quolls are mainly a forest dependent species, are solitary animals that occur at low densities and are difficult to detect. Males have very large home ranges of up to “a few thousand hectares in size (TSSC 2020).

#### **Criterion a: lead to a long-term decrease in the size of a population of a species**

The proposed works will result in the temporary removal of a very small area of native vegetation (approximately 0.21 ha), that comprises potential foraging habitat for the Spot-tailed Quoll. Given the species high mobility and wide-ranging foraging behaviour, this is highly unlikely to lead to a long-term decrease in the size of the population. The impact area is part of a much larger (> 250ha) patch of habitat in the locality, most of which is proposed as a Biodiversity Stewardship Agreement site (BSA) and/or a new National Park (Georges River Koala National Park).

#### **Criterion b: reduce the area of occupancy of the species**

The proposed works will result in the temporary removal of a very small area of foraging habitat (approximately 0.21 ha). As the area will be restored and is part of a much larger contiguous patch of habitat, the temporary loss of this area is highly unlikely to have any long-term impacts on the area of occupancy of the population.

#### **Criterion c: fragment an existing population into two or more populations**

The proposed works will result in the removal of a small area of vegetation (approximately 0.21 ha) which represents potential foraging habitat for the Spot-tailed Quoll. As the species is highly mobile, the proposed works are unlikely to result in the fragmentation or isolation of populations of Spot-tailed Quolls.

#### **Criterion d: adversely affect habitat critical to the survival of the species**

The Recovery Plan for the Spot-tailed Quoll (DELWP) states that there is ‘insufficient information to identify ‘habitat critical to the survival of the species’, and therefore all habitat is considered habitat critical to the survival of the species’.

Given the very small area to be impacted, it is considered that habitat critical to the survival of the species is unlikely to be adversely affected by the action.

#### **Criterion e: disrupt the breeding cycle of a population**

The Spot-tailed Quoll shelters in fallen logs, boulder piles, burrows and tree, and uses these features for breeding purposes. These attributes are largely absent from the impact area. Accordingly it is considered that the proposed action is unlikely to disrupt the breeding cycle of a population.

#### **Criterion f: modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline**

The proposed works will result in the temporary removal of a very small area of native vegetation (approximately 0.21 ha). It is highly unlikely to remove or isolate the availability or quality of habitat ‘to the extent that the species’ is likely to decline.

#### **Criterion g: result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered species’ habitat**

The proposed works are unlikely to assist invasive species becoming established as the subject site is already vulnerable to weed invasion, due to its location adjacent to the powerline easement and road. Once registered as a BSA site, the prevalence of invasive weeds will be reduced by annual conservation management.

**Criterion h: introduce disease that may cause the species to decline; or**

The proposed works would be unlikely to introduce a disease that may cause this species to decline.

**Criterion i: interfere substantially with the recovery of the species**

The National Recovery Plan for the Spot-tailed Quoll states that the overall objective is to reduce the rate of decline of the Spot-tailed Quoll and ensure viable populations remain throughout its current range in eastern Australia (DEWLP 2016). The proposed action is unlikely to affect meeting this objective.

**Conclusion:** The proposed action is unlikely to have a significant impact on the endangered species, Spot-tailed Quoll.

***Lathamus discolor (Swift Parrot)***

The Swift Parrot is listed as a critically endangered species under the EPBC Act.

The Swift Parrot is a widespread highly mobile species which is endemic to South-Eastern Australia. The species breeds in Tasmania between September and January then migrates to the mainland in autumn to feed on eucalypt species in flower. It has been recorded foraging in Brown Bush in 2018 and there are historical records of foraging birds from the Gilead area including Beulah and Noorumba Reserves.

**Criterion a, b and c: Lead to a long-term decrease in the size of a population; reduce the area of occupancy of a species; fragment an existing population into two or more populations**

The proposed works will result in the removal of a very small area of native vegetation (approximately 0.21 ha). This area represents a very small proportion of foraging habitat for this highly mobile species, within the larger study area and wider landscape. The proposed works are unlikely to lead to the long-term decrease in the area of occupancy or fragment an existing population into two or more populations.

**Criterion d, e and f: Adversely affect habitat critical to the survival of a species; 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 National Recovery Plan for the Swift Parrot (Saunders and Tzaros 2011) states that the priority habitat for the Swift Parrot on mainland Australia (as the species breeds in Tasmania) is areas regularly used by a large proportion of the population and used for prolonged periods of time. The study area has only been used infrequently by a small number of birds (less than 10). The proposal will temporarily remove 0.21 ha of foraging habitat from a much larger area of suitable habitat for this species in the locality. The species is highly mobile and extensive areas of potential foraging habitat will remain within the locality. Therefore the proposal is unlikely to significantly modify, remove or decrease the availability of habitat or adversely affect habitat critical to the survival of the Swift Parrot to the 'extent that the species' is likely to decline.

**Criterion g: 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 proposed works are unlikely to result in the establishment of an invasive species that is harmful to the Swift Parrot.

**Criterion h: Introduce disease that may cause the species to decline;**

The proposed works are unlikely to result in the introduction of diseases causing the Swift Parrot to decline.

**Criterion i: Interfere with the recovery of the species;**

Given that the Swift Parrot does not breed on the mainland, forages widely and that extensive potential habitat for Swift Parrot will remain within the study area and surrounding landscape, the proposed works are unlikely to interfere with the recovery of this species.

**Conclusion:** it is unlikely that the proposed works will lead to a significant impact on the Swift Parrot.



### ***Calyptorhynchus lathami lathami* (Glossy Black Cockatoo)**

*Calyptorhynchus lathami lathami* (Glossy Black Cockatoo) is listed as a vulnerable species under the EPBC Act.

The species has been observed in the study area and broader locality. There are no large hollow bearing trees suitable as breeding sites in the impact area and very limited feed trees (*Allocasuarina* and *Casuarina* cones).

#### **Criterion a: lead to a long-term decrease in the size of an important population of a species**

Whilst the species is known to breed and forage in the locality, as there are no potential nesting sites or foraging habitat being impacted, the action is unlikely to lead to the long-term decrease in the size of an important population of Glossy Black Cockatoo.

#### **Criterion b: reduce the area of occupancy of an important population**

The area of occupancy for Glossy Black Cockatoo is estimated at 470,000 km<sup>2</sup>. The loss of 0.21 ha of potential breeding habitat would not reduce the area of occupancy of an important population.

#### **Criterion c: fragment an existing important population into two or more populations**

Given the mobility of this species, the proposed action is unlikely to fragment an important population into two or more populations.

#### **Criterion d: adversely affect habitat critical to the survival of a species**

The Conservation Advice for the species (DCCEEW 2022) refers to areas necessary for foraging, breeding, roosting and dispersal. As these features are not present in the impact area, the action is unlikely to adversely affect habitat critical to the survival of the species.

#### **Criterion e: disrupt the breeding cycle of an important population**

The proposed action will not disrupt the breeding cycle of the Glossy Black Cockatoo as there is no breeding habitat being impacted.

#### **Criterion f: Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat**

The subject site is already disturbed and modified and the proposed works will not result in the establishment of an invasive species that is harmful to the Glossy Black Cockatoo .

#### **Criterion g: modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline**

The proposed works will result in the temporary removal of a very small area of native vegetation (approximately 0.21 ha). It is highly unlikely to remove or isolate the availability or quality of habitat 'to the extent that the species' is likely to decline.

#### **Criterion h: introduce disease that may cause the species to decline; or**

The proposed works would be unlikely to introduce a disease that may cause this species to decline.

#### **Criterion i: interfere substantially with the recovery of the species**

The proposed action is unlikely to affect meeting this objective.

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

*Pteropus poliocephalus* (Grey-headed Flying-fox) is listed as a vulnerable species under the EPBC Act.

This species inhabits a wide range of habitats including rainforest, mangroves, paperbark forests, wet and dry sclerophyll forests and cultivated areas (Churchill 1998, Eby 1998). Camps are often located in gullies, typically close to water, in vegetation with a dense canopy (Churchill 1998).

This species was not recorded within the study area during field survey, but has been recorded frequently within 5 km of the study area and will likely use resources within the study area and subject site from time to time, the subject site therefore represents potential foraging habitat. The closest flying-fox camp is Campbelltown, approximately 10 km north of the study area. The latest count for this camp in November 2017 estimated a maximum population of up to 2, 500 individuals.

#### **Criterion a: lead to a long-term decrease in the size of an important population of a species**

An important population is defined as a population that is necessary for a species' long-term survival and recovery (DoE 2013). The GHFF is considered to be one population that intermixes up and down the east coast, therefore any bat population is a meta-population of this one "important population".

Under the proposed action 0.21 ha of vegetation representing foraging habitat will be impacted. The amount of habitat to be affected is relatively small given the large amount of foraging habitat available in the broader region. The removal of this potential foraging habitat would not lead to the long-term decrease in the size of an important population of GHFF.

#### **Criterion b: reduce the area of occupancy of an important population**

The distribution of the GHFF extends from Bundaberg in Queensland to Melbourne, Victoria and from the coast inland to the western slopes of New South Wales. The removal of potential foraging habitat from the study area would not reduce the area of occupancy of an important population of GHFF.

#### **Criterion c: fragment an existing important population into two or more populations**

The GHFF is a highly mobile species and forms one large intermixing population along the east Australian coast. No roosting habitat will be impacted and large areas of foraging habitat are present in the region. The proposed action will not fragment an existing important population into two or more populations.

#### **Criterion d: adversely affect habitat critical to the survival of a species**

The draft recovery plan for GHFF (DECCW 2009) identifies foraging habitat that is critical to the survival of GHFF as follows:

*Foraging habitat that meets at least one of the following criteria can be explicitly identified as habitat critical to survival, or essential habitat, for GHFF. Natural foraging habitat that is:*

- 1. productive during winter and spring, when food bottlenecks have been identified*
- 2. known to support populations of > 30 000 individuals within an area of 50 km radius (the maximum foraging distance of an adult)*
- 3. productive during the final weeks of gestation, and during the weeks of birth, lactation and conception (September to May)*

4. *productive during the final stages of fruit development and ripening in commercial crops affected by Grey-headed Flying-foxes (months vary between regions)*

5. *known to support a continuously occupied camp.*

There are a small number GHFF camps within 50 km of study area (DoE 2017). While populations fluctuate between the camps, the Macquarie Fields bat camp has been known to have a population greater than 30,000 individuals and is situated approximately 25 km north of the study area.

The tree species within the study area includes native winter-flowering Eucalypts. While the vegetation on the site may form part of “habitat critical to survival, or essential habitat” based on the above criteria, the loss of 0.28 ha of foraging habitat, is unlikely to lead to a decline in the species or increase survival risk to the species.

**Criterion e: disrupt the breeding cycle of an important population**

The proposed action will not disrupt the breeding cycle of the GHFF. The closest camp is located 10 km north of the study area at Campbelltown. The proposed action is situated far enough away and is unlikely to disrupt this camp during construction.

**Criterion f: Adversely affect habitat critical to the survival of a species; modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;**

No GHFF camps would be removed or disturbed, and extensive foraging habitat exists in the region within large conservation areas and in urban areas. The proposed works would be unlikely to modify, destroy, remove, or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

**Criterion g: Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species’ habitat;**

The subject site is already disturbed and modified and the proposed works will not result in the establishment of an invasive species that is harmful to the GHFF.

**Criterion h: Introduce disease that may cause the species to decline;**

Grey-headed Flying-foxes are reservoirs for the Australian bat lyssavirus (ABL) and can cause clinical disease and mortality in GHFF (DECCW 2009a). The proposed works is unlikely to present a significant ecological stress on known individuals or camps utilizing the subject site and therefore unlikely to affect this species. The proposed work would be unlikely to introduce a disease that may cause this species to decline.

**Criterion i: Interfere substantially with the recovery of the species;**

A Draft National Recovery Plan for the Grey-headed Flying-fox was developed in 2009. As no maternity camps would be removed, proposed works will only result in the removal of a small amount of potential foraging habitat, and that foraging habitat exists in the surrounding landscape it is therefore unlikely the proposed works would to interfere with the recovery of this species.

**Conclusion**

The proposed will result in impacts to 0.21 ha of native vegetation representing potential foraging habitat for this species. The proposed action is unlikely to impact the lifecycle of the GHFF or lead to a decline in the population of GHFF.

Based on the information provided above, the proposed works are unlikely to result in a significant impact for the Grey-headed Flying-fox.

### ***Chalinolobus dwyeri* (Large-eared Pied bat)**

The Large-eared Pied-bat is listed as a vulnerable species under the EPBC Act.

This species occurs in sandstone cliffs and fertile woodland valley habitat within close proximity of each other habitat of importance (NSW DECC 2007d). The species requires a combination of sandstone cliff/escarpment to provide roosting habitat that is adjacent to higher fertility sites, particularly box gum woodlands or river/rainforest corridors which are used for foraging (Pennay 2010 pers. comm. cited in TSSC 2012ad). Roosting has also been observed in disused mine shafts, caves, overhangs and disused Fairy Martin (*Hirundo ariel*) nests (Hoye & Dwyer 1995; Schulz 1998). It also possibly roosts in the hollows of trees (Duncan et al. 1999).

The diet and foraging behaviour of the Large-eared Pied Bat has not been well studied. The relatively short broad wings of this bat suggest that it is manoeuvrable and forages below the canopy (Hoye 2005).

This species has been recorded foraging within the Mt Gilead area (ELA 2018) and potential foraging habitat exists within the study area.

#### **Criterion a: lead to a long-term decrease in the size of an important population of a species**

An important population is defined as a population that is necessary for a species' long-term survival and recovery (DoE 2013). The study site does not support key source populations for breeding or dispersal, populations necessary for maintaining genetic diversity, or populations near the limit of the species range.

#### **Criterion b: reduce the area of occupancy of an important population**

The distribution of the Large-eared Pied Bat extends from Rockhampton in Queensland south to Bungonia in the NSW Southern Highlands. The removal of potential foraging habitat from the subject site would not reduce the area of occupancy of an important population of Large-eared Pied Bat. This species is not known to occupy the study site.

#### **Criterion c: fragment an existing important population into two or more populations**

This is not an important population. The proposed works will result in the removal of a small area of vegetation (approximately 0.21 ha) which represents potential foraging habitat for this species. The proposed works are unlikely to result in the fragmentation or isolation of areas of potential habitat as the proposed works are located on the edge of a larger existing vegetation patch and the Large-eared Pied Bat is a highly mobile species.

#### **Criterion d: adversely affect habitat critical to the survival of a species**

The proposed removal of a small area (0.21 ha) of potential foraging habitat is minimal when compared to the large areas of potential foraging habitat which are present within the study area and surrounding landscape, which would be accessible to this highly mobile species.

Given the small amount of habitat to be removed, that potential foraging habitat will be conserved with the study area and adjacent to the site and that this species is highly mobile, it is unlikely that the habitat to be removed would be considered important to the long-term survival of the species in the locality.

#### **Criterion e: disrupt the breeding cycle of an important population**

No important Large-eared Pied bat populations have been identified in the study area. The area of vegetation to be removed does not represent potential roosting habitat for this species, as it requires a combination of sandstone cliff/escarpment adjacent to higher fertility sites to provide roosting habitat, and has been observed in

disused mine shafts, caves, overhangs, disused Fairy Martin nests and occasionally tree hollows. As such, the proposed works will not disrupt the breeding cycle of an important population.

**Criterion f: Adversely affect habitat critical to the survival of a 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 proposed works will result in the removal of a small area of vegetation (approximately 0.21 ha), which is considered minimal when compared to the large areas of potential foraging habitat which are present within the study area and surrounding landscape, which would be accessible to this highly mobile species. Given the small amount of habitat to be removed, that potential foraging habitat will be conserved with the study area and adjacent to the site and that this species is highly mobile, it is unlikely that the habitat to be removed would be considered important to the long-term survival of the species in the locality.

Given the highly mobile nature of the species and the fact that the vegetation on site does not represent primary roosting or foraging habitat the potential for fragmentation or isolation is minimal.

**Criterion g: 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 an invasive species that is harmful to the Large-eared Pied bat.

**Criterion h: Introduce disease that may cause the species to decline;**

The project will not result in the introduction of a disease that is harmful to the Large-eared Pied bat.

**Criterion i: Interfere substantially with the recovery of the species;**

Considering the above factors, the project will not interfere substantially with the recovery of this species.

The action is not likely to have a significant impact on the Large-eared Pied bat.

***Ardea ibis (Cattle Egret)***

*Ardea ibis* (Cattle Egret) is listed as a migratory species under the EPBC Act.

The Cattle Egret is widespread in Australia, though a relatively recent migrant to Australia. The Cattle Egret occurs in tropical and temperate grasslands, wooded lands and terrestrial wetlands. It has occasionally been seen in arid and semi-arid regions however this is extremely rare. High numbers have been observed in moist, low-lying poorly drained pastures with an abundance of high grass; it avoids low grass pastures. The Cattle Egret has a diverse diet, which includes fish, macroinvertebrates, frogs, lizards, snakes and small birds and mammals (DEWHA, online).

This species has been recorded within 5 km of the study area, and the study area provides potential marginal foraging habitat.

**Criterion a: 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;**

The study area does not represent important habitat for the Cattle Egret as it does not occur on the limit of the species' range, and does not support an ecologically significant proportion of the population of the species, is not of critical importance to the species at particular life cycle stages and is not within an area where the species is declining.

The proposal would result in the removal of potential marginal foraging habitat for this species. However, removal of vegetation would not represent a substantial loss of foraging habitat for this species, as it is unlikely to be reliant on the resources present in the study area and able to use other areas due to its highly mobile nature. The proposed works would not impact on wetland areas or water bodies. Therefore, the proposed loss of 0.28 ha of potential foraging habitat is not likely to substantially modify, destroy, or isolate an area of important habitat for this species.

**Criterion b: 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**

The project will not result in the establishment of an invasive species that is harmful to the Cattle Egret.

**Criterion c: seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.**

The proposal is unlikely to seriously disrupt the lifecycle of an ecologically significant proportion of the population of the Cattle Egret. The removal of vegetation within the study site represents a relatively small amount of potential marginal foraging habitat, compared with potential habitat remaining within the study area and wider landscape, and will not impact on wetland areas or water bodies. As such the proposed works would be unlikely to affect this species, which has a diverse diet and forages over a range of habitats.

Based on the information provided above, the proposed works are unlikely to result in a significant impact for the Cattle Egret. Therefore, a referral to the Commonwealth is not required.

***Merops ornatus (Rainbow Bee-Eater)***

The Rainbow Bee-eater is listed as a migratory species under the EPBC Act.

The Rainbow Bee-eater is distributed across the majority of mainland Australia, with the exception of the most arid zones of the central and western deserts. It can be found on several near-shore islands, but is not found in Tasmania. Southern populations of Rainbow Bee-eater are known to migrate following breeding to spend winter



in northern Australia. It is found mainly in open forests, woodlands and shrublands, and can tolerate some level of human disturbance or habitation, but has been found in a wide range of habitat types from vine thickets to sedgeland to dune systems. The Rainbow Bee-eater generally forages from open perches, from which it may scan for prey. Prey usually consists of flying insects, however they have been known to occasionally eat earthworms, spiders and tadpoles (DEWHA, online).

This species has not been recorded within 5 km of the study area, however the study area represents potential foraging habitat for this species.

**Criterion a: 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;**

The study area does not represent important habitat for the Rainbow Bee-eater as it does not occur on the limit of the species' range, and does not support an ecologically significant proportion of the population of the species, is not of critical importance to the species at particular life cycle stages and is not within an area where the species is declining.

The proposal would result in the removal of potential foraging habitat for this species. However, removal of vegetation would not represent a substantial loss of foraging habitat for this species, as it is unlikely to be reliant on the resources present in the study area and able to use other areas due to its highly mobile nature. Therefore, the proposed loss of 0.28 ha of potential foraging habitat is not likely to substantially modify, destroy, or isolate an area of important habitat for this species.

**Criterion b: 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**

The project will not result in the establishment of an invasive species that is harmful to the Rainbow Bee-eater.

**Criterion c: seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.**

The proposal is unlikely to seriously disrupt the lifecycle of an ecologically significant proportion of the population of the Rainbow Bee-eater. The removal of vegetation within the study site represents a relatively small amount of potential foraging habitat, compared with potential habitat remaining within the study area and wider landscape, and as such would be unlikely to affect this species, which forages over a range of habitats including cleared areas.

Rainbow Bee-eaters nest predominantly in banks of rivers, creeks, or dams. No areas of potential breeding habitat occur within the study site. Therefore, the proposed works will not disrupt the lifecycle of the Rainbow Bee-eater.

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# Appendix F

## Heritage assessment

4 November 2022

Will Laurantus  
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Exchange Place, 300 Barangaroo Avenue, Barangaroo NSW 2000

Our Reference: 19-0457F wlc1

Re: Additional heritage information, to GML 2022, Mt Gilead, Stage 2, Appin Road Koala Crossing

GML Heritage Pty Ltd (GML) was commissioned by Lendlease Communities (Lendlease) to prepare an Aboriginal heritage Archaeological Research Design (ARD) for the two proposed Appin Road Koala Crossing, at Glen Lorne and Browns Bush. GML's 2022 report is part of the larger package of Aboriginal cultural assessment for the Mt Gilead Stage 2 project, which will lead to an eventual application for a 'whole of area' Aboriginal Heritage Impact Permit (AHIP), under Section 90 of the *National Parks and Wildlife Act 1974*. The locations subject to this ARD are zoned in GML 2022: Figures 1.3 and 1.4. Aboriginal heritage assessment and the ARD did not include land areas outside these two zones. We understand that other areas along Appin Road have been previously assessed by Virtus Heritage (2017, and 2019), Ecological (2019), and GML in 2022.

The original assessment of the Appin Road corridor identified some landforms with archaeological sensitivity (Virtus Heritage, 2017). However their opinion on the sensitivity of the corridor was entirely changed following their program of archaeological test excavation.

The synopsis of the three latest heritage investigations is that the Appin Road corridor holds low Aboriginal archaeological potential for Aboriginal objects. This opinion is espoused by all three separate studies. We have provided a review of these reports below for reference.

We have also provided a response to the TfNSW comments to the GML 2022. We trust these responses provide direction for the management of the koala fence installation. Yours sincerely,

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Dr Tim Owen  
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## Prior Heritage Assessments

Prior Aboriginal heritage assessment for landforms with archaeological potential associated with the full Appin road corridor, including the route of the fence, has been made by Virtus Heritage (2017), Ecological Australia (August 2018), and Virtus Heritage (2018):

- Virtus Heritage (2017), modelling presented in Virtus Heritage 2019
- Ecological Australia (August 2018), *Appin Road Safety Improvements Stage 2 PACHCI Aboriginal Archaeological Survey Report*
- Virtus Heritage (April 2019), *Mt Gilead MDP Lands Archaeological Test Excavations AHIP # C0003570, Campbelltown LGA*

In addition, GML has prepared the following reports which are relevant:

- GML (October 2021), *Mt Gilead Stage 2, Historical Archaeological Assessment*
- GML (September 2022), *Mt Gilead Stage 2, Appin Road Koala Crossing, Archaeological Research Design*. This report has been issued to the TfNSW, but not distributed further.
- GML (July 2022a), *Mt Gilead Stage 1 Aboriginal Archaeological Salvage Excavation Report*. This report has been issued to Stage 1 RAPs and Heritage NSW.
- GML (July 2022b), *Mt Gilead Stage 2 Aboriginal Cultural Heritage Report*. This report (which is iterative, and will be added to as work continues) will be issued to Stage 2 RAPs in December 2022.

A review of reports as relevant to Appin Road is as follows.

Virtus Heritage 2017 zoned lands with a variety of archaeological potential levels, ranging from little-nil to high potential, this mapping is shown in Figure 1. We note this designation was prior to the archaeological test excavation which encompassed landforms west of Appin Road. Virtus Heritage 2017 assessment has been used by TfNSW as part of the review for Pain Road and GML 2022.







