Transport for NSW

Jenolan Caves Road Five Mile Failure

Review of environmental factors (for national parks)

August 2023

NSW GOVERNMENT

transport.nsw.gov.au

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.

Prepared by Aurecon Australasia Pty Ltd and Transport for NSW.
ISBN:

Approval and authorisation

Accepted on behalf of Transport for NSW by	Pete Styles
Title	Senior Project Development Manager
Signed	
Dated	29/08/2023

Executive summary

The proposal

Transport for NSW (Transport) proposes to restore about 500 metres of Jenolan Caves Road at the Five Mile main failure (slope #94244) and nearby second failure (slope #94242) to near pre-failure conditions (the proposal). The proposal is located within the Oberon local government area (LGA) in Jenolan, New South Wales. The road failures occurred as a result of reduced vegetation from the bushfires in 2019 and subsequent heavy rainfall in 2021 and 2022, that have led to landslides. The work would occur at two slopes, about 1.2 kilometres north (slope #94244) and 1.4 kilometres north (slope #94242) of Jenolan Caves House.

Jenolan Caves Road is a narrow two-way road and is the only access route to Jenolan Caves (from Lithgow in the north and Oberon in the west). It runs from Hampton, past the Jenolan Caves, to the intersection of Edith Road and Kanangra Falls Road, south-west of Jenolan Caves. Jenolan Caves Road is an important connection as it provides access to the Jenolan Caves House and Jenolan Caves, which attract about 230,000 visitors each year. The proposal is a part of an overall Jenolan Caves Road program of works which involves restoration to a 10-kilometre-long section between Lithgow and Jenolan Caves House.

The key features of the proposal include:

- Upslope treatment including stabilisation by pattern bolting and the installation of a rock fall barrier prior to road work to allow safe access for workers to the failure sites
- Reinstatement of Jenolan Caves Road at the two failure locations, including:
  - Reinforced soil wall (RSW) structures at the two failures, and along the length of the construction access ramps, which would be excavated to reach the bottom of the failures
  - A foundation anchor beam and geogrid reinforcement in each RSW
  - A widened carriageway at the failures for vehicle turns paths
  - New bridge twin rail barriers on the failure side at both failures.
- Provision of new stormwater drainage, including:
  - Kerb and grated table drains at each failure adjacent to the reinstated road
  - Four new culverts underneath the RSW at the main failure
  - Three new culverts underneath the RSW at the second failure
  - Upgrade of one existing culvert north of the RSW at the second failure.
- Installation of a permanent scour protection structure at the base of the RSWs
- Construction activities and ancillary work, including:
  - Establishment of hardstand areas for ancillary facilities
  - Final roadworks including tie-in work to adjoining sections of Jenolan Caves Road and re-surfacing of sections of Jenolan Caves Road damaged by construction plant and equipment.

Construction is expected to take up to three years to complete, assuming no unforeseen disruptions.

Need for the proposal

Jenolan Caves Road serves as the main vehicular connection between Hampton and the Jenolan Caves. Due to extreme weather events including bushfires in 2019 and heavy rainfall in 2021 and 2022, landslides have occurred over the road resulting in multiple road failures. Jenolan Caves Road has since been closed to vehicles between the Jenolan Caves Road / Bulls Camp Trail intersection and the Jenolan Caves.

The proposal would restore the Five Mile main failure and the nearby second failure to pre-failure conditions to re-open Jenolan Caves Road to the public and to reduce safety risks to road patrons. In addition, the proposal would improve the resilience of existing road infrastructure by reducing the potential for future road failures from similar weather events.

Proposal objectives

The objectives of the proposal are to:

- Stabilise the main and second failures which occurred on Jenolan Caves Road as a result of extreme weather events
- Ensure that the risk of future slope failures is reduced including the risk of debris falling onto Jenolan Caves Road and blocking access
- Improve the safety for road users along this failed section of Jenolan Caves Road
- Enable public vehicular access into the Jenolan Caves precinct to be reinstated to improve overall access to the precinct.

Options considered

Options for the proposal were assessed in a value management (VM) workshop. The options assessed in the VM workshop were selected based on previous multi-criteria analysis workshops as well as a re-evaluation of the sites given the changes occurring on site.