The Ecological Australia Stage 2 PACHCI assessment of the Appin Road corridor returned a significantly different outcome to the Virtus Heritage 2017 mapping, concluding that:

Landscape features that were identified within the PAD area (for example being located on a hill crest within 200 m of a water source) do not continue within the study area it is therefore unlikely that the archaeological potential continues within the study area.

As a result of this study it has been concluded that no further heritage assessment is warranted prior to the commencement of work. (Ecological 2018:31)

The assessment that the Appin Road corridor holds a general low level of archaeological potential was consequentially tested through archaeological test excavation, on Lendlease owned land to the west of Appin Road, by Virtus Heritage (2018) (AHIP C0003570), with archaeological salvage excavation undertaken by GML Heritage (2022) (C0005248).

The program of archaeological test excavation (2018) confirmed a very low density of Aboriginal objects on most landforms in the wider area. As such Virtus Heritage (April 2019) revised entirely the mapping of Aboriginal archaeological sensitivity for all landforms adjacent and along Appin Road, on both side of the road. The revised mapping is shown in Figure 2. With respect to revision of the archaeological sensitivity for Appin Road Virtus Heritage (April 2019) stated:

Much of the remainder of the sandstone creek landform has been subject to a variety of disturbances (damming of creek lines, vegetation removal, erosion) and none of the other testing areas contained artefact densities above one artefact per m<sup>2</sup>. These were therefore included in the area of general background scatter of artefacts and designated as low archaeological sensitivity.

The following definitions apply to the revised categorisation of the relative sensitivity of the project area as mapped in Figure 24 [reproduced to Figure 2, below].

Low archaeological sensitivity – these are areas where the testing has shown a general low density background artefact scatter and/or ground surface disturbance would indicate that there is little chance of locating intact concentrations of artefacts that could be used to answer regional research questions....

In light of these results, it was decided to re-assess the archaeological potential of the study area as a whole. The landforms presented in Figure 22 [not shown here] were used to consider potential for past land use.

Areas of steeper slope were considered to have lower potential for sites. Areas of ridgeline, flats and adjacent to watercourses are initially considered to have higher potential. A conservative approach was taken to enable testing of the variety of landforms to confirm the potential of the various areas. In considering the overall potential of the study area, levels of ground disturbance from previous land use were also taken into account.





As expected, testing results did not support the prior mapping of PADs. A revised sensitivity map (Figure 24 [Figure 2 below]) was produced to take into account the results of the testing, as discussed above. Although all PAD areas that overlapped with testing areas contained some Aboriginal objects in most cases the densities did not support designation as a PAD above and beyond the background artefact densities. (Virtus Heritage 2019:82-83)

The Mount Gilead Stage 2 lands include the biobanking areas on the east of Appin Road and have been surveyed by GML (July 2022a). This survey work did not identify any Aboriginal stone objects, nor allocate areas with PAD adjacent to the road. The survey did however identify cultural trees in and around the road corridor. These have been entered on AHIMS.

A further recent assessment of just the Koala Crossings locations at Glen Lorne and Browns Bush was made by GML (September 2022). This assessment concluded

In summary, both study areas are positioned on landforms which have not previously been associated with high density expressions of subsurface Aboriginal objects. The landforms are flat to shallow slopes, away from creek lines and more permanent water. On the basis of landform association, these locations would possibly contain a background expression of Aboriginal objects, similar to MGS1 Areas O and P. (GML 2022:28)

In conclusion we find that three independent studies on the Aboriginal archaeological potential of the Appin Road corridor have each identified the landforms have low sensitivity for Aboriginal objects.

## **Response to ARD Comments**

### **AHIP C0005248**

AHIP C0005248 commenced on 29 April 2020 and remains in force until 29 April 2035. On 31 August 2020 the AHIP was varied to revise the description of the proposed works to include:

All works associated with the development of the MDP lands and as generally described in documentation submitted with the AHIP application by Lendlease Communities (Figtree Hill) Pty Limited, including residential construction and associated infrastructure works, bulk earthworks, tree removal works, landscaping works and road works.

GML understand that Lendlease must ensure that all works within the AHIP area (all works on the western side of the road) will be completed in accordance with the requirements of the AHIP.

### **Archaeological Test Excavation**

As detailed above, three prior archaeological assessments have described the Appin Road corridor as holding low potential for Aboriginal objects. The area to which the fauna fence





is proposed to be installed are considered significantly disturbed. The disturbance of the land can be described as activities which have disturbed the land, namely: construction of rural infrastructure (such as dams and fences), construction of roads, trails and tracks, construction or installation of utilities and other similar services and substantial grazing involving the construction of rural infrastructure. Lendlease has prepared a review of disturbances, provided images of the whole route, and prepared a methodology work statement for the proposed action. Reference should be made to this document for further information.

GML has reviewed and input into the work methodology. The methodology has been prepared to limit all new impacts, with a positional like-for-like replacement of existing fence posts, and use of the already degraded firetail. All site workers must be inducted in requirements for Aboriginal cultural heritage, through the already prepared induction package, which is implemented for Mt Gilead Stage 1.

We also understand that Lendlease identify the proposed action as a low impact land management activity as described under the NPW Act Regulations 2019, Section 58 (b)(iii), and (c)(iv). The action therefore has a defence against harm should any unexpected Aboriginal objects be identified during the works. Should any unexpected Aboriginal objects be found during work, the Aboriginal cultural heritage induction includes a discovery and stop work mechanism.

If Aboriginal objects were identified, then an AHIP would need to be sought under Section 90 of the NPW Act.

## Extent of testing

GML 2022 ARD is associated with the two koala crossing works. These works both extend back and away from Appin Road, and require removal of topsoil from a relatively wide area (when contrasted against the footprints for the fence posts). Despite three archaeological assessments of low archaeological potential, to ensure categorically there are no Aboriginal objects in the footprint of the larger koala crossing works, Lendlease has sought the preparation of an ARD, which will be implemented under Requirements 15 and 16 of the *Code of Practice for Archaeological Investigations of Aboriginal Objects in NSW*. This work will form a small part of archaeological test excavation for the much larger Stage 2 project, noting the outcomes would inform the statutory process for the koala crossings.

Beyond the assessment of archaeological potential for landforms along Appin Road by Virtus Heritage, Ecological and GML, we do not support a program of archaeological test excavation for the exact locations of any new fence posts on the following basis:

- The landforms associated with the fence posts have been disturbed by prior works. A review of disturbance has been prepared by Lendlease.





- The location for the new fence is directly adjacent to Appin Road, which raises a significant safety concern for any workers. Work in close proximity to vehicles travelling at 80kmh is clearly not safe.
- We understand that the impacts from installation of the fence posts will be minimal, and to a large degree constrained to existing fence post locations, which have already been impacted through any soil horizon capable of retaining Aboriginal objects. Testing would therefore not be required for the majority of fence post locations.
- Any new fence post augered will have a smaller impact than the minimum size of an archaeological test unit. The width of the largest proposed 'end-posts' has a maximum diameter of 450mm, which is an area of 0.16m<sup>2</sup> (the smaller posts have an area of 0.1m<sup>2</sup>). Test units excavated under the *Archaeological Code of Practice* have a minimum area of 0.25m<sup>2</sup>. The impact from test units would be considerably greater than the impact of the fence post augers.
- We understand that Lendlease have a defence against harm under the NPW Act Regulations 2019, Section 58 (b)(iii), and (c)(iv) for this activity.

## Historical archaeology

We support the need for undertaking historical archaeology at the Browns Bush site. This action was identified in GML's historical heritage assessment (GML 2021, item 27, pp 157). We have prepared a historical archaeology research design (HARD) for this work, which would be undertaken following completion of Aboriginal test excavation—thereby ensuring the historical archaeological work did not knowingly impact Aboriginal objects.

Historical archaeology testing is assessed as having a minimal impact on relics of local significance and as such qualify for an Excavation permit Exception s139(4) under clause 2 (d):

(d) Any disturbance or excavation of land for archaeological test excavation of relics of local heritage significance completed in accordance with the guideline 'Relics of local heritage significance: a guide for archaeological test excavation' published by Heritage NSW.

If relics are found during the course of the historical archaeological program, a notification of the relic's location under Section 146 of the Heritage Act is required. Depending on the nature of the discovery, additional assessment and approval may be required prior to the recommencement of excavation and works in the area. If the archaeological program identifies that further archaeological work is required, for example salvage excavation, then a Section 140 excavation permit may be necessary prior to the koala fence being installed.





## Consultation log

We confirm that Aboriginal community consultation for the Mt Gilead Stage 2 project has adhered to the OEH 2010 *Aboriginal cultural heritage consultation requirements for proponents 2010*. Consultation has included reviews by the RAPs of assessment methodologies, and participation in the formal archaeological field survey. We have also implemented a program of Aboriginal community interviews to obtain understanding of local and regional cultural connections.

The outcome from the consultation is a standalone community engagement report, and the formal consultation log. These are not publicly distributed documents, and access will need to be restricted. These documents cannot be placed on public exhibition.

Request for access to these documents can be arranged through Lendlease.

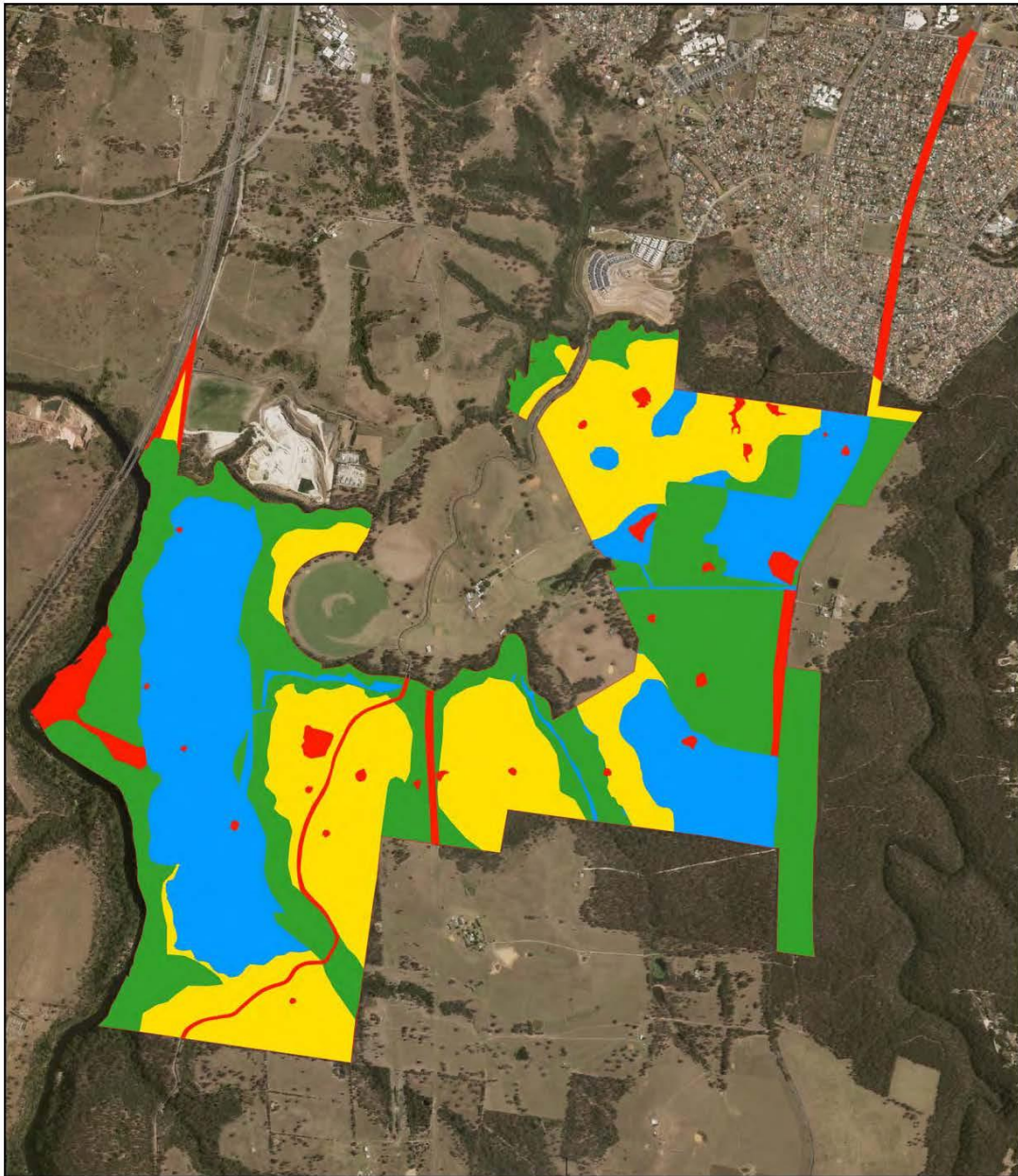
## Archaeology methods and other matters

Archaeological methods to be enacted through the program of test excavation will adhere with the *Archaeological Code of Practice*. Any Aboriginal objects would be stored within GML's office in a secure artefact facility. During the excavation, any identified archaeological features would be sampled in accordance with best practice. Post excavation archaeological surveyor Guy Hazell will prepare a spatial survey of the testing areas, which includes all pre and post levels.

As the proposed test excavation work is located within the Mt Gilead Stage 2 project area, it is proposed that the GML 2022 ARD will be distributed to the Mt Gilead Stage 2 RAP group for their review and comment. As required under the *Archaeological Code of Practice* (Requirement 15) the formal review must precede any on site work. Comments and responses will be logged within the Mt Gilead Stage 2 consultation log.







Source: Lendlease, SIXMAPS, Mitchell (2016)

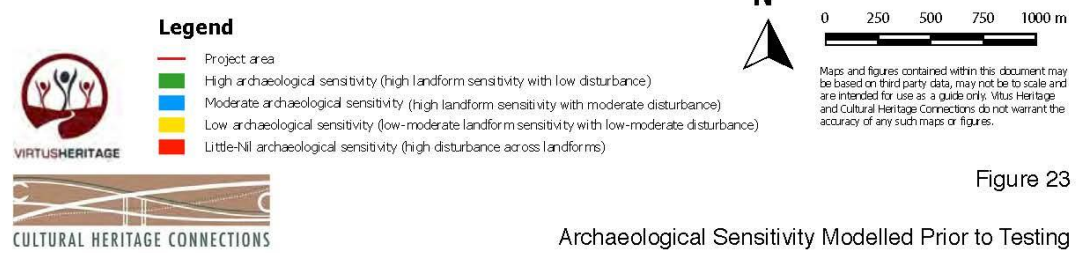


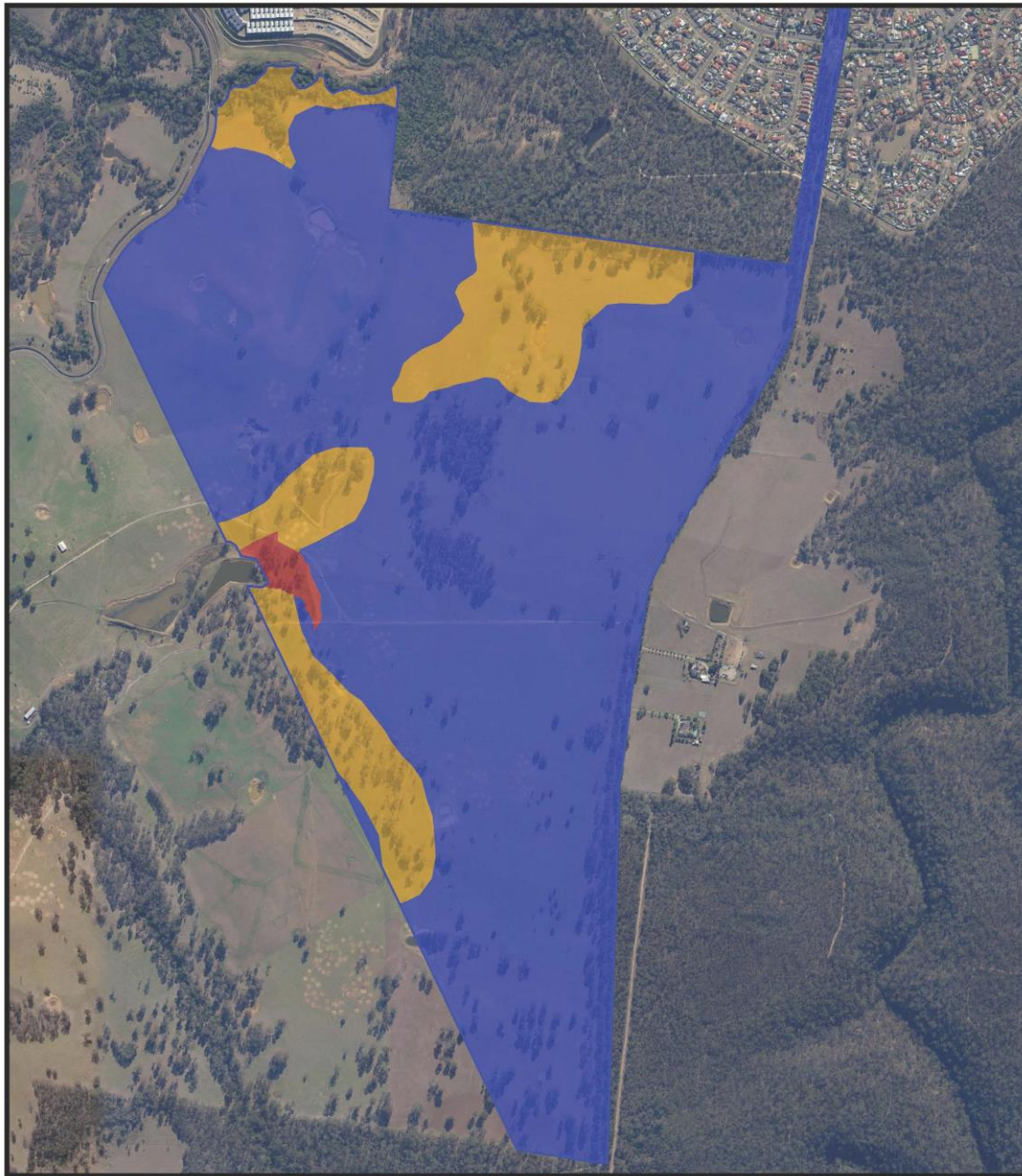
Figure 23

Archaeological Sensitivity Modelled Prior to Testing

Figure 1 Virtus Heritage 2019, Figure 23. This shows Aboriginal archaeological modelling prior to the program of archaeological test excavation. This modelling was altered in 2019 after test excavation.







Source: NSW LPI

**Legend**

Project Boundary

Archaeological Sensitivity:

Low

Low to Moderate

Moderate to High



0 250 500 750 m



Maps and figures contained within this document may be based on third party data, may not be to scale and are intended for use as a guide only. Virtus Heritage and Cultural Heritage Connections do not warrant the accuracy of such maps or figures.



**Figure 24**

**Mt. Gilead Revised Archaeological Sensitivity**

Figure 2 Virtus Heritage 2019, Figure 24. This figure shows the revised archaeological sensitivity of the Appin Road corridor following their archaeological test excavation within the Mt Gilead Stage 1 area.



# 1 Introduction

## 1.1 Preamble

GML Heritage Pty Ltd (GML) has been engaged by Lendlease Communities Pty Ltd (Lendlease) to prepare an Historical Archaeological Research Design (HARD) for historical archaeological investigations at Browns Bush; one of two koala crossings along Appin Road, Gilead (Figure 1.1, Figure 1.2, Figure 1.3). The two locations will be subject to construction of koala crossings, with infrastructure located beneath Appin Road. The road corridor is owned and maintained by the NSW government. Land east and west of Appin Road is owned by Lendlease.

The land on the eastern side of Appin Road is associated with a designed biobanking area positioned within the larger Mount Gilead Stage 2 (MGS2) project area. GML is in the process of undertaking Aboriginal community consultation, heritage assessment and reporting for the wider MGS2 area. A program of Aboriginal archaeological test excavations (subject of a separate report—*Mount Gilead, Stage 2, Appin Road Koala Crossing Archaeological Research Design, GML September 2022*) is to be conducted within the proposed area of works within MGS2 at both the Glen Lorne and Browns Bush koala crossings.

Previous historical archaeological assessment of the Browns Bush site (*Mount Gilead Stage 2, Historical Archaeological Assessment, GML October 2021*) included an area with a former c1880s cottage—Site 27 (Figure 1.4). There was an identified moderate level of potential for historical archaeological remains associated with the cottage site—such as post holes, wall footings, paths, subfloor surfaces, water management structures, yard surfaces and garden beds. Following review of the draft Review of Environmental Factors (REF) Addendum documents—and given the potential for historical archaeological remains within the Browns Bush site—it is recommended that a program of historical archaeological test excavations be undertaken concurrent to the Aboriginal archaeological testing program.

The following HARD has been prepared to support an application for a program of historical archaeological testing under s139(4) of the *Heritage Act 1977* (NSW) (Heritage Act) at the Browns Bush site. This report includes a research framework and methodology to guide the archaeological investigations. The testing program has been designed to understand the nature, extent and significance of the potential historical archaeological resource. This report forms part of the REF for the two proposed koala crossings.





Figure 1.1 Mt Gilead, location in southern Sydney, between Campbelltown and Appin.

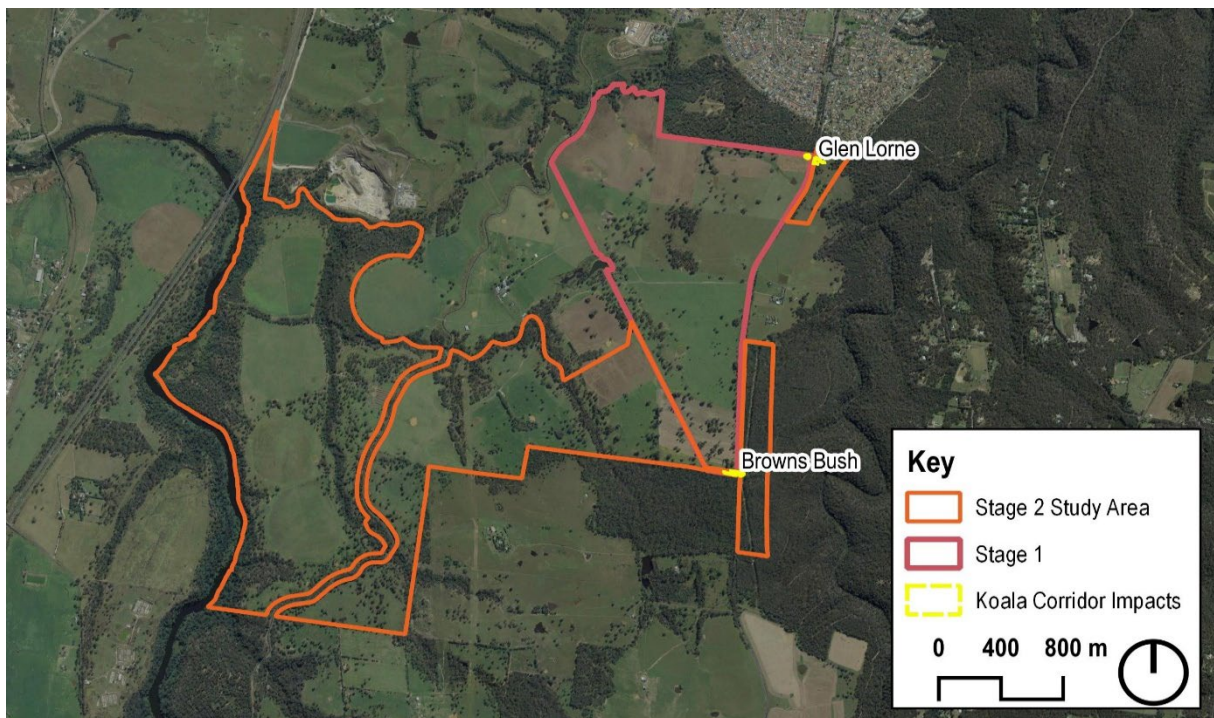


Figure 1.2 Showing the locations of the Glen Lorne and Browns Bush koala crossings, inside the MGS2 eastern biobanking zones.



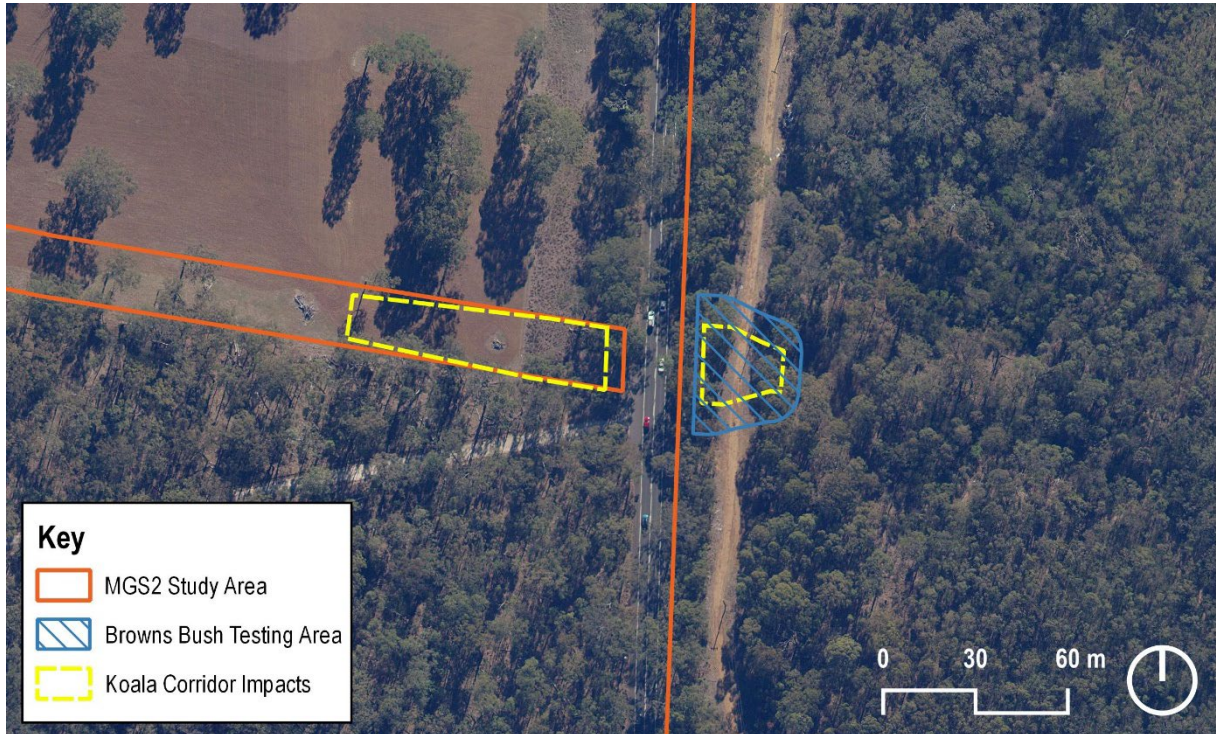


Figure 1.3 Details of the Browns Bush koala crossing, showing proposed testing area.

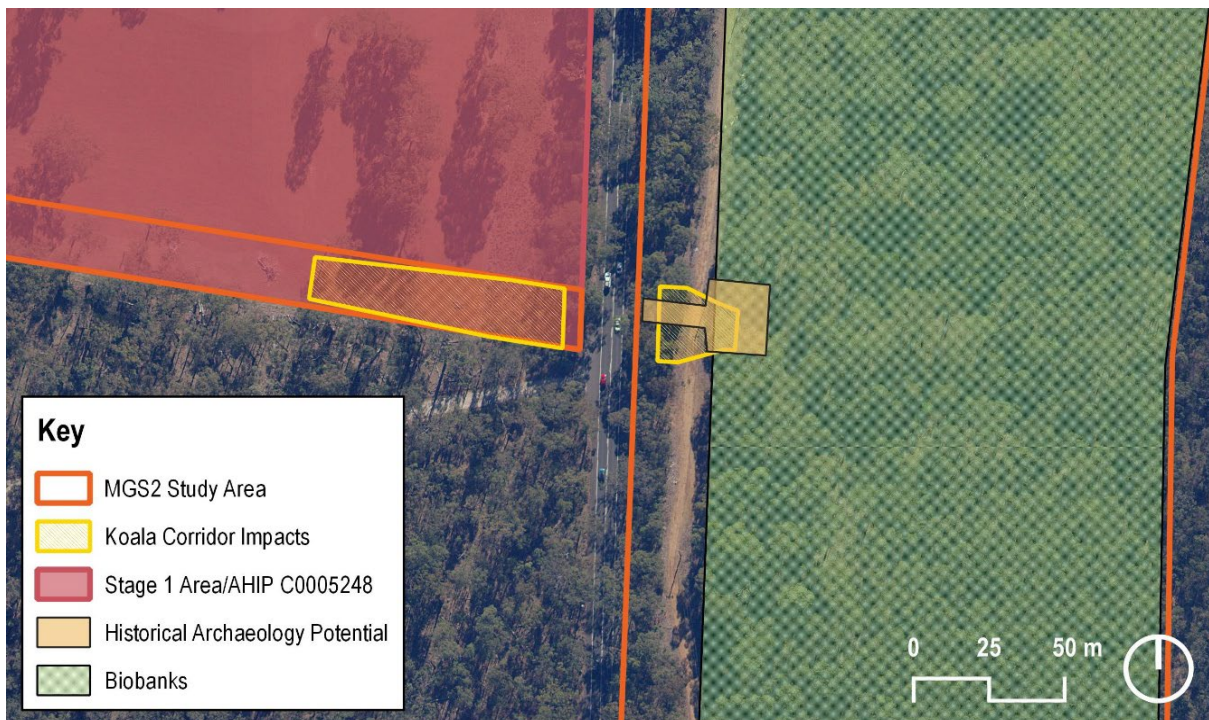


Figure 1.4 Browns Bush Site in relation to Potential Cottage Site 27, showing existing permits, curtilages and environmental zones.

## 1.2 Background

### 1.2.1 Statutory context

In NSW, historical archaeology is principally protected under the following Acts:

- the *Heritage Act 1977* (Heritage Act)
- the *Environmental Planning and Assessment Act 1979* (EP&A Act).

#### Heritage Act 1977

The Heritage Act affords automatic statutory protection to 'relics'. The Act defines 'relic' as any deposit, object or material evidence that:

- a) relates to the settlement of the area that comprises New South Wales, not being Aboriginal settlement, and*
- b) is of State or local heritage significance.*

Sections 139–145 of the Heritage Act make it an offence to excavate a relic, except in accordance with an excavation permit (or an exemption from the need for a permit) issued by the Heritage Council of New South Wales.

Section 139 [1] of the Act states that:

A person must not disturb or excavate land knowing or having reasonable cause to suspect that the disturbance or excavation will or is likely to result in a relic being discovered, exposed, moved, damaged or destroyed unless the disturbance or excavation is carried out in accordance with an excavation permit.

Approval to impact or harm archaeological relics is required under these provisions.

#### Environmental Planning and Assessment Act 1979

The EP&A Act is administered by the NSW Department of Planning and Environment and provides for the protection of archaeological sites through listings on LEPs, which guide local councils in making planning decisions.

The EP&A Act provides a statutory framework for the determination of development proposals. It provides for the identification, protection and management of heritage items through inclusion in schedules to planning instruments such as Local Environmental Plans (LEPs) or Regional Environmental Plans (REPs). Heritage items in planning instruments are usually historic sites but can include archaeological items. The EP&A Act requires that appropriate measures be taken for the management of the potential archaeological resource by means consistent with practices and standards adopted in meeting the requirements of the NP&W Act.

## Heritage items in the vicinity

The Browns Bush site is in the vicinity of several heritage items listed on the *Campbeltown Local Environmental Plan 2015* (Campbeltown LEP). In 2020, the Mount Gilead Estate was officially added to the State registry. These items are listed in Table 1.1 and are shown on Figure 1.5.

Table 1.1 Heritage items in the vicinity of the Browns Bush site.

Item Name	Address	Significance	Listing	Item No
Humewood Forest	767 Appin Road	Local	CLEP	53
Beulah	767 Appin Road	State	CLEP	00368
Mount Gilead	901 Appin Road	State	SHI	02020
Glen Lorne	982 Appin Road	Local	CLEP	55

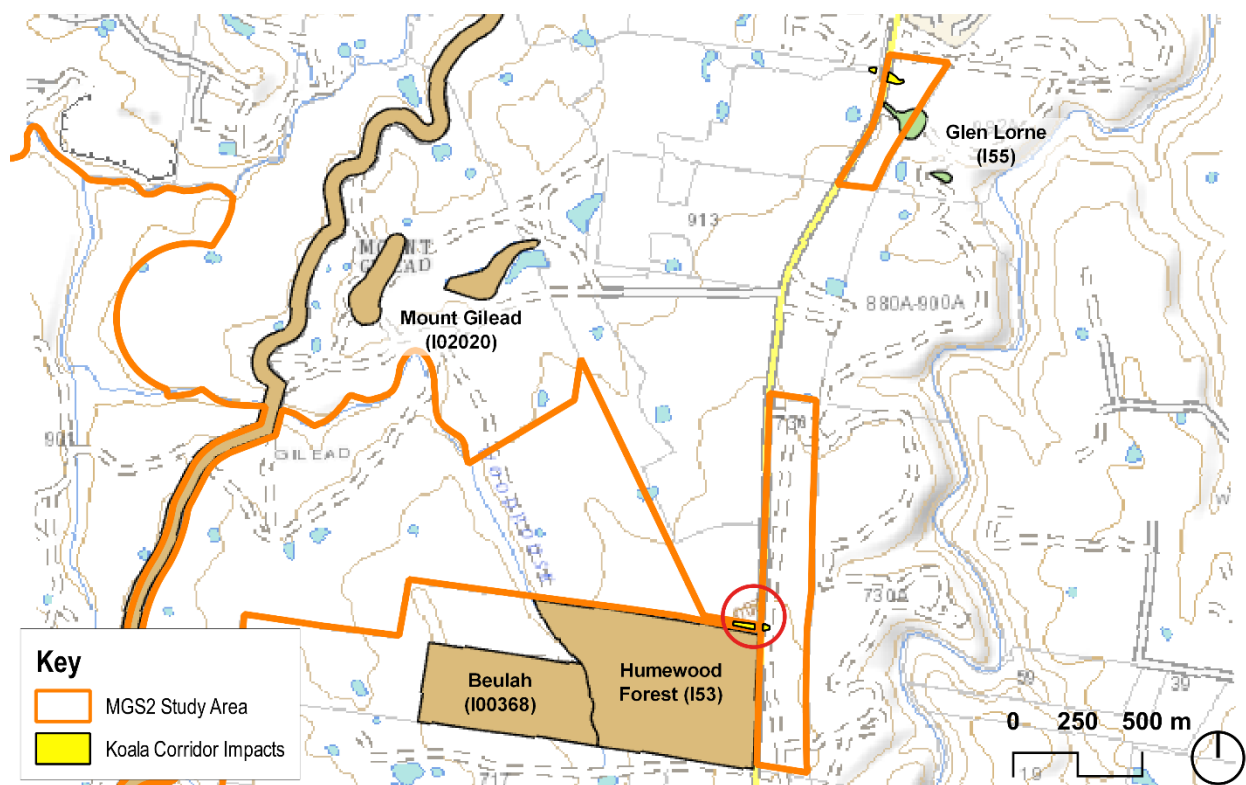


Figure 1.5 Heritage items in the vicinity of the Browns Bush site (red circle). (Source: NSW ePlanning Spatial Portal with GML overlay)



## 1.2.2 Previous historical archaeological assessment

### Historical archaeological potential

Previous historical archaeological research (*Mt Gilead Stage 2, Historical Archaeological Assessment, GML October 2021*) identified the Browns Bush investigation area—east of Appin Road—as the site of a former c1880s cottage (Site 27). The following historical background and summary archaeological assessment has been adapted from this research (GML October 2021, Sections 2.1.1 and 5.7).

The site was situated within an early 300-acre grant (Portion 76) between Appin Road—completed by 1823—and Georges River, in the Menangle Parish, granted to William James Brown in 1823 (GR 62 18). By 1867, Portion 76 formed part of the Mount Gilead Estate, under the ownership of Edmund Hume Woodhouse (GR 53 197). Woodhouse developed Mount Gilead as a dairy and grazing property. He introduced dairying to the Campbelltown district and invested in a variety of livestock, including cattle—dairy and beef breeds; sheep for wool and meat; poultry; Berkshire pigs and more exotic animals—deer, alpacas and llamas. The property title was transferred to his son, Edmund Bingham Woodhouse, in 1876.

A cottage is depicted in this location—immediately east of Appin Road—on the 1888 Dawson and Dawson survey of the Mount Gilead Estate (Figure 1.6), prepared for the—unsuccessful—sale of Mount Gilead. Early twentieth century accounts of the estate note several ‘early’ workers’ cottages survived ‘at some distance from the main buildings’ (*Sydney Mail* 22 Dec 1920, p.24). It is possible Site 27 is one such workers’ cottage, dating from the later nineteenth century. We note that while the later 1917 plan shows several buildings within the estate, no structure is located in the position of Site 27 (Figure 1.7).

The assessment of historical archaeological potential for ‘Potential 1888 Cottage Site (Site 27)’ identified an overall low to moderate potential for remains associated with the 1888 cottage site (Table 1.2).

Table 1.2 Assessed Levels of Archaeological Potential and Significance for the Potential 1888 Cottage Site (Site 27). (Source: GML 2021, Table 7.1)

Possible Archaeological Remains	Archaeological Potential	Extent	Significance
<ul style="list-style-type: none"> <li>Tree boles (burnt or stumped) associated with land clearing.</li> <li>Ephemeral evidence associated with garden beds, including pollen and seeds that could identify plant types.</li> </ul>	Low	Unknown	Local, but further research is required

Possible Archaeological Remains	Archaeological Potential	Extent	Significance
<ul style="list-style-type: none"> <li>• Potential remains of cottage might include postholes, wall footings/foundations, paths, yard surfaces and floor surfaces.</li> <li>• Water management structures, including wells and cisterns.</li> <li>• Pits cut and filled with rubbish as a form of expedient disposal.</li> <li>• Sealed artefact deposits contained within structural features, such as cesspits, wells, drains, cisterns, etc.</li> <li>• Isolated artefacts or surface scatters.</li> <li>• Evidence of fencing, including fenceposts and gates.</li> </ul>	Moderate	Unknown	Local, but further research is required

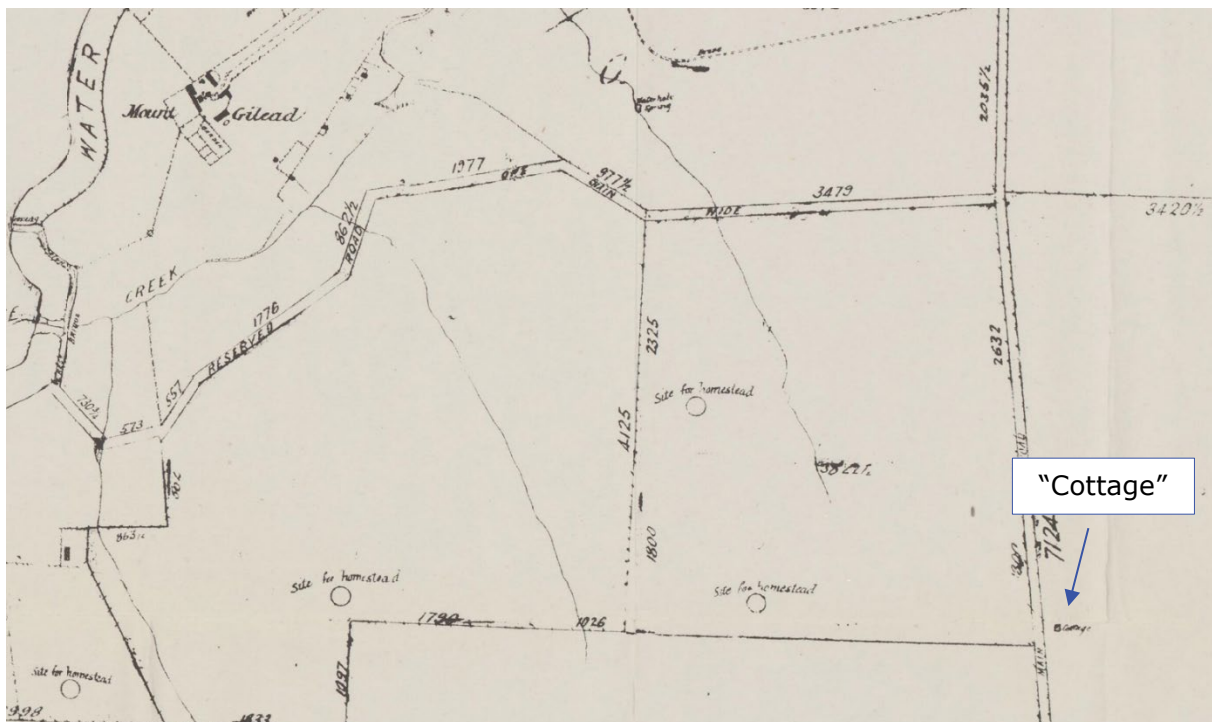


Figure 1.6 Cottage identified on the 1888 Dawson & Dawson plan. (Source: 1888 Dawson & Dawson plan with GML addition 2021, Figure 5.1)



Figure 1.7 Detail from 1917 Commonwealth Department of Defence plan, showing numerous house and cottage structures, including the 'ruins' of Hamilton Hume's c1920 homestead 'Brookdale'. There are no markings on the site of the c1880s cottage (red circle). (Source: NLA MAP G8971.R1)

## Significance assessment

It was generally considered that the significance of the 'Potential 1888 Cottage Site (Site 27)' was unable to be determined without further research and investigation into its archaeological potential and history. Overall, the potential historical archaeological resource was assessed as holding a **local** level of significance for its potential historical archaeological research potential. The significance assessment, extracted from GML 2021, is presented in Table 1.3. Supplementary assessment, and a summary statement of significance, has been provided.

Table 1.3 Significance Assessment of the Potential Archaeological Remains of Site 27 against the NSW Heritage Criteria. (GML 2021, Table 7.6)

Criterion	Response
(a) an item is important in the course, or pattern, of NSW's cultural or natural history (or the local area)	Very limited information is known about the Site 27 cottage. The extent, intactness, and type of archaeological remains associated with the house, outbuildings, and activities must be further investigated. As there has been no further development on the site, it is likely that any sub-surface archaeological remains would be fairly intact and may

Criterion	Response
	<p>provide additional information about the lives of local people living in the area in the nineteenth century.</p> <p>Without additional exploration of the site, its significance under this criterion cannot be determined.</p>
<p><b>Additional Assessment 2022</b></p>	<p>The site was situated within an early 1820s grant, although there is no documentary evidence to suggest any development of the site at this time. By 1867 the site formed part of the Mount Gilead Estate and several workers' cottages had been erected across the estate by the late nineteenth century. It is likely that the cottage, depicted on the 1888 Mount Gilead estate plan, is associated with the dairy and grazing property of Woodhouse, and his son (c1867-1890s). The Mount Gilead estate is significant as a location of important agricultural development, and for the introduction of dairying to the Campbelltown region.</p> <p>Archaeological remains associated with much of the early estate would likely be ephemeral and would not meet the threshold for local significance. Substantiative archaeological remains associated with the c1880s cottage, as part of the broader Mount Gilead estate, could be of <b>local significance</b> for their historic association.</p>
<p><i>(b) an item has a strong or special association with the life or works of a person, or group of persons, of importance in NSW's cultural or natural history (or the local area)</i></p>	<p>The location of Site 27 was marked 'cottage' on the 1888 Dawson &amp; Dawson survey map. No further information has been gleaned about the owner or occupiers of the site. As a result, it presently possesses no strong or special association with the life or any person or group of persons of importance.</p> <p>At the current time, Site 27 does not meet this criterion.</p>
<p><b>Additional Assessment 2022</b></p>	<p>The 1888 cottage site, in its likely associated with Mount Gilead estate, has a strong association with Edmund Hume Woodhouse and his family. Woodhouse was a prominent member of the local community, particularly for his introduction of dairying to the Campbelltown region.</p> <p>Much of the anticipated archaeological resource of the 1888 cottage site <b>is unlikely</b> meet the threshold for significance for their historic associations.</p>
<p><i>(c) an item is important in demonstrating aesthetic characteristics and/or a high degree of creative or technical achievement in NSW (or the local area)</i></p>	<p>The technical and aesthetic characteristics of archaeological remains associated with the potential cottage sites are unknown, as they have not been excavated. While the remains of built structures, artefacts and other material evidence may demonstrate some distinctive or visual qualities, the potential archaeological resource is unlikely to contribute to the aesthetic significance of the site.</p> <p>At the current time, Site 27 does not meet this criterion.</p>

Criterion	Response
<p><b>Additional Assessment 2022</b></p>	<p>The anticipated historical archaeological resource is unlikely to demonstrate aesthetic characteristics, or a high degree of creative or technical achievement.</p> <p>Under this criterion the potential archaeological resource of the 1888 cottage site <b>is unlikely</b> meet the threshold for significance.</p>
<p><i>(d) an item has strong or special association with a particular community or cultural group in NSW for social, spiritual or cultural reasons (or the local area)</i></p>	<p>The location of Site 27 was marked 'cottage' on the 1888 Dawson &amp; Dawson survey plan. No further information has been gleaned about the owner or occupiers of the site. As a result, it possesses no strong or special association with any community or group.</p> <p>At the current time, Site 27 does not meet this criterion.</p>
<p><b>Additional Assessment 2022</b></p>	<p>Archaeological investigations of the 1888 cottage site could be of interest to local community groups, particularly those interested in the history and development of the Campbelltown region.</p> <p>Under this criterion, it is possible that the potential archaeological resource of Hillsborough would be significant at a <b>local level</b>.</p>
<p><i>(e) an item has potential to yield information that will contribute to an understanding of NSW's cultural or natural history (or the local area)</i></p>	<p>Very limited information is known about the Site 27 cottage. The extent, intactness, and type of archaeological remains associated with the house, outbuildings, and activities must be further investigated before it can be determined whether the site has the potential to yield information that will contribute to an understanding of the cultural history of the area. As there has been no further development on the site, it is likely that sub-surface archaeological remains will be fairly intact and may provide additional information about the lives of local people living in the area in the nineteenth century.</p> <p>On the basis of the locations wider archaeological research potential, and ability to inform the local historical record, this site holds a local level of significance.</p>
<p><b>Additional Assessment 2022</b></p>	<p>There is limited documentary evidence available for the 1888 cottage site. Archaeological investigation into the layout of the cottage site may provide new evidence for the working of the Mount Gilead estate in the late nineteenth century. Artefact-bearing deposits, particularly rubbish pits, backfilled wells and cisterns, could provide information on the lives and working conditions of the occupants of the cottage and the broader Mount Gilead estate during the late nineteenth century that is unavailable from other resources.</p>



Criterion	Response
	Substantiative archaeological remains—particularly artefact-bearing deposits—could be of <b>local significance</b> for their potential archaeological research values.
<i>(f) an item possesses uncommon, rare or endangered aspects of NSW's cultural or natural history (or the local area)</i>	<p>The extent and integrity of archaeological evidence associated with the Site 27 cottage is unknown. Further investigation and excavation is required. At present, the site does not appear to possess any uncommon, rare, or endangered aspects of the cultural history of NSW or the local area.</p> <p>At the current time, Site 27 does not meet this criterion.</p>
<b>Additional Assessment 2022</b>	<p>The potential archaeological resource of the 1888 cottage site is expected to be largely associated with the domestic occupation of the cottage. Archaeologically excavated domestic sites from the nineteenth century are common in urban areas, but there are fewer such sites in rural areas.</p> <p>Substantiative archaeological remains associated with the cottage could be of <b>local significance</b> for their rarity.</p>
<i>(g) an item is important in demonstrating the principal characteristics of a class of NSW's cultural or natural places or cultural or natural environments (or the local area)</i>	<p>The history and archaeological evidence associated with the Site 27 cottage is unknown. Further investigation and excavation is required. At present, the site does not appear to possess any uncommon, rare, or endangered aspects of the cultural history of NSW or the local area.</p> <p>At the current time, Site 27 does not meet this criterion.</p>
<b>Additional Assessment 2022</b>	<p>In the absence of any historical evidence of the cottage site, it is difficult to predict the nature of the early archaeological resource. The potential archaeological remains could, however, be considered representative of the occupation of a farm in the late-nineteenth century.</p> <p>Under this criterion, it is possible that the potential archaeological resource of the cottage site would be significant at a <b>local level</b>.</p>

## Summary statement of significance

The 1888 cottage site (Site 27) is significant in its association with the nineteenth century Mount Gilead estate, owned and operated by Edmund Hume Woodhouse and his son, and a significant dairy and grazing property in the Campbelltown region. The cottage is likely associated with one of several workers cottages, noted in newspaper reports from the early twentieth century. The potential historical archaeological resource is unlikely to be directly associated with Edmund Hume Woodhouse or his family. Archaeological remains of the cottage site, particularly artefact-bearing deposits, have the potential to help inform our understanding of the domestic lives and working



conditions of farm workers in the Campbelltown area throughout the later nineteenth century. The potential archaeological resource of Site 27 is of **local significance** for its historical, and potential archaeological research values.