The four options assessed at the VM workshop were:

1. Soil nail foundation with gravity / RSW structure above
2. Anchored/nail solution with shotcreted anchored wall
3. Reinforced soil wall
4. Frame on corbels

The recommended option from the value management workshop was Option 1. Option 1 scored the highest weighted average score of the short-listed options and consistently scored the highest for the sensitivity analysis.

Design refinements also occurred following the selection of the preferred option. Drainage infrastructure throughout the proposal area was increased to include seven new culverts underneath the proposed reinstated road in addition to the replacement and increase in size of the existing large culvert at the northern end of the proposal area. Additionally, an increase in the required earthworks for the proposal's construction was also identified through the concept design phase. Access ramps from the northern side of both failures were deemed necessary to provide access for construction vehicles to the base of each failure. These access ramps would need to be excavated and then reinstated as part of the proposal's construction.

Statutory and planning framework

The proposal is for a road infrastructure facility and is to be carried out by Transport and can therefore be assessed under Division 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). Under section 2.109 of State Environmental Planning Policy (Transport and Infrastructure) 2021 (Transport and Infrastructure SEPP), the proposal is permissible without consent. The proposal is not State Significant Infrastructure or State Significant Development. The proposal can be assessed under Division 5.1 of the EP&A Act. Development consent from council is not required.

The proposal is partially within the Jenolan Karst Conservation Reserve and is therefore subject to authorisation under the *National Parks and Wildlife Act 1974* (NPW Act). For this portion of the works, authorisation is required from National Parks and Wildlife Service (NPWS). The proposal is permissible under the NPW Act and is consistent with the NPWS Policy.

Transport is the determining authority for the proposal. This REF fulfils the determining authority's obligation under section 5.5 of the EP&A Act, including 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.

A Section 60 approval under the *Heritage Act 1977* is also required due to the positioning of the works within the State Heritage Listed Jenolan Caves Reserve.

Community and stakeholder consultation

Community consultation has been ongoing since March 2021 and has consisted of public community updates on Transport's West Region Projects webpage nswroads.work/jcroad. The first community updated provided details on the closure of Jenolan Caves Road due to the multiple slope failures as a result of severe weather. The update also included information on initial geotechnical and road assessments. The latest community update was published in December 2022. This informed communities of the additional failure that had occurred on the Five Mile due to rainfall in July 2022, as well as of the completion of geotechnical investigations and detailed surveys for both road failures. It is anticipated that these updates would continue to be published as the proposal progresses.

Environmental impacts

The environmental impacts of the proposal area outlined in section 6. Given the proposal would reinstate an existing road, impacts are generally anticipated to be minor, including Aboriginal cultural heritage, traffic and transport, and socio-economic impacts. Areas where higher impacts are anticipated as a result of the proposal are summarised below.

Landscape character and visual impacts

A landscape character and visual impact assessment was carried out to understand the visual impacts of the proposal, which included assessment of different landscape character zones and viewpoints within and near the proposal area. Four landscape character zones (LCZs) were identified during desktop studies in the broad vicinity of the proposal area:

- LCZ 1: Residential/staff accommodation
- LCZ 2: Tourism
- LCZ 3: Existing road corridor
- LCZ 4: Natural landscape.

Impacts on LCZ 1 and LCZ 2 as a result of the proposal were determined to be negligible. For LCZ 3 and LCZ 4, a moderate impact rating was assigned based on the moderate sensitivity and magnitude of the localised impacts in the case of the existing road corridor, and the high sensitivity and low magnitude of the impacts in the case of the natural landscape.

Viewpoints were selected to be representative of the range of locations both within and beyond the road corridor. The viewpoints included:

- Viewpoint 1 – existing view from Jenolan Caves Road at the main failure
- Viewpoint 2 – existing view from a drone at the main failure
- Viewpoint 3 – existing view from Jenolan Caves Road at the second failure
- Viewpoint 4 – existing view from a drone at the second failure.

Each viewpoint would be impacted by vegetation removal, the installation of the reinforced soil walls and upslope cuttings. Viewpoints 1 and 3 were impacted to a moderate and moderate-high extent, respectively, with the reinforced soil wall being more visible from the road corridor at the second failure due to the tight bend of the road, resulting in a high magnitude of change. Viewpoints 2 and 4 were both impacted to a high extent due to the high sensitivity of the highly vegetated view and the high magnitude of change on the views associated with the installation of the reinforced soil wall.

Visual impacts to the wider Jenolan Karst Conservation Reserve are noted to arise during the construction phase around ancillary facilities. Users of the Binoomea Ridge Trail and Bulls Camp Trail would experience minor visual impacts given ancillary facilities A and B, respectively, are located at the beginning of these trails. Additionally, visual impacts would be experienced within the Jenolan Caves precinct as a result of plant and equipment storage and vehicle movements at ancillary facility E, however given this facility would be located in an existing carpark, these impacts would also be minimal. Ancillary facilities C and D would be located in areas not currently accessible to the public, meaning visual impacts at these sites would be negligible.

Appropriate mitigation measures to minimise landscape character and visual impacts are provided in section 6.1.4

Non-Aboriginal heritage

The Jenolan Karst Conservation Reserve is located within the World Heritage and National Heritage Listed 'Greater Blue Mountain Area'. It is also listed on the State Heritage Register as well as being heritage listed locally. The Reserve has heritage significance at the State and local level for its historic, associative, aesthetic, and social values, as well as for its rarity. It is of National and World significance for its rarity, research (scientific) and events values, and its ability to show principal characteristics of a class of places.

As the slope failures have damaged and removed much of the road surface and sub-structure at the failure locations, the construction phase would involve rebuilding and stabilisation in and around heritage listed areas. This would include excavation works which would be required to construct access ramps to the base of each failure on the downslope, as well as upslope excavations. Downslope excavations would require the removal of a remnant stone embankment wall which formed part of the original road infrastructure. The overall construction phase impacts on the heritage significance of the proposal area would be minor adverse as a result of the establishment of ancillary facilities, the removal of the remnant stone embankment wall, excavations on the upslope and downslope, stabilisation works, drainage infrastructure installation.

There would be a minor adverse operational impact on the heritage significance of the proposal area, largely due to changes to the upslope. The upslope excavations and rockfall barrier would have a minor adverse operational (visual) impact on the heritage values of Jenolan Caves Road and a negligible operational (visual) impact on the heritage significance of the Jenolan Karst Conservation Reserve.

Mitigation measures for these non-Aboriginal heritage impacts are presented in section 6.2.4.

Water and soils

The proposal lies in the Mid Coxs River sub-catchment of the Sydney Drinking Water Catchment, which forms part of the Hawkesbury-Nepean River system. The proposal traverses several first order feeder streams of an unnamed tributary of Jenolan River.

Topography is very steep, and the road sits on a midslope position, carved into an east-facing hillside. Due to the two failures, there are large volumes of exposed sediment that may be displaced into receiving waters due to the unstable, highly eroded, steep lands during rainfall events.

On the inside of road bends against the hillside, roadside drainage through the proposal area includes informal table drains that flow over natural rock. During site investigations, groundwater was not encountered. Excavation work required during the construction phase of the proposal would be relatively shallow in depth and is not likely to intersect regional groundwater. As such, no significant impact to groundwater quality or groundwater resources is anticipated as a result of the proposal.

Potential adverse water quality impacts from the construction phase of the proposal would include:

- Potential for soil or water contamination from spills or leaks through the use of hazardous materials as well as from plant and equipment
- Potential for pollutants to wash into waterways and then into the receiving environment through earthworks, drainage works, vegetation removal and material stockpiling
- Potential for polluted water to be accidentally discharged offsite following rainfall or for inadequate treatment of water prior to being discharged
- Potential for water quality impacts on surface water from concreting.

However, the Neutral or Beneficial Effect (NorBE) assessment carried out for the proposal identified that a neutral effect on water quality would occur during construction following implementation of the safeguards identified in section 6.3.4 prior to and during construction.

Construction of the proposal would require excavation and the removal of vegetation which has the potential to expose large areas of soil. The largest construction impacts to soil would result from excavations which are required for the construction of access ramps to the base of the failures. Access constraints at the failures would require these ramps to be excavated, meaning the extent of disturbed soil would extend beyond the existing failures. If not adequately managed this could have the following impacts:

- Dust generation during excavation

- Erosion of exposed soil and any stockpiled material
- An increase in sediment loads entering the stormwater system and/or local runoff, and therefore nearby receiving waterways including tributaries of Jenolan River.