### 1.2.3 Updated assessment of historical potential

Landforms at Browns Bush are generally flat to very shallow sloping. The area is associated with an eroded vehicle track and old entrance off Appin Road (Figure 1.8). The area retains old growth vegetation. Survey failed to identify any evidence of an archaeological site associated with the c1880s cottage, and analysis of aerial photography shows no clear evidence for a structure in this location. The only evidence noted was a gate in the position of an entrance driveway (Figure 1.8). The only landscape evidence of a potential site was in an area cleared of trees.



Figure 1.8 View east of Appin Road to the koala crossing area.

The approximate location of the cottage site has been identified in Figure 1.9. Given the absence of available documentary evidence, the extent of the cottage site—including any associated features, such as wells and cess pits—is unknown. Wells, cess pits and rubbish pits are more likely to be located at the rear of the cottage and are therefore

outside—east of—the impact area. Localised disturbance of the potential archaeological resource can be expected, particularly along the route of the vehicle track and former access drive.

Overall, there is a moderate potential for archaeological remains (relics) associated with the cottage—such as footings, postholes, surfaces, occupation deposits—and former access drive within the impact area. Archaeological remains associated with the driveway are unlikely to meet the threshold for significance.



Figure 1.9 Detail showing approximate location of the cottage identified on the 1888 Dawson & Dawson plan. (Source: GML 2021, Figure 5.12)

### 1.3 Proposed works & statutory approvals

The proposed koala crossing (fauna underpass) requires trenching, and excavation works to shape the approaches to the underpass and for installing twin culverts across Appin Road (Figure 1.10, Figure 1.11). These works will require bulk excavation in the footprint of the fauna underpass.



### 1.3.1 Interface with Aboriginal test excavation

A program of Aboriginal test excavation has been designed for the Browns Bush site. Aboriginal test excavation units (0.5m by 0.5m) will be placed in a systematic grid at intervals of 10m. Sample locations will be modified in the field to avoid areas of existing disturbance and the eroded fire trail (Figure 1.12). The outcomes of the Aboriginal archaeological investigations will determine the statutory heritage pathways for the koala crossings:

- Should the program encounter no Aboriginal objects, historical archaeology work can proceed (without the need for an approval under the NPW Act 1974, subject to caution).
- Should Aboriginal objects be identified during the program of Aboriginal archaeology, a location specific AHIP for the works would be sought; with respect to Aboriginal objects, this AHIP would need to provide approval for both historical archaeology and the koala crossing works.

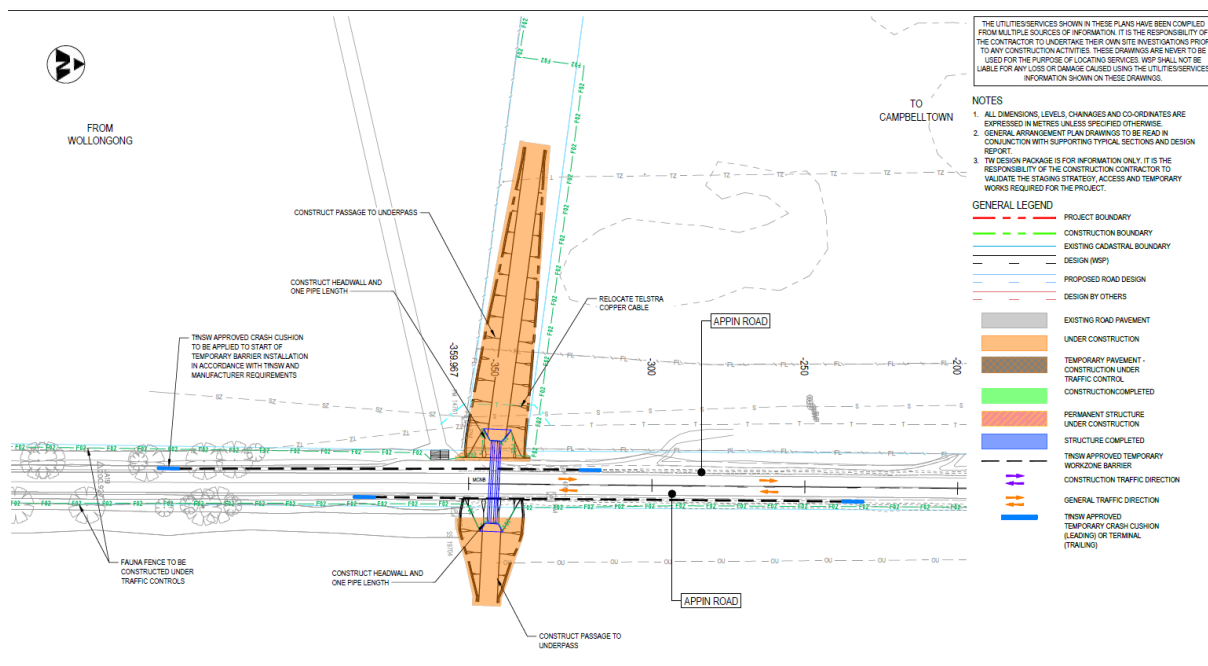


Figure 1.10 Concept design showing general arrangement of Browns Bush underpass. (Source: WSP, Sheet CS-01301, Issue 01)

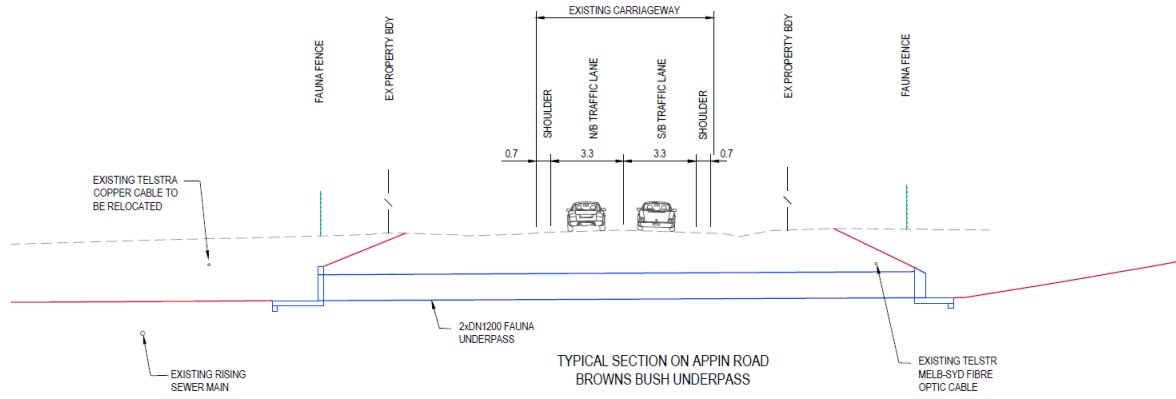


Figure 1.11 Concept design showing typical section on Appin Road Browns Bush underpass.  
(Source: WSP, RD-00022, Issue 01)



Figure 1.12 Browns Bush indicative Aboriginal archaeological sample pattern.

### 1.3.2 Historical archaeological management

The recommended management for the potential cottage site (Site 27), was conservation (GML 2021, Table 5.1). If conservation was not possible, it was advised that an Archaeological Research Design (ARD) be undertaken for any 'works'. Given that neither the extent nor survival of the c1880s cottage site is known, an historical archaeological testing program is recommended to help determine the nature of any potential historical archaeological resource, including its significance.

The proposed historical archaeological testing program outlined below, qualifies for a self-assessed Excavation permit Exception s139(4) under clause 2(d),

- (d) Any disturbance or excavation of land for archaeological test excavation of relics of local heritage significance completed in accordance with the guideline 'Relics of local heritage significance: a guide for archaeological test excavation' published by Heritage NSW.

This exception **does not** apply to relics of State heritage significance.

If relics are found during the course of the historical archaeological program, a notification of the relic—via email—under Section 146 of the Heritage Act is required (Section 2.2.3). Depending on the nature of the discovery, additional assessment and approval may be required prior to the recommencement of excavation in the affected area(s). If the archaeological program identifies that further archaeological work is required, for example salvage excavation, then a Section 140 excavation permit may be necessary.



## 2 Archaeological research design

### 2.1 Research framework

#### 2.1.1 Research themes

Any historical archaeological investigation should consider the physical evidence of the site development and occupation within a broad thematic context. This framework would allow the documentary and archaeological evidence from Browns Bush to be compared to similar sites across NSW. The Australian Historic Themes Framework (AHTF) were developed in 2001 by the Australian Heritage Commission as the Australian Historic Themes Framework (AHTF). These themes were adapted by the Heritage Council of NSW to produce the NSW Historical Themes, to ensure that information recovered from a site can be understood within a broader research framework, beyond the site itself.

The historical themes that are relevant to the potential archaeological resource at Browns Bush are outlined in Table 2.1 and have been adapted from the ‘Glen Lorne Historical Archaeological Project—Archaeological Research Design’ prepared by GML Heritage and Sydney University, July 2021.

Table 2.1 NSW historical themes relevant to the potential historical archaeological resource within Hillsborough archaeological site.

Theme	Sub Theme	Explanatory Note
Tracing the Natural Evolution of Australia		<p>The existing baseline dataset for environment information does not provide specific information on the c1880s cottage at Browns Bush.</p> <p>The site has the potential to assist in wider research questions associated with the natural landscape, and ecology. Attempts by the early colonial settlers to modify this landscape, notably in connection with water and vegetation management of the broader Mount Gilead Estate, could be addressed by the Browns Bush site.</p>
Peopling Australia	<ul style="list-style-type: none"> <li>• First Nations</li> <li>• Convicts</li> <li>• Migrations</li> </ul>	<p>This region was at the forefront of early colonial expansion into southwest Sydney. The cottage likely formed part of the Mount Gilead Estate (c1867-1890s), an important dairy and grazing property, significant in its association</p>

Theme	Sub Theme	Explanatory Note
		<p>with the introduction of dairying to the Campbelltown region.</p> <p>These early farms would have been seen as substantial opportunities to gain a significant foothold in the NSW colony. Equally, these prospects would have been daunting because new farming ventures were in remote and unfamiliar areas at a time of hostilities between Aboriginal people and settlers in the Appin and wider Sydney area.</p> <p>The outcome could have been the development of a very strong early community where common problems were addressed across the landscape. Differences in the approaches to land management, especially water management, would provide great insight into how this region was approached, along with the hopes and aspirations of the farming families.</p>
<p>Developing local, regional, and national economies</p>	<ul style="list-style-type: none"> <li>• Agriculture</li> <li>• Environmental – cultural landscape</li> <li>• Exploration</li> <li>• Pastoralism</li> </ul>	<p>Documentary evidence suggests mixed farming was undertaken at Mount Gilead Estate throughout the nineteenth and twentieth centuries.</p> <p>The process of land clearing, construction, the commencement of farming, and approaches to land and water management would have underpinned the social and economic fortunes of the property.</p>
<p>Building settlements, towns, and cities</p>	<ul style="list-style-type: none"> <li>• Land tenure</li> <li>• Utilities</li> <li>• Accommodation</li> </ul>	<p>The location and establishment of the cottage at Browns Bush may be linked to perceived qualities of the land. Investigations into these could reveal new information on land management planning and practices.</p>
<p>Working</p>	<ul style="list-style-type: none"> <li>• Labour</li> </ul>	<p>It is possible the cottage at Browns Bush was associated with workers on Mount Gilead estate throughout the late nineteenth century. The site has the potential for archaeological evidence that could provide information regarding the nature of</p>

Theme	Sub Theme	Explanatory Note
		farming practices and labour division at the property.
Developing Australia's cultural life	<ul style="list-style-type: none"> <li>• Domestic Life</li> </ul>	Domestic elements are likely to be associated with the use at the cottage site, with the potential to provide insight into the daily lives of those living and working in the area.
Marking the phases of life	<ul style="list-style-type: none"> <li>• Birth and Death</li> <li>• Persons</li> </ul>	The site has the potential for domestic sealed artefact deposits associated with the occupation of the cottage, as well as associated domestic features such as kitchen gardens, outbuildings, and water management structures (cesspits, cisterns, wells) resulting from the occupation of the site.

## 2.1.2 Broad Research Questions

The following broad research questions address the issues of what survives in the study area, the scope of resources, and the processes that have influenced the formation of the landscape and built environment. The types of questions that might be asked of the cottage site include:

- What is the extent of the surviving archaeological evidence of the cottage site?
- What is the nature of any extant archaeological features?
- What is the date of the identified elements?
- What can the material culture contribute to our knowledge about this site or other sites?

## 2.1.3 Site-Specific Research Questions

The following site-specific research questions were developed as part of the Glen Lorne Archaeological Project and have been adopted here:

- What physical evidence of former activities survives on the site?
- What kinds of interactions occurred between the settlers and First Nations inhabitants in this area, and do these have an expression visible in the archaeological record?
- How is the site related to the broader landscape context?
  - Is there landscape evidence for water management?
  - How were introduced plants and animals managed, and what is the historical and archaeological evidence?

- What historical or archaeological evidence of the c1880s cottage site relates to connections with the broader Mount Gilead Estate?
- How do the archaeological remains compare between Glen Lorne, Hillsborough and neighbouring still-extant buildings at Beulah and Mount Gilead? Does variation reflect differences in identity or social class?
- What kinds of material culture did people use on a daily basis, and how did it relate to their identities?
- Do any visible artefacts at the sites represent particular economic or domestic activities, eg materials relating to sewing or dairying?

## **2.2 Archaeological research design**

### **2.2.1 Archaeological investigation methodology**

To mitigate any impacts of the proposed koala crossing on significant historical archaeological remains, and to determine the nature (significance) and extent of the potential archaeological resource, a program of historical archaeological test excavation at the Browns Bush site is proposed. This program will be undertaken following the completion of Aboriginal test excavation—thereby ensuring the historical archaeological work did not knowingly impact Aboriginal objects.

The following section presents the archaeological investigations program developed to determine the nature and extent of the archaeological resource. The proposed archaeological testing will be conducted concurrently with the Aboriginal archaeological testing. This methodology outlined below will guide the historical archaeological testing program. Detailed post-excavation analysis, final report preparations, and methodologies to mitigate impacts to archaeology are also included.

### **2.2.2 Heritage induction**

Prior to the commencement of ground impacts, a heritage induction would be provided to all contractors to ensure that they are aware of the requirements under the project approval and the procedure for advising the Excavation Director of unexpected finds. All project personnel should attend a general project induction prior to commencing work on the project.

## 2.2.3 Archaeological investigations

A series of Aboriginal test pits (12 test units) are proposed to determine the extent and nature of any Aboriginal objects (Figure 1.12), as outlined in Aboriginal ARD, GML September 2022. These will also serve to identify any historical material overlaying the natural subsoils. Any historical archaeology encountered in the Aboriginal archaeology test units would be recorded, but not removed, in accordance with the methods set out in Section 2.2.4. Aboriginal testing areas outside the footprint of the potential cottage site test would be managed through an unexpected finds procedure, as these areas are considered to have a lower potential for historical archaeological remains.

Following the Aboriginal testing program further historical archaeological testing should be undertaken, in order to determine the nature, extant and significance of the potential historical archaeological resource associated with the c1880s cottage site.

The proposed historical archaeological testing program comprises three strip test trenches (TT1 – TT3); two running approximately north-south, and one running approximately east-west. The test trenches are to be located within the general footprint of the koala crossing. Their exact position will be determined following the results of the Aboriginal test excavations. The indicative arrangement of the testing areas is shown in Figure 2.1. Each trench will be c.1.2m (the width of the machine bucket) x approximately 20m.

### Testing methodology

- Testing will involve a combination of mechanical and hand excavation. Modern surface material and fills would be removed using a mechanical excavator, under the supervision of the archaeologists, to the top of archaeological features.
- Archaeological features within the trench would be exposed and cleaned by hand to assist in interpretation and to clarify significance. Hand excavation would be undertaken with trowels, shovels, hoes, picks, brushes, and coal shovels.
- The test trenches will be excavated to the top of archaeology only. No excavation or removal of structural remains and features associated with the former cottage.
- Significant archaeology within trenches would not be removed during the testing program. Small sondages and localised areas may be hand excavated to confirm the nature of the archaeology, determine if there are multiple phases and clarify significance.
- Archaeological recording of all significant archaeological remains would be undertaken in accordance with the methods set out in Section 2.2.4.

- Excavated fills would be sample-sieved to test for displaced artefacts associated with the Browns Bush site. More extensive sieving would be undertaken if significant artefacts are exposed.
- Test areas and trenches will be backfilled on completion of the testing program. Any archaeological remains would be protected with geofabric prior to backfilling.
- The size and location of some trenches may be modified in response to on-site constraints (for example, to avoid in-ground services or tree roots). If the proposed test trenches are inconclusive, then some trenches may be expanded in an appropriate direction to clarify findings.

## Unexpected Heritage Finds Procedure

Unexpected archaeological remains and artefacts may be uncovered in areas assessed as having nil to low potential during the Aboriginal archaeological testing program. The following procedure would apply for unexpected archaeological finds:

- Cease activity in the affected area and secure/protect the suspected archaeological find from impact.
- Contact the nominated Excavation Director to assess and inspect the suspected archaeological find.
- Historical archaeological finds will be managed in accordance with this HARD and requirements of the Heritage Act.
- The program of historical archaeology will follow the Aboriginal test excavation. Should an Aboriginal object be identified during the historical archaeology work, the process for its management will be defined by its context:
  - if the Aboriginal object is in a historical archaeology context (eg out of situ), the object will be recorded as a displaced Aboriginal object, and curated with any objects from the Aboriginal archaeology work. Historical archaeology work would continue;
  - if the Aboriginal object is in an intact soil horizon, that location would be subject to a further Aboriginal archaeology test unit, adhering with the methodology provided under the Aboriginal assessment. This would be excavated by the Aboriginal archaeology team.
  - All reporting and management for any Aboriginal objects would be undertaken as a component of the Aboriginal heritage assessment.
- Work in the affected area can recommence once the archaeological work is complete and the consent conditions and/or permit requirements have been met.



## **Notification of the discovery of a relic**

If relics are found during the course of the archaeological testing program, a notification of the relic under Section 146 of the Heritage Act is required. Depending on the level of significance of the relics, further management, including possible retention and/or interpretation of the relics, may be required before further works can continue in that area.

A notification email should be sent to the Heritage Council of NSW via email [HERITAGEMailbox@environment.nsw.gov.au](mailto:HERITAGEMailbox@environment.nsw.gov.au). The email must contain:

- The exception used and site address (for example 'Relics found at Browns Bush, Gilead, using exception 2d')
- The GPS location of the relic
- A photograph of the relic in its location (for context), and
- A short summary of the test excavation results (no more than 500 words)

It is recommended that other documentation relating to the exception such as the [Section 139\(4\) Exception Record of Use Form \(DOC 2MB\)](#) is also submitted.



Figure 2.1 Proposed historical archaeology test trenches, shown in combination with Aboriginal test units, and the proposed koala crossing works.

## 2.2.4 Recording

The recording of archaeological data would be based on the single context recording system. Phasing and interpretation of the archaeological features in relation to the entire site would also be included in the record sheets and survey. The recording process for the archaeological testing program would be as follows:

- Trench locations and main findings would be recorded and surveyed to provide detailed plans of the location of trenches and remains. RLs (Reduced Levels)—according to the Australian Height Datum (AHD)—will be taken on all the archaeological remains identified within testing areas.
- Archaeological structural remains, deposits and features would be recorded on context sheets.
- A digital (JPEG files) photographic record of the archaeological program would be made. Significant archaeological remains would be recorded using both JPEG and RAW files. All photographs would include a scale.
- Scale drawings would be prepared and include location of the archaeological remains within the overall site. A surveyor would take geo-referenced survey data to prepare survey drawings and photogrammetry.
- Artefacts from excavated non-significant deposits, such as topsoil and fill layers, would be collected for analysis (Section 2.2.5) Those artefacts that do not satisfy the threshold for relics would be recorded on the context sheet and photographed as appropriate, and discarded prior to post-excavation analysis.
- Building material samples may be collected for further analysis and inform the archaeological assessment.
- Registers of contexts, photos, samples, and drawings would be kept, digitised and collated for the site archives.

## 2.2.5 Artefacts

Some artefacts are likely to be retrieved during the archaeological testing program. The artefact policy for the testing program is as follows:

- Non-diagnostic material from non-significant layers and disturbed fills would be recorded on the context sheet and photographed as appropriate. They would then be reburied within the test trench. Examples of such material include:
  - tiny body sherds of ceramic and glass vessels or tiny clay pipe stem fragments;
  - corroded and unidentifiable ferrous items; and
  - decayed and unidentifiable animal bone, shell, leather and fabric.

- Diagnostic, complete and potentially significant artefacts from significant and non-significant layers and disturbed fills would be collected and retained for analysis. Examples of such artefacts include:
  - whole ceramic and glass vessels;
  - partial ceramic and glass vessels which include rim or base sections, or identifiable patterns; – identifiable ferrous and copper nails, horse shoes and horse equipment (metal and leather);
  - buttons, coins and other personal items of various materials (metal, bone, clay, shell, leather etc); and
  - clay pipe bowls.
- Artefacts recovered would be provenanced according to their context. They would be cleaned, sorted and stored in an appropriate repository, observing specialist conservation requirements where appropriate.
- Artefacts recovered that do not satisfy the threshold for relics would be recorded on the context sheet and photographed as appropriate, and discarded prior to post-excavation analysis.
- Building materials (brick, stone, mortar) and environmental samples (soil, pollen, marine sediment, shell) would be collected from significant contexts for further analysis, archiving purposes and to inform the research questions.

## 2.2.6 Artefact Storage

Artefacts recovered during the archaeological investigation are the property of the landowner, Lendlease. The long-term storage of artefacts recovered from the archaeological excavation is the responsibility of the applicant (Lendlease). A suitably safe and secure repository for long-term storage within the new development or an appropriate alternative location should be identified.

## 2.2.7 Reporting

The results of the archaeological testing program will be presented in a final report. It will include a plain English synthesis of the post-excavation analysis, and any technical and specialist reports. It will be presented within a framework based on the key historical themes and archaeological research outcomes outlined in this report.