Potential adverse impacts from the operational phase of the proposal would include:

- Soil and water contamination from vehicle movements
- Potential for rubbish to be ejected from vehicles into the receiving water environment
- Accidental blockages of stormwater systems leading to downslope scour from diverted waters
- Potential pollution to the environment as a result of poor pavement and vegetation maintenance.

By providing greater culvert capacity (through additional culverts and upgrading the existing northern culvert), the proposal would substantially reduce the volumes of sediment discharged into the drinking water catchment (subject to ongoing maintenance). As such, the NorBE assessment carried out for the proposal identified that a beneficial effect on water quality would occur during operation.

Soil contamination could occur as a result of any accidental spills or leaks of fuels, oils and other chemicals from equipment and vehicles during construction. There is also the potential for unexpected finds of contaminated soils. These impacts are likely to be minor as exposure of soil would be temporary and short term. Operation of the proposal is not likely to result in any substantial impacts on soils, landscape, topography or geology.

Safeguards for these impacts are included in section 6.3.4.

Biodiversity

The proposal is located within the Jenolan Karst Conservation Reserve, which is home to a diverse flora and fauna population. A biodiversity assessment report was prepared for the proposal. The assessment mapped two plant community types (PCTs) within the proposal area:

- PCT 821 - Eurabbie - stringybark shrubby woodland on limestone in the Jenolan Caves area, Sydney Basin Bioregion
- PCT 963 - Narrow-leaved Peppermint - Mountain Gum - Brown Barrel moist open forest on high altitude ranges, northern South Eastern Highlands Bioregion.

Additionally, it was noted that there is a high potential for groundwater dependent ecosystems near ancillary facility B, and one species credit flora species with a moderate likelihood of occurring (Paddys River Box) was recorded within the proposal area. No listed TECs were recorded within the proposal area.

The habitat assessment mapped several hollow-bearing trees within the proposal area ranging from 10 centimetres to more than 25 centimetres in diameter. Other fauna habitat features observed within the proposal area included woody debris, a small burrow, rocks and rubble (providing crevices for small mammals and reptiles), and freshwater habitat along several first and second order streams, as well as Surveyors Creek (a third order stream). Foraging habitat for mobile birds, bats and mammals was also present within areas of native vegetation. One threatened fauna species, *Petroica phoenicea* (Flame Robin), was incidentally recorded foraging around 145 metres from the proposal area. Nine species credit fauna species and three ecosystem credit fauna species with a moderate to high likelihood of occurrence were assumed present within the proposal area.

The proposal would result in the clearance of 0.995 hectares of PCT 821, which would include the removal of threatened flora habitat. However, it is noted that given the proposal area would only result in a small clearance of threatened fauna habitat and that there is sufficient habitat for threatened flora in the surrounding reserve, the impacts to threatened species would be minimal. Some noise impacts would be felt by wildlife during the installation of the rockfall barrier, which would require the use of a helicopter. These impacts are anticipated to be minor and temporary as the helicopter is expected to only be used for short periods (e.g., during the installation of the rockfall barrier). Paddys River Box was not found in the proposal area during field surveys. As there are no other known threatened flora species within the proposal area, impacts to threatened flora species are not anticipated.

The operation of the proposal is not anticipated to result in any major adverse impacts to fauna or flora given conditions at the Jenolan Caves Road Five Mile would return to pre-failure conditions, which would not

increase the risk of impacts such as injury and mortality to wildlife. Additionally, no offsets have been triggered by the proposal.

Noise and vibration

Noise and vibration impacts on surrounding residential, commercial and recreational receivers are generally anticipated to be minor. Temporary noise impacts would result from the installation of the rockfall barrier during the construction phase as this would be installed with the use of a helicopter. Noise impacts from the helicopter are anticipated to be high, although impacts are expected to only be for a short time. The helicopter would only be used during daylight hours and is expected to be required only for a few shifts (subject to confirmation during detailed design). After the use of the helicopter, the residential receiver near the proposal area would be affected by noise during standard hours, but not to a moderately or highly intrusive extent, and would experience clearly audible noise during out of hours periods. Commercial receivers such as the Jenolan Caves Reserve Trust, Jenolan Caves House and Jenolan Mountain Lodge would be unaffected by noise from the proposal area.

Noise impacts were also estimated for receivers near ancillary facilities. Passive receivers using walking tracks, such as the Binoomea Ridge Trail and Bulls Camp Trail, would be impacted by noise from ancillary facilities A and B, however this is expected to be minor given impacts would only be felt at the beginning of the tracks. Additionally, the use of the helicopter for activities such as the installation of the rockfall fence would impact users of Bulls Camp Trail, which is located near ancillary facility B (to be used as a helicopter base). The helicopter would also use ancillary facility C, near Mount Inspiration Lookout, as a winch site, however the lookout is located in the closed section of Jenolan Caves Road, meaning noise impacts would not be experienced. As is the case with other receivers, noise impacts from the helicopter would only be felt at ancillary facilities for a short time. Safeguards have been included in section 7.2 to minimise these impacts.

The proposal would not have any noise and vibration impacts following the completion of the reinstatement works. Road conditions would return to pre-failure conditions, meaning traffic access into the Jenolan Caves precinct via the Five Mile section would be reinstated with only minor changes to the pre-failure road alignment.

Justification and conclusion

The proposal is considered to be justified as it would allow the reopening of the Jenolan Caves Road Five Mile which is currently closed to the public due to vehicles being unable to travel through this section. The reopening of the road would benefit businesses within the Jenolan Caves precinct as it would restore full access to the precinct for all workers and visitors.

The 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. The proposal would be unlikely to cause a significant impact on the environment. Therefore, it is not necessary for an environmental impact statement to be prepared nor approval to be sought from the Minister for Planning under Division 5.2 of the EP&A Act. A Biodiversity Development Assessment Report or Species Impact Statement is not required. Additionally, there would be no significant impacts to matters of national environmental significance, meaning the proposal has not been referred to the Department of Agriculture, Water and the Environment.

This REF has concluded that the adverse impacts and risks of the proposal would be outweighed by the long-term benefits of providing access and road safety for all users of Jenolan Caves Road.

What happens next?

Transport will determine whether or not the proposal should proceed as proposed. Transport for NSW will inform the community and stakeholders of this decision.

NPWS has an authorisation role for the section of the proposal within the Jenolan Karst Conservation Reserve. NPWS will consider the proposal before deciding whether to authorise this section. Authorisation from NPWS needs to be received prior to work occurring on this land.

If the proposal is determined to proceed, Transport for NSW will continue to consult with the community and stakeholders prior to and during construction.

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1. Introduction

1.1 Proposal identification

Transport for NSW (Transport) proposes to restore about 500 metres of Jenolan Caves Road at the Five Mile main failure (slope #94244) and nearby second failure (slope #94242) to near pre-failure conditions (the proposal). The proposal is located within the Oberon local government area (LGA) in Jenolan, New South Wales. Location of the proposal is shown in Figure 1-1. The road failures occurred as a result of reduced vegetation from the bushfires in 2019 and subsequent heavy rainfall in 2021 and 2022, that have led to landslides. The work would occur at two slopes, about 1.2 kilometres north (slope #94244) and 1.4 kilometres north (slope #94242) of Jenolan Caves House shown in Figure 1-2.

Jenolan Caves Road is a narrow two-way road and is the only access route to Jenolan Caves (from Lithgow in the north and Oberon in the west). It runs from Hampton, past the Jenolan Caves, to the intersection of Edith Road and Kanangra Falls Road, south-west of Jenolan Caves. Jenolan Caves Road is an important connection as it provides access to the Jenolan Caves House and Jenolan Caves, which attract about 230,000 visitors each year. The proposal is a part of an overall Jenolan Caves Road program of works which involves restoration to a 10-kilometre-long section between Lithgow and Jenolan Caves House.