The final report will include the following:

- plain English executive summary of the archaeological findings;
- overview of the archaeological investigation program and methodology;

- historical background including additional primary or secondary resource research if required;
- a discussion of the archaeological investigation results and response to the research questions;
- illustrations including photographs, scale drawings and interpretive graphics;
- a reassessment of archaeological significance and the further research potential of the archaeological collection; and
- details of the archaeological collection repository, long-term management and access.

The final report will be lodged with Lendlease and the Campbelltown Library's local studies collection.

## 3 Conclusions and recommendations

### 3.1 Conclusions

- Previous historical archaeological research (*Mt Gilead Stage 2, Historical Archaeological Assessment, GML October 2021*) identified the Browns Bush koala crossing investigation area—east of Appin Road—as the site of a former c1880s cottage (Site 27).
- There is a moderate potential for archaeological remains (relics) associated with the cottage site—such as post holes, wall footings, paths, subfloor surfaces, water management structures, yard surfaces and garden beds—within the proposed impact area. Given the absence of available documentary evidence, the extent of the cottage site is unknown.
- Wells, cess pits and rubbish pits are more likely to be located at the rear of the cottage and are therefore outside—east of—the impact area.
- Localised disturbance of the potential archaeological resource can be expected, particularly along the route of the vehicle track and former access drive.
- The potential archaeological resource of Site 27 is of **local significance** for its historical, and potential archaeological research values.
- A program of archaeological testing is proposed to help to understand the nature, extant and significance of the potential historical archaeological resource.
- The archaeological testing program will mitigate/prevent the impacts of trenching and excavation works associated with the proposed koala crossing at Browns Bush.

### 3.2 Recommendations

- The archaeological testing of relics of local significance, as outlined in this HARD, qualifies for an Excavation permit Exception s139(4) under clause 2(d).
- A copy of this HARD, as well as the GML October 2021 archaeological assessment, must be lodged with the TfNSW Heritage team ([ES\\_Heritage@transport.nsw.gov.au](mailto:ES_Heritage@transport.nsw.gov.au)) at least 2 weeks prior to the proposed archaeological testing program.
- The archaeological testing program should be undertaken in accordance with the research design and methodology provided in this report.
- The program of historical archaeology will follow the Aboriginal test excavation (outlined in GML September 2022). Should an Aboriginal object be identified during the historical archaeology work, the process for its management will be defined by its context:



- if the Aboriginal object is in a historical archaeology context (eg out of situ), the object will be recorded as a displaced Aboriginal object, and curated with any objects from the Aboriginal archaeology work. Historical archaeology work would continue;
  - if the Aboriginal object is in an intact soil horizon, that location would be subject to a further Aboriginal archaeology test unit, adhering with the methodology provided under the Aboriginal assessment. This would be excavated by the Aboriginal archaeology team.
  - All reporting and management for any Aboriginal objects would be undertaken as a component of the Aboriginal heritage assessment.
- If relics are found during the course of the archaeological program, a notification of the relic under Section 146 of the Heritage Act is required. A notification email should be sent to the Heritage Council of NSW [HERITAGEMailbox@environment.nsw.gov.au](mailto:HERITAGEMailbox@environment.nsw.gov.au). The email must contain:
    - The exception used and site address (for example 'Relics found at Browns Bush, Gilead, using exception 2d')
    - The GPS location of the relic
    - A photograph of the relic in its location (for context), and
    - A short summary of the test excavation results (no more than 500 words).
  - On completion of the historical archaeological investigation program, post-excavation analysis should be undertaken and a detailed final report prepared sharing the investigation results for use. The final report will be lodged with Lendlease and the Campbelltown Library's local studies collection.
  - Lendlease will need to provide a suitable repository for the long-term storage and care of the artefact collection and archive.

### **3.3 Authorship**

This report has been authored by Dr Kat McRae and Dr Tim Owen, with GIS input from Declan Coman.



**APPENDIX A – Appin Road Fence Replacement  
Typical Site Conditions**

Appin Road Corridor, Lot 7 DP 736034 & Lot 2 DP 603674



Figure 1 Appin Road Corridor, Lot 7 DP 736034 & Lot 2 DP 603674





*Figure 2 Lot 7 DP 736034 - Fencing, gate vehicle access and mown area*



*Figure 3 Electrical maintenance track adjacent to fence route*





*Figure 4 Fence line with wires removed and concrete blocks placed to block vehicle access from Appin Road*



*Figure 5 Existing fence line and strainer post with wires removed. Concrete blocks placed to prevent access from Appin Road.*





*Figure 6 Electrical maintenance track and access to Appin Road temporarily blocked by concrete*



*Figure 7 Communication trench markers along fence alignment. Electrical maintenance track adjacent to fencing*





Figure 8 Lot 2 DP 603674, Lot 10 and Lot 11 DP 613878



Figure 9 Lot 10 DP 613878 fence line mown for access. Electrical overhead adjacent to fence route.





*Figure 10 Electrical overhead route along fence line. Mown access for maintenance.*



*Figure 11 Driveway access and communications service route along fence line.*





*Figure 12 Cattle present within paddock. Fence line preventing cattle access to Appin Road.*



*Figure 13 Entry structure across existing fence route. Overhead electrical services adjacent to fence route.*





*Figure 14 Mown access along fence line. Grazing pasture within fence line.*



*Figure 15 Mown access along fence line. Grazing land contained within fence line. Entry structure.*





*Figure 16 Communications trench along front of fence alignment.*



*Figure 17 Communications trenching and access pit along fence route.*





Figure 18 Lot 12 DP 613878, Lot 1 DP 603675, Lot 21 DP 1132464





*Figure 19 Mown access along Appin Road and fence line. Grazing pasture within fence line. Overhead wires and underground communications adjacent to fence line.*



*Figure 20 Existing gate structures and driveway within fence line. Communications trenching and overhead wires adjacent to fence route.*





*Figure 21 Mown maintenance access along Appin Road. Existing communications trenching and overhead wires adjacent to fence line.*



*Figure 22 Communications marker posts indicating presence of communications services along fence line.*





*Figure 23 Cleared access to fence line for maintenance. Communications markers indicating underground communications line. Overhead wires adjacent to fence line. Grazing pastureland within fencing.*



*Figure 24 Overgrown fence line. Wires cut and concrete blocks placed to prevent access from Appin Road. Access gate installed along fencing route for electrical maintenance and bush fire access.*





*Figure 25 Electrical maintenance and bushfire access gate overgrown. Communications trenching along fence route.*



*Figure 26 Communications marker indicating presence of services along route of fence line.*





*Figure 27 New fencing installed immediately adjacent to existing timber fencing.*



*Figure 28 Existing stockpiles of road pavement surplus material adjacent to fence line. Debris and concrete scattered along fence line indicating possible prior road construction hardstand.*





*Figure 29 New fencing along previous fence alignment. Disused fencing materials left in place or lying along disturbed route.*



*Figure 30 Access gate for electrical maintenance, bushfire track access and access to property along fence line. Evidence of dumped rubbish scattered along fence line.*





*Figure 31 New fencing immediately adjacent to older fencing. Rubbish dumped along fence line. Hardstand area from previous road works and evidence of pavement materials stockpiled adjacent to fence line.*



*Figure 32 New fencing installed adjacent to previous fence. Disused gate and fence posts left in place. Dumped rubbish along fence line.*





*Figure 33 Overgrown section of new fencing adjacent to disused timber fencing. Communications trenching adjacent to fence alignment.*



*Figure 34 Communications marker post indicates adjacent service trenching. New fencing installed adjacent to disused timber fencing.*





Figure 35 Electrical maintenance access track and bushfire track adjacent to existing fence line. Concrete blocks stockpiled for use to prevent access from Appin Road.



Figure 36 Access gate and driveway to Beulah Biobank. Communications services adjacent to fence line.





*Figure 37 New fencing installed to replace previous fencing along Beulah Biobank boundary.*



*Figure 38 Concrete blocks to prevent further access and dumping along fence line.*





*Figure 39 New fencing and signage installed along Beulah Biobank site.*



*Figure 40 New fencing and signage installed along Beulah Biobank boundary.*





*Figure 41 Road shoulder and pavement materials extending to boundary and fence line adjacent to Beulah Biobank.*



*Figure 42 Concrete blocks placed along fence line to prevent access to property from Appin Road.*





*Figure 43 New fencing installed adjacent to disused fencing. Rubbish dumped along fence line. Communications services along fence line.*



*Figure 44 Overgrown stockpile of concrete and pavement materials adjacent to newly installed fence.*





*Figure 45 New fencing installed along Beulah Biobank. Rubbish dumped along fence line.*



*Figure 46 Dumped rubbish along fence line.*





*Figure 47 New fence installed adjacent to disused fencing. Communications marker post indicating communications services along fence line.*



*Figure 48 New fencing damaged along boundary of Beulah Biobank*





*Figure 49 Access to neighboring property adjacent to Beulah Biobank and driveway access.*



*Figure 50 Communications marker posts indicating services adjacent to fence line.*





*Figure 51 Access gate to neighboring property adjacent to fencing route.*



*Figure 52 Corner post along existing fence line.*





*Figure 53 Communications marker post indicating communications services adjacent to fence line.*



## Memorandum

**To:** GML Heritage  
**From:** Will Laurantus  
**CC:** Mark Anderson  
**Date:** 4 November 2022  
**Subject:** Appin Road – Fencing Upgrade - Fauna Fencing Installation Methodology

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### Purpose

The memorandum seeks to outline the proposed methodology for the upgrade of existing fencing along a 3-kilometre stretch of Appin Road between Noorumba Reserve and Beulah Biobank. The installation methodology aims to utilise the existing fence line to locate the new fauna fencing within disturbed land. The intention is to use both the existing alignment, and as far as possible, replace existing fence posts like for like in location.

### Background

As part of its commitment to undertake local and state government level infrastructure upgrades associated with the delivery of the Figtree Hill development, Lendlease is widening Appin Road and implementing fauna protection measures. The initial protection of fauna includes the installation of fauna fencing along a 3-kilometre stretch of the upgrade works.



Figure 1. Fauna Fencing Extent

## Scope of Works

The proposed fencing detail consists of 1.5 metre high, chain link mesh with climb-proof metal sheeting affixed to the vegetated side to prevent fauna from climbing over the structure and entering the Appin Road corridor (refer Figure 2).

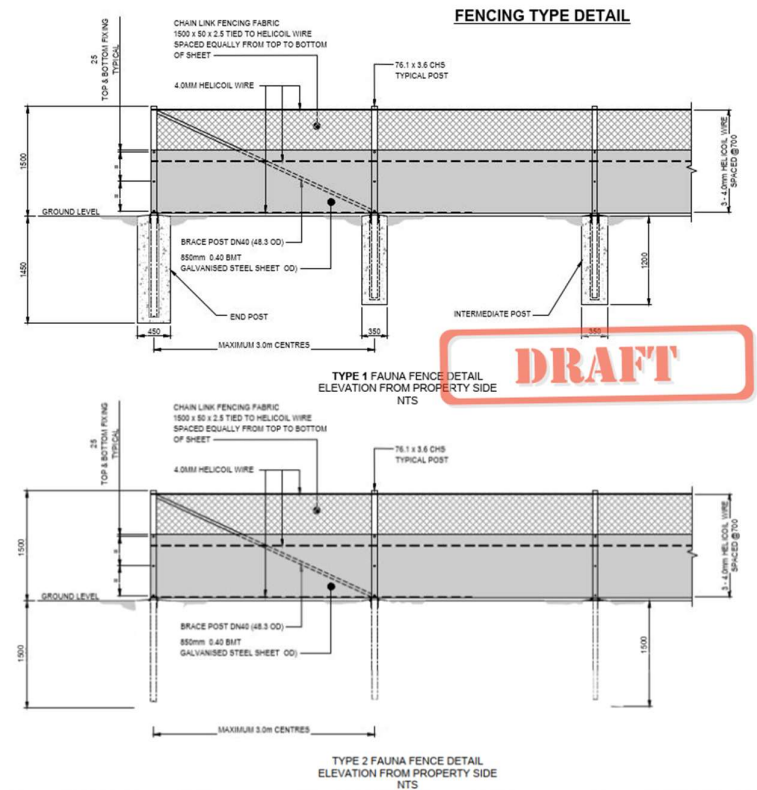


Figure 2. Proposed Fauna Fencing Detail

## Investigation of Site Conditions

A review of prior archaeological assessment for Appin Road includes Virtus Heritage (2017), Ecological Australia (August 2018), and Virtus Heritage (2018). Portions of the Mt Gilead Stage 2 lands associated with the Glen Lorne and Browns Bush koala crossings has been made by GML (2022). The outcomes of these investigations have been summarised by GML in the letter which accompanies this methodology. Succinctly, whilst Virtus Heritage in 2017 identified some locations adjacent to Appin Road with moderate or high archaeological potential, they revised their opinion in 2018 following a program of archaeological test excavation, and clearly zone the whole of the Appin Road corridor as holding 'low archaeological sensitivity' (Virtus Heritage 2018, Figure 24).

The assessment of low sensitivity was seconded by Ecological Australia (August 2018, pp 31), and GML (2022, pp 28). To provide additional information and insight into prior known impacts associated with the road corridor we have prepared a detailed photographic record of the landform conditions along the proposed fence route (Appendix A). We also note:

1. An existing fencing is present for the length of the proposed fencing. This fence has been installed with +300mm diameter wooden fence posts, and there is evidence for their replacement over the last 100 years.
2. As such, the installation of the proposed fencing is an upgrade from the current fencing to an improved specification.
3. There are multiple adjacent services existing along the length of the proposed fencing upgrade, including:
  - a. Telstra cables extend adjacent to the route of the fencing and are direct buried through tractor and plough method.

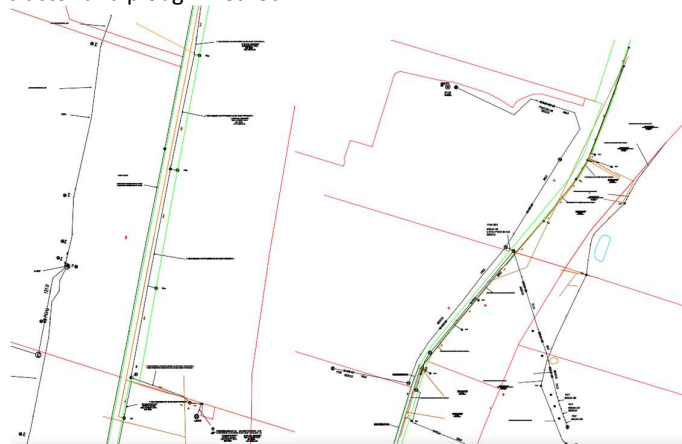


Figure 3. Telstra DBYD Maps Indicating Existing Services Adjacent to Fence Route (source: <https://www.byda.com.au/>)

- b. Overhead electrical lines and an associated maintenance track adjacent to the fence line. This track has eroded soils into basal clay and in some places exposed bedrock.



Figure 4. Electrical Overhead and Maintenance Track Alignment (source: [maps.six.nsw.gov.au](https://maps.six.nsw.gov.au/))





## **Installation Methodology**

Notwithstanding the three separate archaeological assessments which described the route for the Koala fence as holding low sensitivity for Aboriginal objects, we propose a methodology which is low impact, seeking to minimise further disturbance to the route. Further Lendlease identifies the replacement of the fence as a low impact land management activity as described under the NPW Act Regulations 2019, Section 58 (b)(iii), and (c)(iv).

The installation of the proposed fencing is to follow the following steps:

1. Landowners are to be provided sufficient notice (14 days) of the intent to remove and replace existing fencing to allow livestock to be relocated.
2. The existing communications services are to be positively identified and traced along the route of the existing fence to ensure that no damage is caused during the removal of the existing fencing or the installation of the new fence.
3. Dumped rubbish and concrete blocks are to be carefully removed from the alignment and disposed of at a licenced facility.
4. Prior to any works commencing, all contractors will need to complete the Mount Gilead Stage 1 Heritage Management Induction—a management requirement we implemented in 2021. This induction can be provided on request for your records.
5. The existing fencing is to be replaced in stages so that the removal and installation occur within the same work area. This is to limit disturbance to a single establishment along the length of the fence and to limit fauna accessing the road corridor through a gap left between removal and installation.
6. The contractor is to utilise existing post holes to install the new posts, where possible, to limit disturbance to the surrounding area and to minimise the risk of damaging adjacent services.
7. Where concrete footings are specified, the contractor is to minimise excavation to the minimum necessary to achieve the required diameter and depth of footing. Excavation is to be undertake by hand or by mechanically driven auger.
8. Spoil is to be removed by hand to prevent excavation of the surrounding surface material. Any excavated spoil will be left in situ adjacent to its point of excavation.
9. Where a concrete footing cannot be access by adjacent maintenance route or cleared paddock, concrete is to be transported by wheelbarrow or by kibble. Concrete agitator trucks are not to be placed adjacent to posts where ground conditions are undisturbed.
10. Sheeting to prevent fauna from climbing the fencing structure is to be securely attached in accordance with the detail provided on the approved construction plans.
11. All offcuts and surplus soil and materials are to be carefully removed with care being taken not to disturb surrounding ground.
12. Should an Aboriginal object (or possible Aboriginal object) be identified during the works, all works in the area will cease, and the unexpected finds protocol, as described in the Heritage Management Induction, will be implemented. In the instance that an Aboriginal objects is identified, an AHIP would be required prior to works continuing in that location.

## **Considerations of Disturbance to Surrounding Land**

1. The contractor is to utilise the existing cleared and mown access points servicing the electrical overhead wires, bushfire access, communications access or pavement maintenance areas to conduct the fencing installation. Undisturbed areas are not to be used to park vehicles or place materials or equipment.

2. Existing post holes are to be utilised as often as possible to install new post footings. Proposed post hole locations are to be adjusted up to 500mm in either direction to facilitate use of existing fencing post holes.
3. Existing fencing materials are to be removed and disposed of at a licensed waste facility. No surplus or disused fencing material is to remain on site upon completion of fencing replacement.
4. Where access is restricted, the contractor is to transport materials by hand or using methods which cause least disturbance to surrounding areas. Where safe to do so, the contractor is to access the fence alignment from the Appin Road corridor to limit disturbance to the already disturbed construction zone.

### Plant and Equipment

The contractor is to limit the use of tracked plant, as far as practical, in favour of wheeled machinery. Equipment such as a backhoe or wheeled excavator are to be used to reach into difficult construction areas to remove existing timber posts.



*Figure 5. Example - wheeled excavator with auger attachment for extended reach.*

Machinery should be limited to 13t maximum weight. Pneumatic drivers are preferred to drive posts to required depth where driven footings are specified.

Wheelbarrows and kibbles are preferred where access to footings is restricted. Concrete agitator trucks are to be used only where direct access from the verge, maintenance areas, or cleared farm tracks is available.





# Mt Gilead, Stage 2

Appin Road Koala Crossing

Redacted Public Version

Archaeological Research Design

**GNL**  
HERITAGE



## **Acknowledgement of Country**

We respect and acknowledge the Dharawal and Cubbitch Barta, their lands and waterways, their rich cultural heritage and their deep connection to Country, and we acknowledge their Elders past and present. We are committed to truth-telling and to engaging with local Aboriginal people and groups to support the protection of their culture and heritage. We strongly advocate social and cultural justice and support the Uluru Statement from the Heart.

## **Cultural warning**

Aboriginal and Torres Strait Islander readers are advised that this report may contain images or names of First Nations people who have passed away.

# Report register

The following report register documents the development of this report, in accordance with GML’s Quality Management System.

Project	Issue No.	Notes/Description	Issue Date
19-0457F	1	Draft report for client review	27 September 2022
19-0457F	2R	Redacted public version	16 November 2022

## Quality assurance

The report has been reviewed and approved for issue in accordance with the GML quality assurance policy and procedures.

## Indigenous cultural and intellectual property

We acknowledge and respect the inherent rights and interests of the Dharawal and Cubbitch Barta in Indigenous Cultural and Intellectual Property. We recognise that Aboriginal and Torres Strait Islander people have the right to be acknowledged and attributed for their contribution to knowledge but also respect their rights to confidentiality. We recognise our ongoing obligations to respect, protect and uphold the continuation of First Nations rights in the materials contributed as part of this project.

## Copyright

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Source of images is GML unless otherwise stated.

## Cover image

View north along the existing service corridor, east of Appin Road.

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# 1 Introduction

## 1.1 Preamble

GML Heritage Pty Ltd (GML) has been engaged by Lendlease Communities Pty Ltd (Lendlease) to prepare an Aboriginal heritage management report, with Archaeological Research Design (ARD) for two Appin Road koala crossing (Figure 1.1, Figure 1.2). The two locations subject to the koala crossings are called Glen Lorne (Figure 1.3) and Browns Bush (Figure 1.4). The two locations will be subject to construction of koala crossings, with infrastructure located beneath Appin Road. The road corridor is owned and maintained by the NSW government. Land east and west of Appin Road is owned by Lendlease.

The land on the west of Appin Road is located inside the development area called Mount Gilead Stage 1 (MGS1). This land has been subject to an Aboriginal Heritage Impact Permit (AHIP) under Section 90 of the *National Parks and Wildlife Act* (NPW Act) 1974. AHIP C0005248 provided approval for harm to some Aboriginal objects inside its boundary. The approval includes all land areas associated with the two koala crossings on the western side of Appin Road. It should be noted that a small east to west area of land at the southern boundary of the MGS1 area is designated as MGS2—however this land area is included within the boundary of the MGS1 AHIP. As such, no further Aboriginal heritage statutory consideration is required for implementation of the koala crossings inside MGS1, which includes all Lendlease lands west of Appin Road.

The land on the eastern side of Appin Road is associated with a designed biobanking area positioned within the larger Mount Gilead Stage 2 (MGS2) project area. GML is in the process of undertaking Aboriginal community consultation, heritage assessment and reporting for the wider MGS2 area.

This report provides an archaeological overview of the two koala crossings for land east of Appin Road. This version of the report has been redacted for public exhibition, and removed information on Aboriginal site locations, Aboriginal cultural values not yet otherwise disseminated, and information on ongoing heritage works associated with Mt Gilead Stage 2. The summary provided details of the local environment and outcomes of archaeological survey in the two biobanking areas.

The landscape context of the two koala crossings is such that either *could* contain Aboriginal objects, as afforded statutory protection under the NPW Act. In order to confirm whether this is the case, we have prepared an Archaeological Research Design (ARD) for archaeological test excavation within the proposed areas of works. This report



forms part of the Review of Environmental Factors (REF) for the two proposed koala crossings.

Following the approval of the REF, the unredacted version of this ARD will be provided to the Aboriginal community for their review prior to a phase when the archaeological methodology, as detailed herein, would be implemented. The outcomes of the work will be prepared as a standalone report, which provides a statutory mechanism for Lendlease to follow, prior to commencing construction of the koala crossings.



Figure 1.1 Mt Gilead, location in southern Sydney, between Campbelltown and Appin.