The key features of the proposal include:

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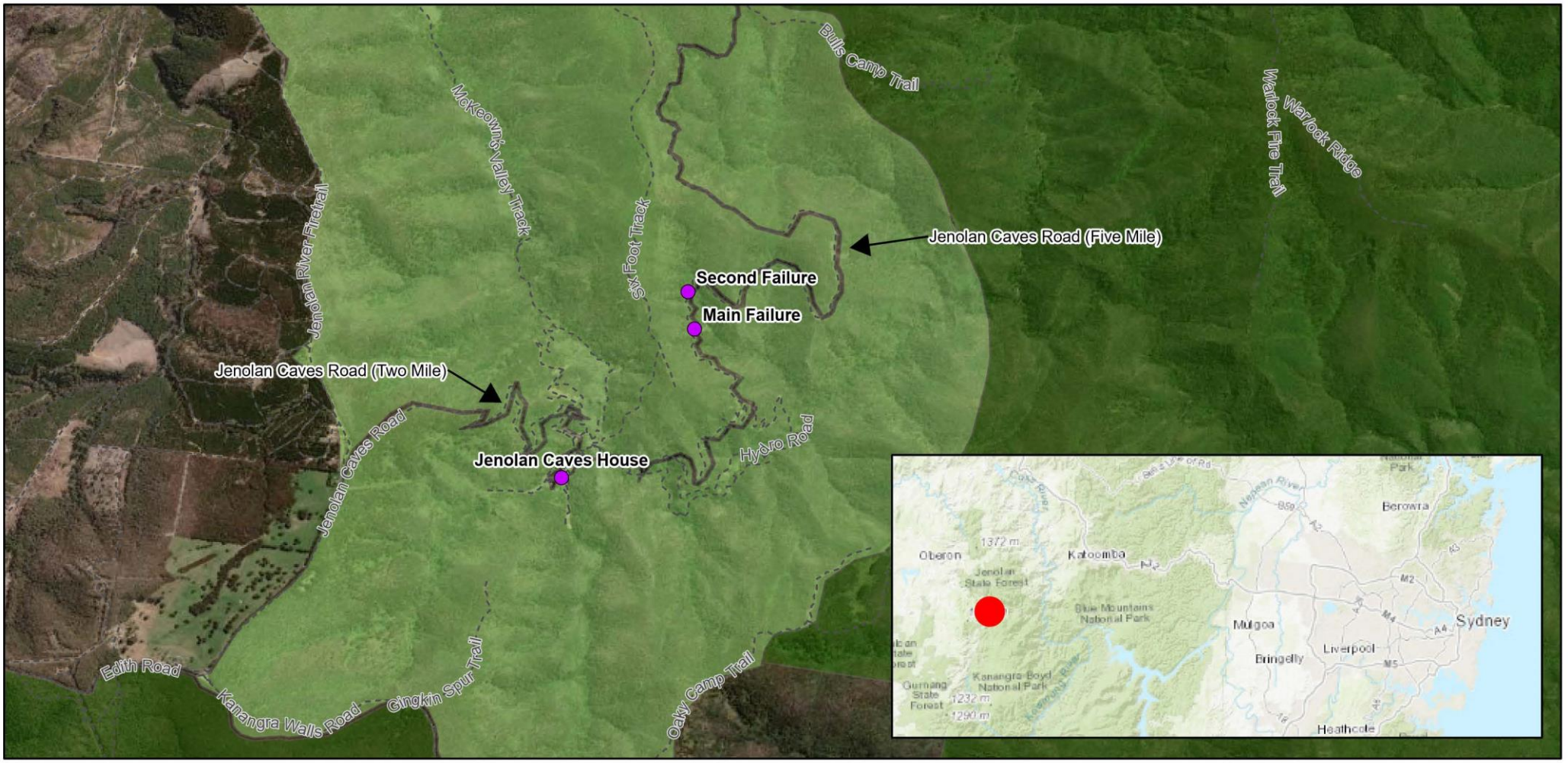
  - Final roadworks including tie-in work to adjoining sections of Jenolan Caves Road and re-surfacing of sections of Jenolan Caves Road damaged by construction plant and equipment.

Construction is expected to take up to three years to complete, assuming no unforeseen disruptions. Chapter 3 describes the proposal in more detail.



The proposal

National park (NPWS Estate)

Jenolan Karst Conservation Reserve

Kanangra-Boyd National Park

1:40,000

0 450 900m

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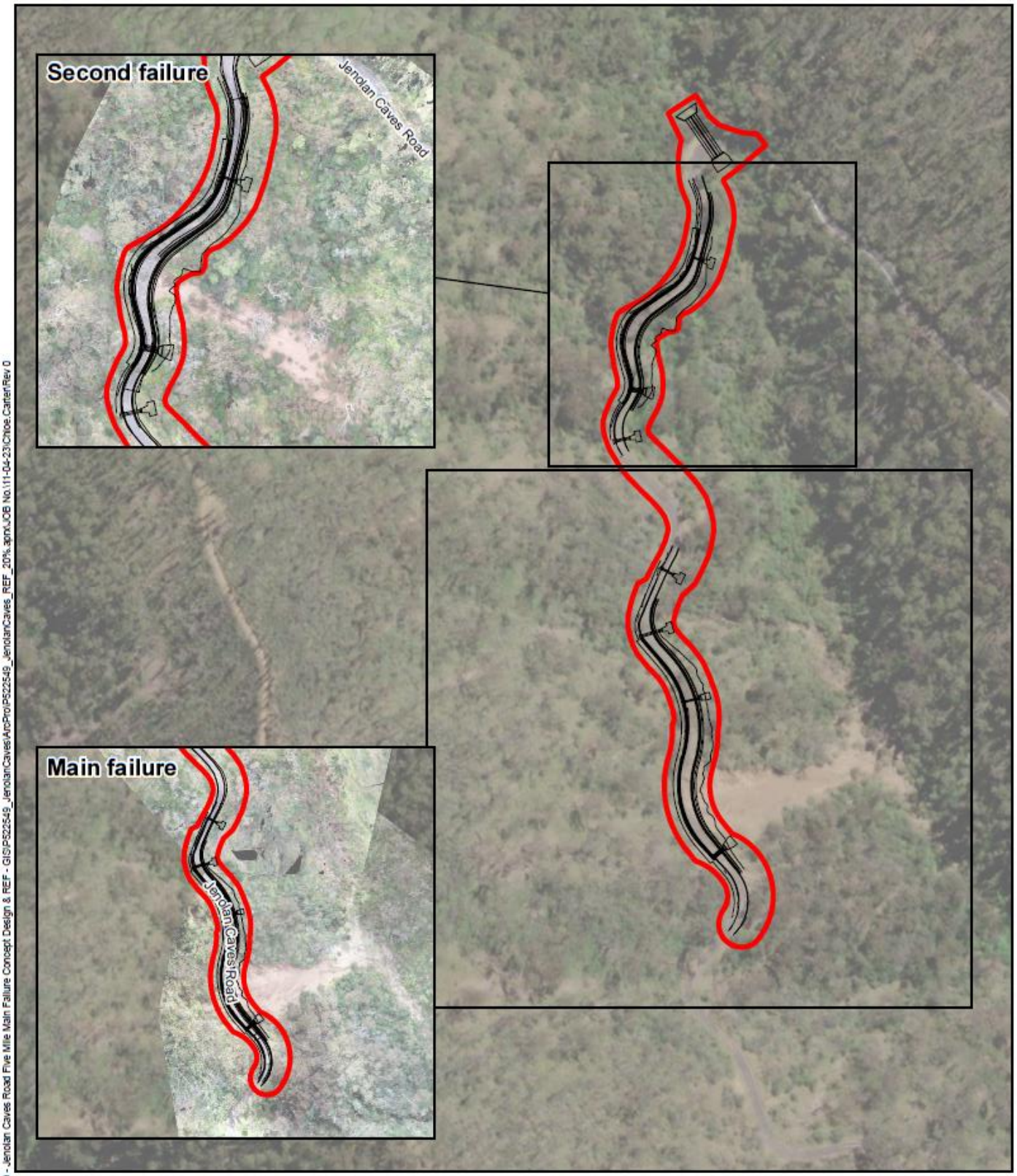
Jenolan Caves Road Five Mile Failure **Review of Environmental Factors**

Projection: GDA2020 MGA Zone 56

Figure 1-1: Proposal location



REF proposal area

Design

1:3,032

0 50 100m

Jenolan Caves Road Five Mile Failure **Review of Environmental Factors**

Projection: GDA2020 MGA Zone 56

Figure 1-2: The proposal

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1.2 Purpose of the report

This review of environmental factors (REF) has been prepared by Aurecon on behalf of Transport. For the purposes of these works, Transport is the proponent under Division 5.1 of the *Environmental Planning and Assessment Act 1979 (NSW)* (EP&A Act). Transport is the determining authority for work within the Jenolan Caves Road road reserve under Division 5.1 of the EP&A Act. Prior to construction commencing, NPWS would need to provide authorisation for work within the Jenolan Karst Conservation Reserve, which is land reserved under the *National Parks and Wildlife Act 1974* (NPW Act), Refer to Figure 4-2 in Section 4.2.2 for further details.