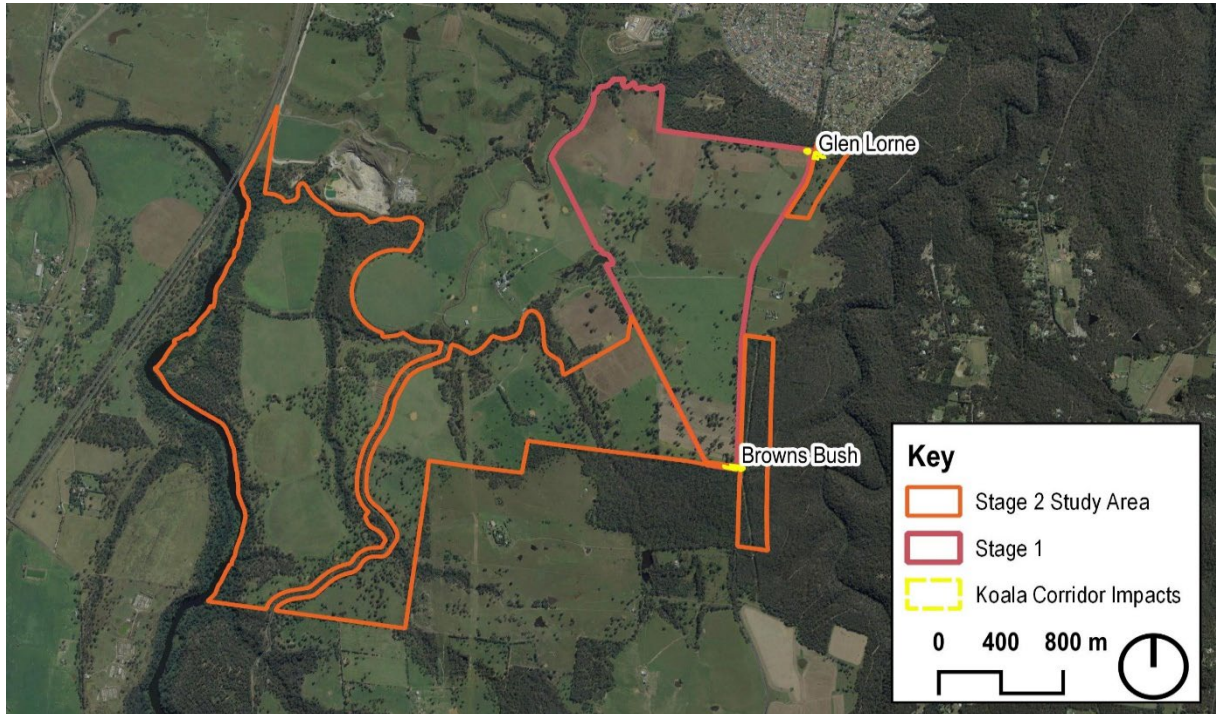


Figure 1.2 Showing the locations of the Glen Lorne and Browns Bush koala crossings, inside the MGS2 eastern biobanking zones.

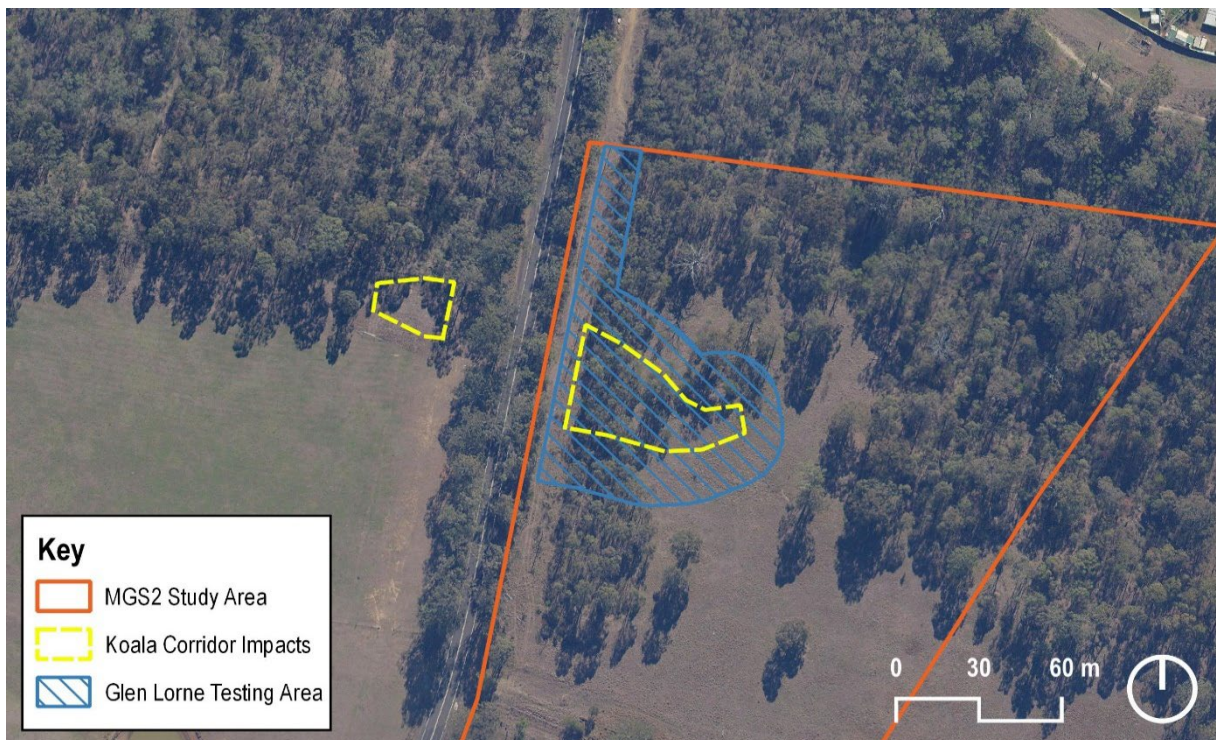


Figure 1.3 Details of the Glen Lorne koala crossing



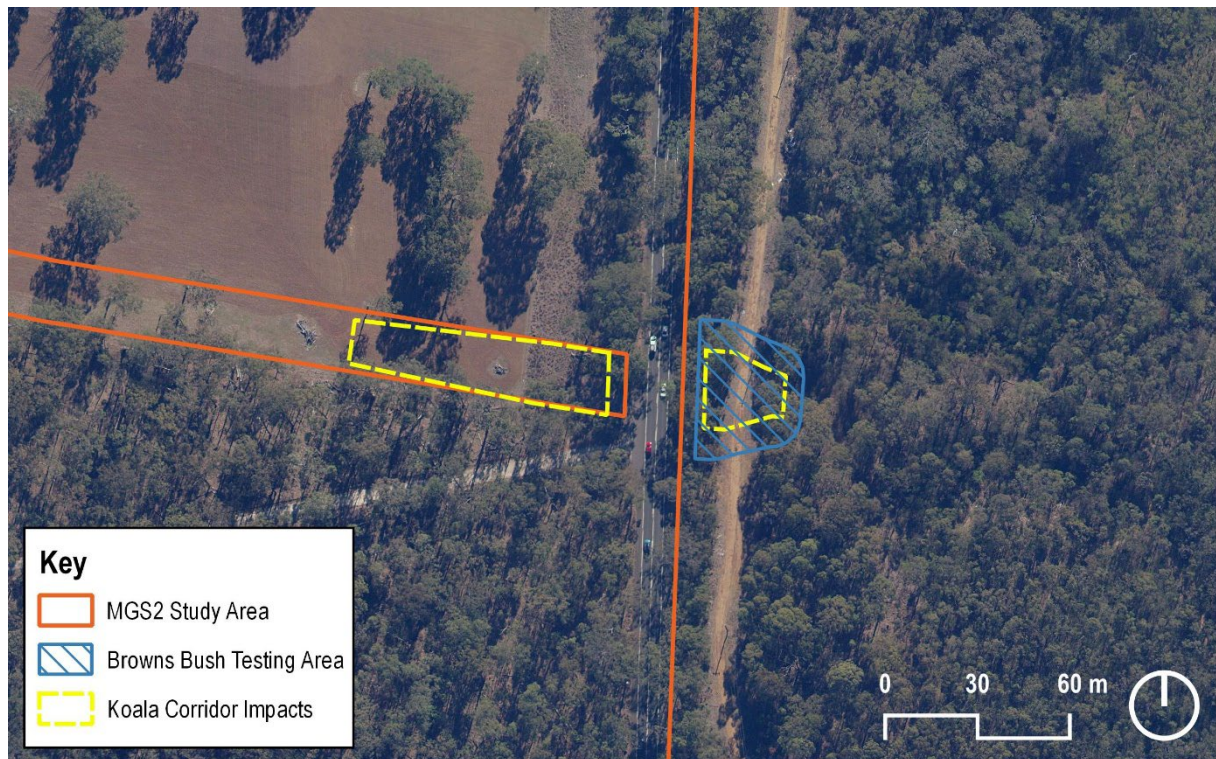


Figure 1.4 Details of the Browns Bush koala crossing. NB the MGS2 area is a component of the MGS1 AHIP.

## 1.2 Objectives of this Aboriginal Cultural Heritage Assessment

Our objectives for this report are to:

- determine how the proposed project could impact any identified Aboriginal cultural heritage values, and aim to minimise impacts through sensible and pragmatic site and land management; and
- provide clear recommendations for the conservation of Aboriginal heritage values and relevant impact mitigation strategies that benefit both Aboriginal cultural heritage and the proponent.

## 1.3 Statutory context

NSW, Aboriginal heritage is principally protected under two Acts:

- the *National Parks and Wildlife Act 1974* (NSW) (NPW Act); and
- the *Environmental Planning and Assessment Act 1979* (NSW) (EPA Act).

### **1.3.1 National Parks and Wildlife Act 1974**

The NPW Act provides statutory protection for all Aboriginal 'objects' (consisting of any material evidence of the Indigenous occupation of New South Wales) under Section 90, and for 'Aboriginal Places' (areas of cultural significance to the Aboriginal community) under Section 84 of the NPW Act. Aboriginal objects and places are afforded automatic statutory protection in New South Wales whereby it is an offence (without the Minister's consent) to 'harm' an Aboriginal object or declared Aboriginal Place.

The NPW Act defines an Aboriginal object as:

any deposit, object or material evidence (not being a handicraft made for sale) relating to the Aboriginal habitation of the area that comprises New South Wales, being habitation before or concurrent with (or both) the occupation of that area by persons of non-Aboriginal extraction and includes Aboriginal remains.

The protection provided to Aboriginal objects and places applies irrespective of the level of their significance or issues of land tenure. Sites of traditional significance that do not necessarily contain material remains may be gazetted as 'Aboriginal Places' and thereby be protected under the NPW Act. However, areas are only gazetted if the Minister is satisfied that sufficient evidence exists to demonstrate that the location was and/or is of special significance to Aboriginal culture.

A strict liability offence applies for harm to or desecration of an Aboriginal object or declared Aboriginal Place. The definition of 'harm' includes destroying, defacing, damaging, or moving an Aboriginal object or declared Aboriginal Place. The strict liability offence of harming Aboriginal objects has a number of defences. The two defences relevant to the proposed development are the statutory defence of due diligence through complying with an adopted industry code or compliance with the conditions of an AHIP.

The potential for Aboriginal objects, sites, places and/or values within the study area, and for the proposed development to impact such objects, has been assessed and the results presented in this report.

### **1.3.2 Environmental Planning and Assessment Act 1979**

The EPA Act provides a statutory framework for the determination of development proposals. It provides for the identification, protection and management of heritage items through inclusion in schedules to planning instruments such as Local Environmental Plans (LEPs) or Regional Environmental Plans (REPs). Heritage items in planning instruments are usually historic sites but can include Aboriginal objects and places. The EPA Act requires that appropriate measures be taken for the management of the



potential archaeological resource by means consistent with practices and standards adopted in meeting the requirements of the NPW Act.

The study area is in the Campbelltown City Council and comes under the Campbelltown Local Environmental Plan.

### **1.3.3 Approach to Aboriginal heritage management**

In NSW Aboriginal heritage assessment and management is underpinned by several guidelines and policies. Our approach is based on the following guidelines:

- Guide to Determining and Issuing Aboriginal Heritage Impact Permits (2009).
- Operational Policy: Protecting Aboriginal Cultural Heritage (2009).
- Aboriginal cultural heritage consultation requirements for proponents (2010) (ACH Consultation Requirements).
- Due Diligence Code of Practice for the Protection of Aboriginal Objects in NSW (2010) (the Due Diligence Code).
- Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales (2010) (the Code of Practice).
- Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW (2011).
- the Australia ICOMOS Burra Charter (2013) (the Burra Charter).

### **1.3.4 The Burra Charter process**

The Burra Charter process (Article 6) outlines a three-stage process for the assessment and management of heritage. The three stages are:

1. develop an understanding of heritage significance;
2. develop policy that is appropriate to the significance; and
3. undertake management in accordance with the policy.

The Burra Charter's explanations for heritage provide the basis for definitions used in this report. The Burra Charter's Indigenous Practice Note provides further guidance for application of the Burra Charter to Aboriginal heritage. We have used the following definitions:

#### **Article 1.1—place**

Place means a geographically defined area. It may include elements, objects, spaces and views. Place may have tangible and intangible dimensions.

'Place' includes locations that embody spiritual value (such as Dreaming places, sacred landscapes, and stone arrangements), social and historical value (such as massacre sites), as well as scientific value (such as archaeological sites). In fact, one place may be all of these things or may embody all of these values at the same time.

## **Article 1.2—Cultural Significance**

Cultural significance means aesthetic, historic, scientific, social or spiritual value for past, present or future generations. Cultural significance is embodied in the place itself, its fabric, setting, use, associations, meanings, records, related places and related objects. Places may have a range of values for different individuals or groups.

## **Article 1.10—Use**

Use means the functions of a place, including the activities and traditional and customary practices that may occur at the place or are dependent on the place.

## **Article 1.11—Compatible Use**

Compatible use means a use which respects the cultural significance of a place. Such a use involves no, or minimal, impact on cultural significance.

## **Article 8—Setting**

Conservation requires the retention of an appropriate setting. This includes retention of the visual and sensory setting, as well as the retention of spiritual and other cultural relationships that contribute to the cultural significance of the place.

Places of significance to Indigenous people require a holistic approach to 'setting'. 'Setting' may encompass the broadest of experiential factors including a sense of 'intrusion' occasioned when people of the 'wrong' gender, age or level of initiation trespass on defined areas, as well as auditory and visual intrusion.

For some Indigenous peoples, nature and culture are indivisible. The social significance and spiritual significance of a place for Indigenous people may be wholly or partly dependent on the natural environment that the place forms a part of, including aspects such as biodiversity, and totemic and resource species.

## **1.4 Best practice: context**

Australia's waters, land, and seas, collectively referred to as 'Country', are alive with a profusion of heritage places. These places are imbued with the essence of the ancestral beings that created them. It is through these places that family descent and kinship connections flow. It is this connection that gives owners' rights, responsibilities and

duties to Country. This is often described as being a Traditional Owner, Traditional Custodian or Native Title Holder. Typically, senior members of the community have the authority to speak for Country.

Culture and heritage are critical to First Nations people and axiomatically connect with concepts of Dreaming and Country. Places of heritage significance extend from the deep past to the present and future. They include enduring cultural landscapes, objects and artistic expressions, and more recent urban areas, built and contemporary features such as missions, protest routes and monuments. First Nations people may not have ancestral connections to the latter but their connection through lived experience is significant and should be recognised.

Therefore, it is important to acknowledge and understand that First Nations heritage:

- encompasses tangible values (stone tools, bone, woven and wooden implements, shell middens, culturally modified trees, rock art sites, ceremonial places and fringe camps);
- encompasses intangible values (Dreaming stories, Song Lines, oral traditions, ceremonies, social practices and lived experience); and
- extends from the deep past to the present and future.

### **1.4.1 Why best practice?**

The current heritage legislation for managing Aboriginal culture and heritage in NSW, the *National Parks and Wildlife Act 1974* (NSW), is inadequate and outdated. It does not adequately recognise the interconnectedness of culture and Country, as described above and in the preamble of this report. It also does not recognise or respect the rights of Aboriginal peoples to control and manage their culture and heritage. These sentiments are echoed in numerous reports by authoritative voices and peak bodies, including the New South Wales Aboriginal Land Council.<sup>1</sup>

In 2018, the Aboriginal Cultural Heritage Bill was developed which proposed a more bespoke system of cultural heritage assessments for projects. The Bill recognised that Aboriginal social/cultural values should be integrated into the consent process in a more meaningful way and intangible cultural heritage provided greater recognition. However, these changes are yet to be formalised.

Therefore, employing best practice standards and approaches not only ensures that results produced are of a high standard—ethically, socially and culturally—but also:

- recognises and respects the views of First Nations peoples;
- encourages a proactive approach to heritage conservation and management where current heritage legislation falls short;

- supports collaboration and co-design with First Nations individuals and groups; and
- identifies and understands heritage and culture more holistically, aligning with Aboriginal and Torres Strait Islander epistemology.

The following current and key best practice guidelines provide the most appropriate standards and frames to support engagement with First Nations community groups and individuals, and a greater understanding of their heritage and culture:

- United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP) (UN General Assembly, 2007);
- Dhawura Ngilan: A vision for Aboriginal and Torres Strait Islander heritage in Australia (Department of Agriculture, Water and the Environment, 2020);
- Connecting with Country (Government Architect NSW, 2020);
- The Uluru Statement from the Heart (2017); and
- The Australia ICOMOS Burra Charter, 2013 (the Burra Charter).

## 1.5 Authorship

This project has been undertaken by the following people. Each person’s role and affiliations are detailed.

Table 1.1 Investigators and contributors.

Person	Affiliation	Role
Dr Tim Owen	GML	Project Director and author
Declan Coman	GML	Project Manager and author
Drew Kennedy	GML	Fieldwork Coordinator and author

## 1.6 Endnotes

- <sup>1</sup> Council, N. S. W. A. L. (2013). INformation Sheet Aboriginal Culture and Heritage Reform New Government Model Reform of Aboriginal Culture and Heritage Laws in NSW.  
 Ellsmore, S. (2012). Protecting the Past, Guarding the Future: Models to reform Aboriginal Culture and Heritage management in NSW.  
 Hunt, J. (2020). Cultural Vandalism: Regulated Destruction of Aboriginal Cultural Heritage in New South Wales. CAEPR Topical Issue. Canberra, Aboriginal Economic Policy Research, College of Arts and Social Sciences.



## **2 Aboriginal heritage and environmental background**

### **2.1 Aboriginal heritage background**

This section provides an outline of the existing archaeological knowledge and information as it related to Mt Gilead and the immediate surrounding area.

The Aboriginal heritage record is presented with an overview of past work that has involved the Mt Gilead area, including a summary of the AHIMS records across the entire Mt Gilead area, and the outcomes of archaeological excavations within the MGS1 area.

Information which provided the locations and details on Aboriginal sites and values has been redacted from the public version of this report.

#### **2.1.1 AHIMS results**

REDACTED FROM THE PUBLIC VERSION

#### **2.1.2 Prior and ongoing heritage work**

Archaeological test and salvage excavation work inside the MGS1 lands provides a benchmark for anticipated archaeological deposits within the Glen Lorne and Browns Bush koala crossing areas. Archaeological survey within the two biobank areas east of Appin Road has previously been undertaken. The results of the prior work provide a context for development of a predictive statement for Aboriginal objects within both the investigation areas. An overview of these prior works is presented below.

#### **MGS1 archaeological test excavation**

Archaeological test excavation was undertaken in 2018 under AHIP C0003570 by Virtus Heritage (Virtus) within the MGS1 area; the locations subject to test excavation are shown in Figure 2.3. A total of 742 test pits were excavated across 29 excavation grids within five landform types. All excavated deposits were wet sieved with 1,183 cultural lithics recovered. Areas O and P are the two areas closest to the Browns Bush study area, both underwent testing in 2018. The two testing grid areas were located at the South-eastern boundary of the project area, within 50m of each other. Table 2.2 provides a summary of artefact types recovered during the testing, and Table 2.3 provides a summary of the raw materials present. In summary the outcomes of testing landforms

closest to Browns Bush were the recovery of a low density 'background' of material, likely representing one off discard events. This is the type of density which could be expected from landforms which do not represent a focus for longer term Aboriginal occupation activities.

## Area O

A total of 15 TUs were excavated in Area O, with six artefacts recovered, which made up 0.05% of the overall assemblage across the MGS1 test excavations. Three artefacts were excavated from TUO13, and three from TUO22.

## Area P

A total of 24 TUs were excavated in Area P, with three artefact recovered, which made up 0.03% of the overall assemblage across the MGS1 test excavations.

Table 2.1 Summary of artefact types excavated during 2018 test excavations.

Area	Flake	Broken Flake	Retouched Flakes		Flaked	Core	Total
			Complete	Broken			
<b>O</b>	1	2	0	0	1	2	<b>6</b>
<b>P</b>	1	1	1	0	0	0	<b>3</b>
<b>Total</b>	<b>2</b>	<b>3</b>	<b>1</b>	<b>0</b>	<b>1</b>	<b>2</b>	<b>9</b>

Table 2.2 Raw material of artefacts excavated.

Area	Silcrete	Mudstone	Chert	Quartz	Total
<b>O</b>	3	0	1	2	<b>6</b>
<b>P</b>	2	1	0	0	<b>3</b>
<b>Total</b>	<b>5</b>	<b>1</b>	<b>1</b>	<b>2</b>	<b>9</b>



Table 2.3 Details of artefacts recovered during the 2021 salvage excavations.

Area	Extent of Excavation	Total Artefacts	Density
Area E	87 m <sup>2</sup>	292	3.3/m <sup>2</sup>
Area EE	13 m <sup>2</sup>	18	1.4/m <sup>2</sup>
Area T	29 m <sup>2</sup>	176	6.1/m <sup>2</sup>
Biobank 208	28 m <sup>2</sup>	13	0.46/m <sup>2</sup>
Total	257 m <sup>2</sup>	499	3.17/m <sup>2</sup>

Several raw material types were recovered: silcrete, indurated mudstone / silicified tuff (IMST) and quartz, and in lower numbers, silicified wood, chalcedony, fine-grained siliceous material, hornfels, porphyry, and two unidentified material types. Silcrete was the predominant material in the assemblage. None of the raw material types occurred naturally in the Mt Gilead area, and would have been collected and transported to the study area. Pigment, and manuport pebbles were also present across the MGS1 area. Identified 'special objects' were also identified and remained onsite.



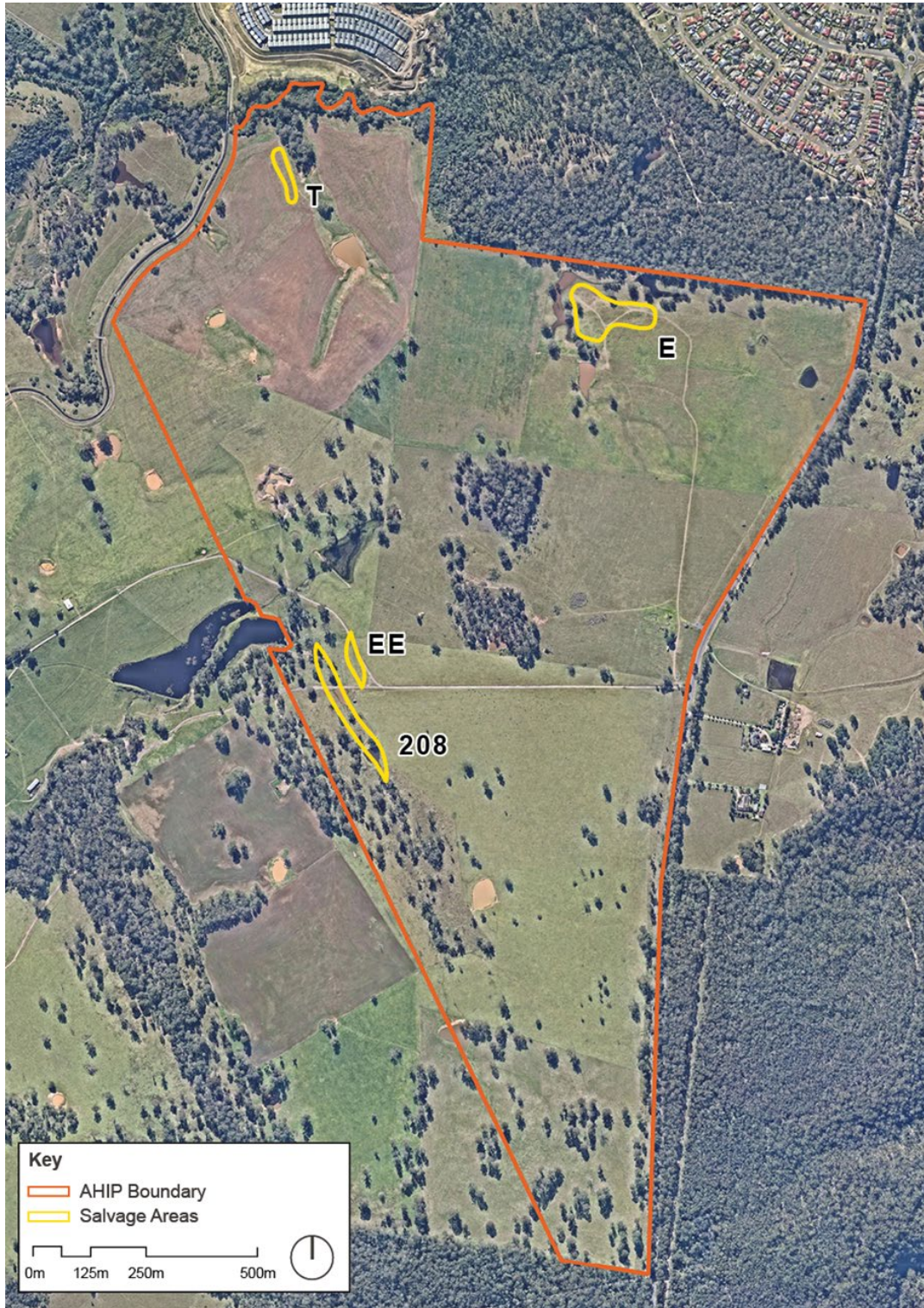


Figure 2.2 Location of salvage works undertaken in 2021.

The assemblage represented a diverse range of tool types. Flaking across the study area is generally 'normal' freehand techniques, and most of the artefacts recovered were produced by on-site flaking, resulting in small tools. Backed artefacts were represented in the assemblage through backing debitage and artefacts that were broken during the backing process. The artefact analysis indicates that people usually only carried small amounts of stone around the landscape. The artefacts lacked cortex in a substantial portion of the assemblage, which indicates that flaking occurred prior to import. Cores were not widely present, implying they were carried on to other places.

The full results and interpretation is presented in the post excavation report *Mount Gilead Stage 1 Aboriginal Archaeological Salvage Excavation Report, July 2022*. This report has been distributed to the Registered Aboriginal Parties (RAPs) involved in the MGS1 project.

## **MGS2 ACHAR**

REDACTED FROM THE PUBLIC VERSION

## **Koala Crossings**

The two koala crossing areas have been inspected as part of prior archaeological inspections of MGS2. An overview of these works is presented below.

### **Glen Lorne**

The Glen Lorne investigation area (east of Appin Road) comprises a very shallow slope, from north to south. The area includes the vegetated margin (abutting Appin Road, Figure 2.7), an electrical transmission line (stripped of vegetation, with an eroded vehicle track, Figure 2.8), and a band of vegetation abutting the east of the vehicle track.

There are currently no identified Aboriginal sites or objects within the Glen Lorne area. The inspection of this area identified a shallow residual soil (up to 300mm deep), overlying B horizon clay and in some instances shale bedrock. It is assumed that soils within the vehicle track, below the transmission line are eroded and disturbed; soils either side of the transmission line remain intact. Analysis of aerial photography shows that trees along Appin Road are not regrowth, but remnant intact vegetation.





Figure 2.3 View east of Appin Road to the koala crossing area.





Figure 2.4 Electrical transmission line and vehicle track facing south.

### **Browns Bush**

Landforms at Browns Bush are generally flat to very shallow sloping. The area is associated with an eroded vehicle track and old entrance off Appin Road (Figure 2.9). The area retains old growth vegetation, but historical archaeological research and investigation (as presented in *Mount Gilead Stage 2 Historical Archaeological Assessment, GML October 2021*) associated the area with a former cottage.

The 1888 Dawson & Dawson subdivision plan of the Mount Gilead Estate, identifies a 'cottage' fronting Appin Road. This location has been described as Site 27 under the GML historical archaeological assessment. Survey of the area failed to identify any evidence of an archaeological site associated with this cottage, and analysis of aerial photography shows no clear evidence for a structure in this location. The only evidence noted was a gate in the position of an entrance driveway (Figure 2.9). The approximate location of the cottage site has been identified in Figure 2.10. However, the only landscape evidence of a potential site was in an area cleared of trees. We note the later 1917 plan shows several buildings, but no structure is located in the position of Site 27.



The historical archaeology assessment identified a high level of potential for evidence of the cottage, such as post holes, wall footings, paths, subfloor surfaces, water management structures, yard surfaces and garden beds. The proposed management for the historical site was conservation—however, should the proposed koala crossing at Browns Bush identify relics, these would need to be managed under the relics provision of the *Heritage Act* 1977. A minimum requirement of monitoring of any ground disturbance works in this area is necessary, although we note the extent of proposed works at this location is likely to avoid historical archaeological deposits (contrast Figure 2.1 against Figure 2.10).

Following the program of Aboriginal archaeological test excavation, a program of historical archaeology testing will be undertaken.



Figure 2.5 View east of Appin Road to the koala crossing area.



Figure 2.6 Detail showing approximate location of the cottage identified on the 1888 Dawson & Dawson plan. (Source: GML 2021, Figure 5.12)

## 2.2 Environmental context

The project area’s environmental context forms a component of the Dharawal traditional lands and Country. Our understanding of the local environment through the geology, soil, water and surrounding disturbance is important for understanding the context of long-term Aboriginal connections to the land. A summary overview of the geology, soil, water, and disturbance present within and surrounding the study area is provided in this section.

The project area is located across Hawkesbury sandstones, formed in the Triassic period. The geology also includes small expressions of the Wianamatta shales. Sandstone and shale outcrops occur within the lands surrounding the area.

The soil landscape associated with the study area is the residual Blacktown soil unit, which is found across 80% of the wider Mt Gilead area (Figure 2.11). Bedrock is commonly found at a shallow depth, often within 300mm of the surface, however the depth of soil often fluctuates between the two rivers east and west of the Mt Gilead area.



The availability of water has significant implications for the range of recourses available and the suitability of an area for early Aboriginal occupation. Two large rivers flow north on either side of the project area, the Nepean River to the west and the Georges River east of the project area (Figure 2.11). A complex network of high order creeks and springs are also present across both the MGS1 and MGS2 project areas. There are no creeks near either the Glen Lorne or Browns Bush investigation areas.

Disturbance to soils profiles has occurred within both study areas. Works/impacts include the construction on Appin Road—which forms the western boundary of the project area, the construction of the fire trails, which runs north-south through both the Glen Lorne and Browns Bush areas, and the possible historical agricultural land uses across the project area.

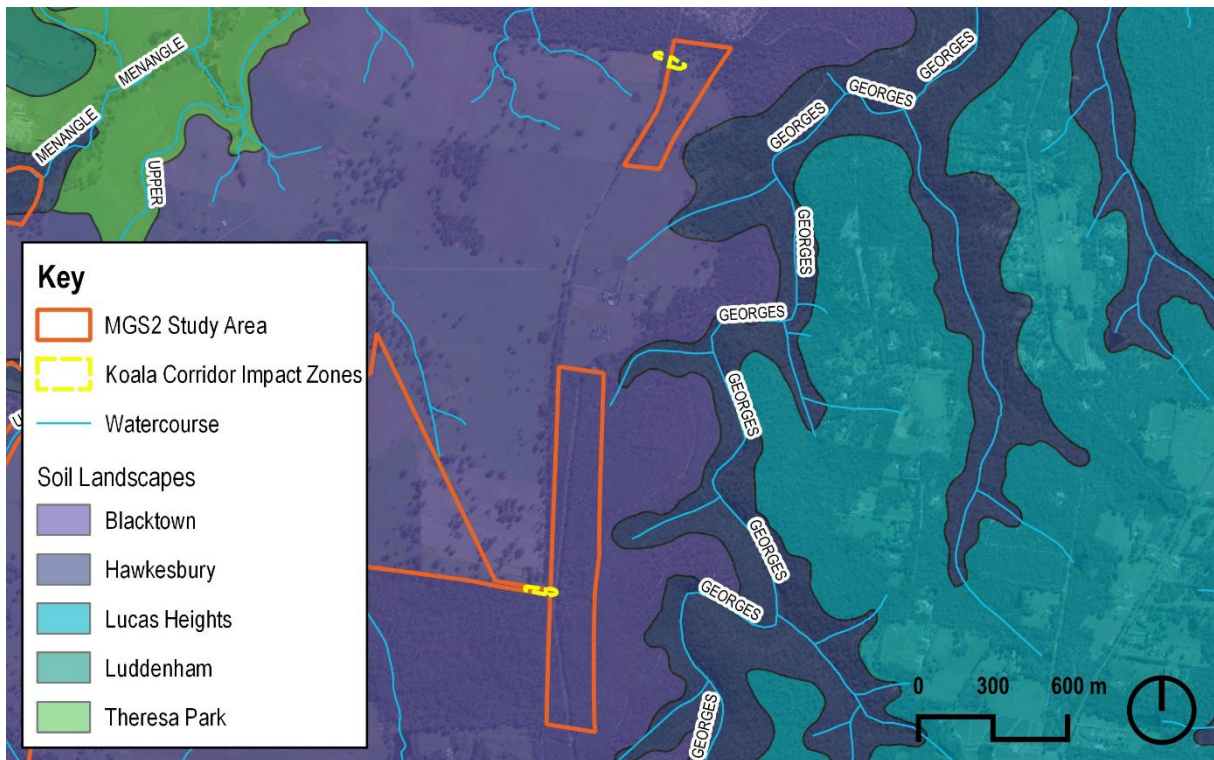


Figure 2.7 Soil landscapes and hydrology across the study area.

## 2.3 Summary of archaeological potential

As part of the *Mt Gilead Stage 2, Aboriginal Cultural Heritage Report*, an assessment of the Glen Lorne and Browns Bush areas, as part of the wider landscape, described the following associations:

Access routes, and places along those access routes, could retain evidence for past Aboriginal connection. Access routes have been described in association with the two ridgelines (Appin Road, east), the ridgeline adjacent to the Nepean River (West), and the Nepean River itself. Further access routes and items associated with way finding should be expected within the MGS2 area. Access routes and key places on these access routes could present important local and regional landscape viewing locations.

Survey identified cultural trees within the wider Browns Bush area, and no Aboriginal objects within the Glen Lorne area. No surface expressions of stone artefacts were observed and no areas of PAD were identified. Areas of disturbance were observed but were not sufficient to have impacted all ground surfaces. In summary, both study areas are positioned on landforms which have not previously been associated with high density expressions of subsurface Aboriginal objects. The landforms are flat to shallow slopes, away from creek lines and more permanent water. On the basis of landform association, these locations would possibly contain a background expression of Aboriginal objects, similar to MGS1 Areas O and P.

Both study areas have been partially impacted, notably by a fire trail which cuts to B horizon clay along a north to south adjacent to Appin Road. The width of this fire trail varies between 5 and 10m, and within its margins there is very low to no Aboriginal archaeological potential.

Landforms either side of the fire trail have little to no known impact, and are likely to retain intact, albeit shallow soil horizons. These areas are assessed to have a low potential for Aboriginal objects.

Irrespective of the level of assessed archaeological potential, all Aboriginal objects known or unknown, have statutory protection under the NPW Act. Therefore, as a risk minimisation action, it is proposed to undertake a program of archaeological test excavation, adhering to the *Archaeological Code of Practice*. This work would occur following approval of the REF, but prior to the commencement of any works associated with the underpasses. Provided a suitable sampling method is implemented, this work should provide Lendlease with a detailed insight into the presence or absence of Aboriginal objects. The outcomes of the work would define whether an AHIP is required for either the Glen Lorne and/or Browns Bush koala crossings.



## 3 Archaeological Research Design

### 3.1 Introduction

The Glen Lorne and Browns Bush areas were initially designated as biobanking reserves. The previous masterplan for the MGS2 works did not include any impacts to ground surfaces. On the basis of no proposed impacts, as well as the lack of any PAD or Aboriginal objects, no further investigation within these areas was proposed.

The 2022 proposal for construction of the two koala crossings necessitates further Aboriginal heritage consideration for these two areas. To confirm the statutory pathway for these specific works, a program of archaeological test excavation (*the program*), within the impact area of the proposed koala corridor works is proposed. The purpose of this program is to confirm that the areas are of low archaeological potential, as per Requirement 15c of the *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales* (DECCW 2010).

This document provides the ARD to guide these archaeological works. Following implementation of the ARD, this report will be modified into a standalone Archaeological Technical Report (ATR), which will form part of the documentation for the larger MGS2 ACHAR. The data from this program of test excavation will be combined with that from MGS1, and used to inform future test excavations undertaken as part of the larger MGS2 archaeological assessment.

The outcomes of the investigations will be determined the statutory heritage pathways for the koala crossings:

- Should the program encounter no Aboriginal objects, The works can proceed without further approval under the *NPW Act 1974*, subject to caution.
- Should Aboriginal objects be present, the programme will collect information about the nature and extent of sub-surface Aboriginal objects. The ATR will be combined with the MGS2 ACHAR, and community consultation to date, and used in the application of a location specific AHIP for the works.

### 3.2 Research Questions

Prior archaeological work for MGS1 has established a series of research questions which aim to further understanding and knowledge relating to the long term Aboriginal occupation and association with this region.

As the findings of the koala crossing test excavation will be used to inform the methodology and supporting the findings of the wider MGS2 assessment, the proposed program of archaeological testing will address the established research questions. Please note that not all of the research questions may be relevant to the current study area, and the findings of the programme may not be applicable in every instance. The established research questions include:

**1. What are the full characteristics of the archaeological deposit present?**

- a. What is the nature (type) of the deposit?
- b. Does the archaeological resource on different soil landscapes change?
- c. Is there archaeological evidence which can be dated (both through scientific methods, such as carbon dating or OSL, and/or relative dating)?
- d. Does the deposit have different degrees of archaeological potential with depth? Is there stratification within the alluvial soils?

**2. How can the deposit be interpreted?**

- a. What, if any, evidence other than stone artefacts is present for Aboriginal occupation and/or use of the study area?
- b. What are the physical attributes of the deposit (stone artefacts, carbon, burnt clay balls or other)?
- c. What are the spatial characteristics of the archaeological deposit in the alluvial soils?
- d. What are the implications of the time and spatial interpretation of stratified and non-stratified archaeological deposits for Aboriginal use of the Holocene landscape of the study area?
- e. For stone deposits, what are the physical characteristics, and do they indicate a specialised use?
  - i. Is there any difference in stone artefact discard or reduction between the different locations?
  - ii. Is there a stratigraphic difference between stone artefact deposits in the assemblage over time? If so, what is the nature of that difference?
  - iii. Does the stone artefact assemblage provide evidence of technological change in the production and use of Aboriginal stone artefacts in the study area?

- iv. Can the stone deposits be classified in line with the categories identified in White 2018, eg White’s definitions for an Upper Quartz Sequence?
- f. Are there comparable temporal episodes and deposits?
  - i. How can we compare deposits and what scales of time can we identify?
  - ii. Is there any evidence in the deposits for repeated occupation over time at the same location within the landscape?
  - iii. Is there any evidence for variation in landscape use and selection strategies?
- g. Does the archaeological deposit vary spatially within one location/site? How?
- h. Is there evidence for domiciliary areas within the deposit?

### **3. Can the archaeology be interpreted in a regional context?**

- a. Where did raw stone materials originate from? Does the pattern of stone procurement differ from that identified at East Leppington?
- b. Is there evidence of trade in connection to stone artefacts and/or their raw materials?
  - i. What is the quality of the raw material used for artefacts within the study area? How can quality be assessed?
  - ii. Within a single context does one stone material exhibit a higher degree of ‘working’ or reduction than another? Can this be linked to scarcity or distance from raw material sources?
  - iii. Does the level of working or percentages of stone change over time through stratigraphical layers (if identified)?
  - iv. How do these differences relate to stone procurement strategies?
  - v. What are the implications for the regional Aboriginal economy?
  - vi. Is there evidence of changes to resource access, the extent of resource use or forced use of different or poorer resources in different strata and over time?
- c. If possible to contrast, are the archaeological deposits different from those in northwest Sydney sites WP1 to WP7? How do the landscape contexts

vary between these locations and how has this potentially altered the nature of the deposits?

- d. Does this landscape contain evidence for the movement of people for traditional activities, and is it connected with the wider cultural landscapes to the south and east? If so, how.
- e. Do the archaeological deposits conform to the regional predictive model and theories (White and McDonald 2010, GML 2016 and Owen and Cowie 2017)?

#### **4. How are the archaeological deposits culturally significant?**

- a. What is the heritage value of the deposit, both scientifically and culturally?
- b. Does the archaeological deposit reflect traditional landscape use, beyond stone artefact manufacture and use?
- c. How does the Aboriginal community view and value the deposit identified? How should other nearby archaeological deposits (eg from Mt Gilead Stage 2) be approached in terms of heritage management?

## **3.3 Proposed Program of Test Excavation**

### **3.3.1 Investigation Areas**

The works proposed as part of the koala crossings, include disturbances to ground surfaces east and west of Appin Road. Impacts to ground surfaces within the Appin Road corridor will be assessed and approved by Roads and Maritime Services, are not within the scope of this assessment and are not included in our program of archaeological test excavation.

Impacts to ground surfaces to the west of Appin Road occur within the following lots:

- Lot 2, DP1218887
- Lot 4, DP1240836
- Lot 10, DP1261146
- Lot 5, DP1240836

These lots are located inside MGS1 on land to which AHIP C0005248 applies. Works within these areas must comply with the conditions of these AHIP but do not require further assessment. No archaeological test excavation will occur inside these MGS1 lots.



Works to the east of the study area occur within the following lots;

- Lot 2, DP1240836 (Glen Lorne Site)
- Lot 1, DP603675 (Browns Bush Site)

These works fall within MGS2, and are not subject to an existing AHIP. These areas will be the focus of the program of archaeological test excavation.

## **Glen Lorne Site**

The extent of Glen Lorne investigation area includes the proposed construction area, and the fire trail to the north which will be used for vehicle and access. A 20m construction buffer has been applied to allow for an appropriate works zone. The layout of these items is shown in Figure 3.1. A total of 31 test units are proposed to be excavated, all on a shallow sloping landform. We note that the Glen Lorne archaeological site resides within the larger biobanking area. This site is identified as I55 'Glen Lorne' on the Campbelltown Local Environmental Plan 2015. The Glen Lorne archaeological site is subject to separate assessment and management, with reporting provided through two documents: *Glen Lorne Archaeology Project, Archaeological Research Design, July 2021 (GML and Sydney University)*, and *Glen Lorne 2023 Sydney University Archaeology Field School, project and archaeology research design, August 2022*.

## **Browns Bush Site**

The Browns Bush site includes all proposed impacts with a 10m construction buffer. The Browns Bush site resides within a Biobanking area but is not subject to any other restrictions. The layout of these items is shown in Figure 3.2. A total of 12 test units are proposed to be excavated, all on a flat landform. Consideration will be given to potential historical archaeology relics which could be located in the western part of this zone.

The program of historical archaeology will follow the Aboriginal test excavation. Should an Aboriginal object be identified during the historical archaeology work, the process for its management will be defined by its context:

- if the Aboriginal object is in a historical archaeology context (eg out of situ), the object will be recorded as a displaced Aboriginal object, and curated with any objects from the Aboriginal archaeology work. Historical archaeology work would continue; or
- if the Aboriginal object is in an intact soil horizon, that location would be subject to a further Aboriginal archaeology test unit, adhering with the methodology provided under the Aboriginal assessment. This would be excavated by the Aboriginal archaeology team.

Should historical relics be identified within an Aboriginal test unit, that unit will not be excavated further. It would be subject to management under the consequent program for historical archaeology.

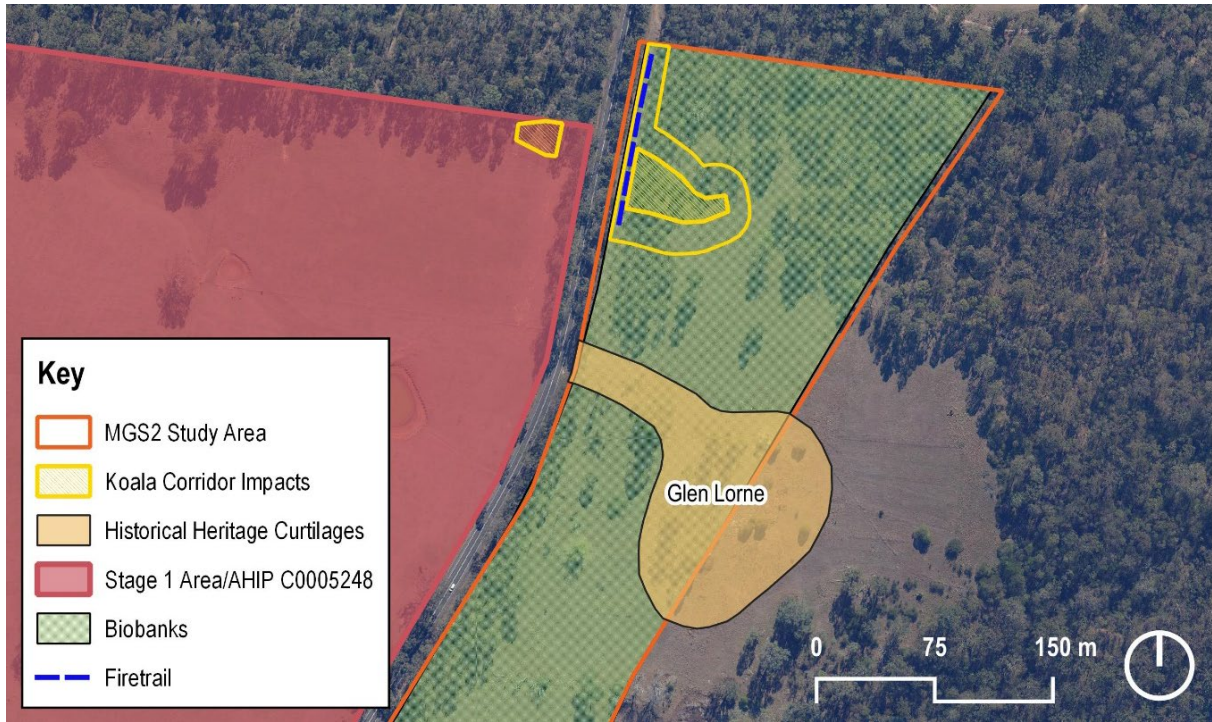


Figure 3.1 Glen Lorne study area in relation to existing permits, curtilages and environmental zones.

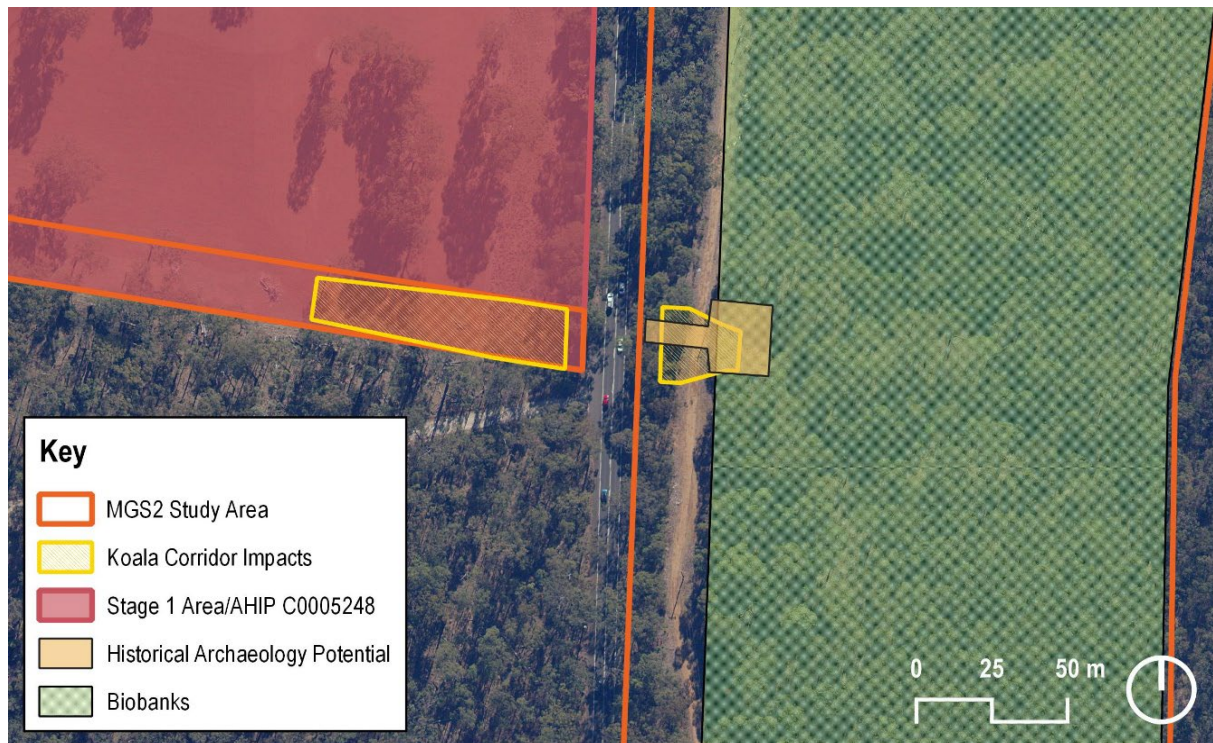


Figure 3.2 Browns Bush Site in relation to existing permits, curtilages and environmental zones.

### 3.3.2 Methodology

The program of test excavation will be conducted in accordance with the *Code of Practice* (OEH 2010):

1. Test excavation units will be placed on a systematic grid appropriate to the scale of each site:
  - a. In the Glen Lorne site, transects will be placed at 10m intervals and test excavation units placed along those transects at 20m intervals in an offset grid. Sample locations will be modified in the field to avoid areas of existing disturbance and the eroded fire trail. The indicative arrangement is shown in Figure 3.3.
  - b. In the Browns Bush site, test excavation units will be placed in a systematic grid at intervals of 10m. Sample locations will be modified in the field to avoid areas of existing disturbance and the eroded fire trail. The indicative arrangement is shown in Figure 3.4.
2. Every test excavation point will be separated by at least 5 m.
3. Test excavations units will be excavated using hand tools only.
4. Test excavations will be excavated in 50 cm x 50 cm units.

5. Test excavations units may be combined and excavated as necessary to understand the site characteristics, however:
  - a. the maximum continuous surface area of a combination of test excavation units at any single excavation point conducted in accordance with point 1 (above) will be no greater than 3 m<sup>2</sup>.
  - b. the maximum surface area of all test excavation units will be no greater than 0.5% of either site:
    - i. The Glen Lorne site is 5,804m<sup>2</sup>; the maximum surface area will not exceed 29m<sup>2</sup> (116 test pits at 50 cm x 50 cm)
    - ii. The Browns Bush site is 1,283m<sup>2</sup>; the maximum surface area will not exceed 6.5m<sup>2</sup> (25 test pits at 50 cm x 50 cm)
6. At no points would a 50 cm x 50 cm excavation unit be greater than 0.5% of the area.
7. The first excavation unit will be excavated and documented in 5 cm spits at each site being investigated. Based on the evidence of the first excavation unit, 10 cm spits or sediment profile/stratigraphic excavation (whichever is smaller) will then be implemented.
8. All material excavated from the test excavation units will be sieved using a 5 mm aperture wire-mesh sieve. If possible a 3mm mesh will be used. It is proposed that dry sieving will be implemented. Should dry sieving not be possible, wet sieving through a 3mm mesh will be undertaken.
9. Test excavation units will be excavated to at least the base of the identified Aboriginal object-bearing units, and will continue, where possible, to confirm the soils below are culturally sterile.
  - a. As described in Section 2.2, the Blacktown soil profile is shallow and sterile layers; B horizon clay or bedrock, are often encountered by 300mm.
10. Photographic and scale-drawn records of the stratigraphy/soil profile, features and informative Aboriginal objects will be made for each single excavation point.
11. Test excavations units will be backfilled with sieved material as soon as each unit is recorded.
12. Should the test excavation encounter an Aboriginal object, an Aboriginal Site Impact Recording form will be completed and submitted to the AHIMS Registrar as soon as practicable.





Figure 3.3 Glen Lorne indicative archaeological sample pattern.



Figure 3.4 Browns Bush indicative archaeological sample pattern.

### **3.3.3 Data to be Collected**

Data will be collected for each Test unit on a specific area context sheet. Data collected will include: spatial location of each test excavation unit, landform, aspect, (if required), depth of spits or stratigraphical layers (as excavated), number of stone objects (or other feature) per spit, total number of objects, identification of any features or inclusions (such as carbon), taphonomic factors (disturbance, bioturbation etc), soil characteristics, section and plan diagrams (especially where features are present), and reasons for expansion (and eventual cessation) of the excavation at any one site. A running total of features and Aboriginal objects will be kept, so as to determine an in-the-field comparison between sample areas. All test excavation units will be photographed.

The excavation director will supervise all recording and determine, in collaboration with the Aboriginal community representatives present, the mode of expansion at each site.

### **3.3.4 Degree of Precision Required**

The location of units for test excavation has been inferred from geo-registered aerial imagery. The precise location of each test trench is known and will be used as the basis for open excavation. The accuracy of the layout is therefore high.

During the excavation, the excavation director will be responsible for the intra-site expansion and layout of test units. Following test excavation the final test unit locations will be recorded by a surveyor, so as to accurately plot the location and reduced levels of the excavated TU. Spatial control of horizontal and vertical excavation will be sufficiently precise to define the location of any Aboriginal objects/deposits within each area and to allow the research questions to be addressed.

### **3.3.5 Method of Measure**

The 'background' density of Aboriginal objects within the study area was determined through MGS1 archaeological excavations. It is defined as between 1 to 3 objects/m<sup>2</sup>. In this region, it is suggested that object densities over 20/m<sup>2</sup> represents a dense deposit. An average around 10 objects/m<sup>2</sup> is required to achieve future salvage parameters. It is possible that expansion of TU, adhering to the parameters of the Code of Practice, may be undertaken to recover archaeological deposits which meet these parameters.

Some test units may have limited evidence relating to Aboriginal objects, but yield other significant deposits, such as hearths, oven/fire pits, heat retaining stone, etc.

Archaeological investigation of such features will be undertaken, within the limits of the

Code of Practice, irrespective of the associated stone artefact deposit, as they could reflect domiciliary areas.

Should the investigation encounter a test unit containing three (3) or more objects, the pit will be expanded to 1m by 1m. The expanded excavation will establish if the artefact density reaches 10 objects/m<sup>2</sup> and achieves salvage parameters.

Test units that contained less than three (3) objects may also be expanded at the discretion of the excavation director and in consultation with the Aboriginal community representatives present.

### **3.3.6 Organisation**

The test excavation will be undertaken by a team, which will include an archaeological excavation director, two field archaeologists and a minimum of three Aboriginal representatives (from the RAPs). The exact details of the field team will be determined closer to the excavation.

### **3.3.7 Post-Excavation Reporting and Outcomes**

The results of the programme will be presented in a standalone Archaeological Technical Report (ATR). The ATR will be included as an appendix to the *Mt Gilead Stage 2, Aboriginal Cultural Heritage Report*, and its findings used to inform further ARDs and testing methodologies that will be conducted as part of the wider MGS2 archaeological investigations.

## **3.4 Aboriginal community review**

This ARD has been provided to the MGS2 RAPs for review in line with the Aboriginal community consultation guidelines. Following completion of the archaeological test excavations, the ATR which provides the results will be provided for RAP review. All comments will be synthesised into the MGS2 consultation log.



# Appendix G

## Groundwater assessment

# Memorandum

27 October 2022

**Subject: Appin Road Upgrade, fauna underpass groundwater inflow assessment**

## 1 Introduction

Appin Road, in southwest Sydney, is proposed to be upgraded by Transport for NSW (TfNSW) in response to increased road traffic to meet additional demand created by the proposed land subdivisions to be built by Lendlease Communities. The Appin Road Upgrade, Mount Gilead to Ambarvale Review of Environmental Factors (REF) (WSP 2018) was prepared for the Appin Road upgrade (the project) in November 2018. Following the receipt of advice from the NSW Chief Scientists regarding the safe passage of local koala populations, TfNSW proposed to modify the project REF via the inclusion of the following two fauna underpasses under Appin Road:

- Glen Lorne (Corridor A) underpass, comprising a 2.4 metre (m) diameter pre-cast concrete pipe; and
- Interim Browns Bush Reserve (Corridor B) underpass, comprising two 1.2 m diameter pre-cast concrete pipes.

These fauna underpasses will be located approximately 3 to 4 m below natural ground level and will include fauna passages at both ends. This groundwater inflow assessment considers potential groundwater ingress to the fauna underpasses once operational. Significant and ongoing groundwater ingress into the subsurface workings would deem them undesirable pathways for koalas.

## 2 Hydrogeological setting

The project area is predominately underlain by Triassic-aged, Wianamatta Group Ashfield Shale, with both fauna underpasses proposed to intersect the Ashfield Shale unit. Ashfield Shale comprises a dark grey to black sideritic siltstone and shale, which is approximately 35 m in thickness at the southern end of the project area based on the publicly available bore log for GW005316 (accessed via the WaterNSW database on 24 October 2022). However, the shale thickness is expected to be variable, and is underlain by Triassic-aged, Hawkesbury Sandstone. A review of project bore logs indicates that the competent Ashfield Shale unit is approximately 4 to 5 metres below ground level (mbgl), with overlying residual clay soils and weathered shale (Douglass Partners 2016).

The Ashfield Shale is a low permeability, aquitard (Ross 2014). Four project bores were drilled into the competent Ashfield Shale to approximately 5 to 7 mbgl, with no reported groundwater ingress (Douglass Partners 2016). These bores did not progress through the entire length of the Ashfield Shale. Minor water ingress (ie at rates too low to measure) was reported in some test pits and boreholes in the residual clay soils and weathered shale. It is not anticipated that this is groundwater, but is rather throughflow, comprising

rainfall recharge that is moving through the unsaturated zone and either discharging at local water courses, being removed via evapotranspiration or contributing recharge to the underlying groundwater system. A permanent groundwater table, representing the depth to saturated conditions, was not intersected during geotechnical drilling investigations.

### 3 Risk assessment

#### 3.1 Fauna underpasses

EMM understand that reinforced, pre-cast concrete culverts are proposed for the fauna underpasses (WSP 2022). For the purpose of this assessment, we have assumed the culverts do not contain weep holes to relieve pressure. The culverts are intended to be installed 3 to 4 mbgl, at the base of the weathered rock profile. Sloped fauna passages at both ends of the fauna underpasses will be constructed and lined with either a ‘hard’ material such as shotcrete or steel mesh or a ‘soft’ material such as erosion matting or topsoil and vegetation. Catch drains, established at the entry to the underpass, will divert potential surface water flows from entering the fauna underpasses and passages (WSP 2022).

#### 3.2 Risk assessment

There are no licensed groundwater bores within 1 km of the fauna underpasses. The key groundwater impact is therefore the ingress of water into the fauna underpasses as this makes them undesirable for use. As the groundwater table is below the culvert depth the potential for through flow is assessed.

A risk assessment has been undertaken using the likelihood and consequence rankings in Table 3.1. The risk assessment is presented in Table 3.2 and considers potential groundwater impacts and management measures in generating a risk ranking.

**Table 3.1 Risk assessment matrix**

		Likelihood				
		A. Improbable	B. Remote	C. Possible	D. Probable	E. Certain
Consequence	5. Catastrophic	Serious (15)	High (19)	High (21)	Extreme (24)	Extreme (25)
	4. Major	Medium (10)	Serious (14)	High (18)	Extreme (22)	Extreme (23)
	3. Moderate	Low (6)	Medium (9)	Serious (13)	High (17)	High (20)
	2. Minor	Low (3)	Low (5)	Medium (8)	Serious (12)	Serious (16)
	1. Insignificant	Low (1)	Low (2)	Low (4)	Medium (7)	Serious (11)

The classification of likelihood for activities is as follows:

- a) Improbable: practically impossible, may occur in exceptional incidents.
- b) Remote: not likely to unlikely to occur, very few incidents.
- c) Possible: could happen and has happened, infrequent incidents.
- d) Probable: has happened, regular incidents.
- e) Certain: common, frequent incidents.

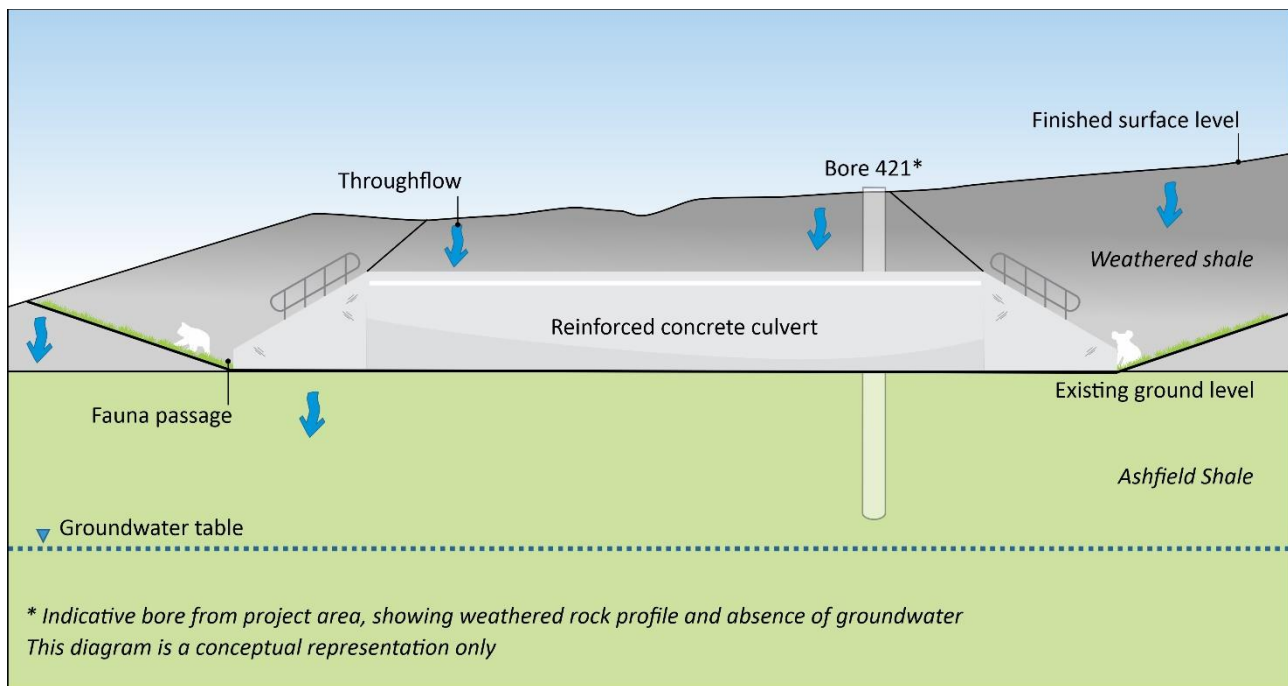
The classification of consequence, as defined within the categories of environment are as follows:

1. Insignificant: no water inflow, considered dry.
2. Minor: minor water inflow, considered damp.
3. Moderate: moderate water inflow, considered wet.
4. Major: major water inflow, considered to have pooled water.
5. Catastrophic: high inflow, considered to have permanently flowing water.

**Table 3.2 Through flow risk assessment**

Impact	Management measures	Likelihood	Consequence	Risk ranking
Throughflow ingress into culverts during operation.	Fully encased concrete structures are proposed, there is no pathway for throughflow into the culverts.	A	1	Low
Throughflow ingress into culvert passages during operation if 'hard' materials are used on the base.	Minor interception of throughflow could occur if steel mesh is used. Use in combination with plantings.	B	1	Low
Throughflow ingress into culvert passages during operation if 'soft' materials are used on the base	Minor interception of throughflow could occur, however this is potentially lost via evapotranspiration hence use plantings and captured in catch drains.	B	2	Low

A conceptualisation of the fauna underpass is included in Figure 3.1, showing groundwater and throughflow relative to the proposed Project.



**Figure 3.1 Hydrogeological cross section**



## 4 Conclusion

This fauna underpass groundwater inflow assessment concludes there is a low potential for groundwater interaction and ingress into the fauna underpasses. The permanent groundwater table is below the culvert levels based on drilling observations but could be confirmed with follow-up groundwater measurements at the Project bores. The culvert structures will be constructed using solid concrete structures, which are not susceptible to groundwater ingress. Potential interaction of throughflow, which is not regarded as groundwater, at the fauna passages can be negated by the use of hard material such as shotcrete, or soft material in combination with vegetation plantings. Evapotranspiration via plantings will presumably prevent throughflow accumulation at the fauna passages, however this could be confirmed with field measurements of throughflow inflow rates, especially following high and sustained rainfall events.

Yours sincerely



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Associate Hydrogeologist

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WSP 2018 *Appin Road Upgrade, Mount Gilead to Ambarvale Review of Environmental Factors* 12 October 2018, prepared for Roads and Maritime Services.

WSP 2022 *Glen Lorne and Browns Bush Underpass Concept Design* September 2022.

# Appendix H

## Consideration of options

Consideration	Noorumba (original concept design in middle of Noorumba Reserve)		Glen Lorne (Current design with Addendum REF)		Browns Bush (Interim measure - cu
<b>Crossing Structure Design Considerations</b>					
Crossing type	Culvert	Pipe	Culvert	Pipe	Pipe
Internal dimensions	2.1m x 2.1m	2.4 Dia	2.1m x 2.1m	2.4 Dia	1.2m Dia
Aperture Size	4.35m <sup>2</sup>	4.32m <sup>2</sup>	4.35m <sup>2</sup>	4.32m <sup>2</sup>	1.13m <sup>2</sup>
width of road / length of pipe	42.16 lin.m	42.16 lin.m	56.75 m Lin	56.75 m Lin	27.125 m Lin
orientation	E/W	E/W	E/W	E/W	E/W
drainage	Free Draining	Free Draining	Piped into future local road network	Piped into future local road network	Free Draining
Koala "furniture" / refuge structures			Batters and through pipe	Batters and through pipe	Batters and through pipe
Koala feed-tree plantings	Existing trees	Existing trees	Existing & Supplementary planting	Existing & Supplementary planting	Existing & Supplementary planting
Evidence of use	TfNSW (Oxley Highway) 48m long underpass (2.4 x 3m)	TfNSW (Oxley Highway) 48m long tunnel underpass (2.4 x 3m)	TfNSW (Oxley Highway) 48m long tunnel underpass (2.4 x 3m)	TfNSW (Oxley Highway) 48m long tunnel underpass (2.4 x 3m)	TfNSW (Wardell Road, near Ballina) - use of 1m diameter pipe
Monitoring	Monitoring with infrared cameras as part of adaptive management program	Monitoring with infrared cameras as part of adaptive management program	Monitoring with infrared cameras as part of adaptive management program	Monitoring with infrared cameras as part of adaptive management program	Monitoring with infrared cameras as part of adaptive management program
Tie into exclusion fencing	Included in design	Included in design	Included in design	Included in design	Included in design
Escape option for koala in road corridor	Wing-wall drop down structures	Wing-wall drop down structures	Wing-wall drop down structures	Wing-wall drop down structures	Wing-wall drop down structures
<b>Environmental Approvals / Impacts</b>					
Land Ownership	Lendlease / Council	Lendlease / Council	Lendlease	Lendlease	Lendlease
Assessment & Approval Form	REF required	REF required	Addendum REF	Addendum REF	Addendum REF
Maintenance	Lendlease / Council	Lendlease / Council	Lendlease / TfNSW	Lendlease / TfNSW	Lendlease - minimum diameter for maintenance under TfNSW requirements is
<b>Design / Engineering / Construction Considerations</b>					
Retaining Walling / Battering	Within Noorumba Biobank	Within Noorumba Biobank	Works on boundary required	Within Lendlease landholding	Works on boundary required
Base footings	In-situ concrete	Compacted subgrade & bedding sand	In-situ concrete	Compacted subgrade & bedding sand	Nil
Adjacent Land considerations	Significant impacts to existing biobank due to associated vegetation removal	Significant impacts to existing biobank due to associated vegetation removal	Minimal tree removal required	Minimal tree removal required	No tree removal
Construction Period	13 weeks	11 weeks	13 weeks	11 weeks	12 weeks
<b>Traffic Management Consideration</b>					
Night Works	Yes	Yes	Yes	Yes	Yes
Closure of whole Road	4 nights	2 nights	4 nights	No - managed by construction zone speed limits	No - managed by construction zone speed limits
<b>Constraints</b>					
	Considerable clearing of vegetation within biodiversity stewardship footprint unavoidable. Strongly consider alternatives.	Considerable clearing of vegetation within biodiversity stewardship footprint unavoidable. Strongly consider alternatives.	The installation of a culvert would require a road shut down of a minimum of 4 nights to construct the in-situ slab.	The installation of a pipe may be achievable with contra-flow and steel plates without a full shutdown pending TfNSW approval.	Bored pipes not feasible given construction work area required. Construction footprint for a Tunnel Boring Machine would also require a much larger construction footprint
	Existing services adjacent to underpass. Protection and relocation study required.	Existing services adjacent to underpass. Protection and relocation study required.	Protection of existing assets required on eastern side of Appin Road	Protection of existing assets required on eastern side of Appin Road	Use of a larger pipe diameter in this location is unfeasible given the depth to which it would need to be sunk to avoid utilities and existing trees
<b>Summary</b>	Impacts to biobank render this option unsuitable	Impacts to biobank render this option unsuitable	Requires a whole road closure for four nights	This option provides a workaround to engineering constraints. Does not require a whole road closure	Single pipe was not considered to be less desirable than dual pipes, which provide greater opportunity for use by koalas/fauna.

urrent design with Addedndum REF)	Beulah (permanent structure - subject to separate approvals)	
Dual Pipe	Bridge (plank)	Bridge Culverts
2 x 1.2m Dia	TBC	TBC
2.26m2	TBC	TBC
27.125 m Lin	TBC	TBC
E/W	E/W	E/W
Free Draining	Free Draining	Free Draining
Batters and through pipe	TBC	TBC
Existing & Supplementary planting	Existing trees	Existing trees
TfNSW (Wardell Road, near Ballina) - use of 1m diameter pipe	TBC	TBC
Monitoring with infrared cameras as part of adaptive management program	Monitoring with infrared cameras as part of adaptive management program	Monitoring with infrared cameras as part of adaptive management program
Included in design	Future design required	Future design required
Wing-wall drop down structures	TBC	TBC
Lendlease	Lendlease	Lendlease
Addendum REF	REF required	REF required
Lendlease	Lendlease	Lendlease
Works on boundary required	TBC	TBC
Nil	Concrete Piers - TBC	Concrete Ground Slab - TBC
No tree removal	Clearing required for access	Clearing required for access
14 weeks	40 weeks	40 weeks
Yes	Yes	Yes
No - managed by construction zone speed limits	Off-line construction and contra-flow required	Off-line construction and contra-flow required
Bored pipes not feasible given construction work area required. Construction footprint for a Tunnel Boring Machine would also require a much larger construction footprint	Clearing of existing vegetation and large work zone required	Clearing of existing vegetation and large work zone required
Use of a larger pipe diameter in this location is unfeasible given the depth to which it would need to be sunk to avoid utilities and existing trees	Existing services adjacent will require relocation study	Existing services adjacent will require relocation study
Pipes are an interim measure until permanent crossing at Beulah constructed. Monitoring will provide valuable information of the success of this underpass configuration	Design and approval of permanent crossing TBC, however LL has undertaken a commitment to construct	Design and approval of permanent crossing TBC, however LL has undertaken a commitment to construct





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