The purpose of the REF is to describe the proposal, to document the likely impacts of the proposal 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 has been undertaken in the context of Section 171 of the Environmental Planning and Assessment Regulation 2021, the Guidelines for Division 5.1 assessments (DPE, 2022a), *Roads and 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 (Commonwealth)* (EPBC Act).

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

- Section 5.5 of the EP&A Act including that Transport examine and take into account, to the fullest extent possible, all matters affecting or likely to affect the environment by reason of the activity.

The findings of the REF would be considered when assessing:

- Whether the proposal is likely to have a significant impact on the environment and therefore the necessity for an environmental impact statement to be prepared and approval 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 if offsets are required and able to be secured
- The potential for the proposal to significantly impact any other matters of national environmental significance or Commonwealth land and the need, subject to the EPBC Act strategic assessment approval, to make a referral to the Australian Government Department of Agriculture, Water and the Environment for a decision by the Commonwealth Minister for the Environment on whether assessment and approval is required under the EPBC Act.

2. Need and options considered

This chapter describes the need for the proposal in terms of its strategic setting and operational need. It identifies the various options considered and the selection of the preferred option for the proposal.

2.1 Strategic need for the proposal

Jenolan Caves Road is both a service road and an emergency access road which serves as the main vehicular connection between Hampton and the Jenolan Caves. Due to extreme weather events including bushfires in 2019 and heavy rainfall in 2021 and 2022, landslides have occurred over the road resulting in multiple road failures. The Jenolan Caves Road Five Mile section has since been closed to vehicles between its intersection with Bulls Camp Trail and the Jenolan Caves.

The proposal would restore the Five Mile main failure and the nearby second failure to pre-failure conditions to allow the road to re-open to the public and reduce the future safety risk to road users. In addition, the proposal would improve the resilience of existing road infrastructure by reducing the potential for future road failures from similar weather events.

2.1.1 NSW policy context

NSW Premier's Priorities

The *Premier's Priorities* (NSW Government, 2021a) represent the NSW Government's commitment to making a difference in enhancing the quality of life of the people of NSW, with each priority set with an ambitious target. The key policy priorities for the NSW Government are:

- A strong economy
- Highest quality education
- Well-connected communities with quality local environments
- Putting customer at the centre of everything we [the NSW Government] do
- Breaking the cycle of disadvantage.

While the proposal is not specifically mentioned within the Premier's Priorities, it does support the key policy priority of enhancing the people of NSW's quality of life through 'well connected communities with quality local environments'. The reinstatement of Jenolan Caves Road at the Five Mile main failure and second failure would reinstate the main access to the Jenolan Caves precinct and the Jenolan Karst Conservation Reserve from Hampton and Lithgow. This would improve connections for visitors and workers requiring access to the area and would also improve safety outcomes for vehicles travelling to and from the major tourist attraction and the Jenolan Karst Conservation Reserve. This would be achieved through the long-term increased stability of the road and the installation of the rockfall barrier on the upper slope.

Future Transport Strategy

The NSW Government's *Future Transport Strategy* (Transport, 2022a) sets the direction for continuing to improve every part of the NSW transport system for the benefit of customers, the community and the economy. It puts people and places at the centre of decision making. It has been developed with the aim of developing the NSW transport system to assist in making NSW the most liveable state in the world, and an economic powerhouse with vibrant, sustainable communities where citizens have choice and opportunity.

The *Future Transport Strategy* is built on five principles:

- More choice, better access
- Environmentally responsible
- Thriving places
- Maximising the use of our network
- Resilient communities.

The proposal would contribute to the 'resilient communities' principle through proactively minimising identified safety risks for road users, as well as through reinstating the existing road infrastructure. Improved resilience of Jenolan Caves Road against extreme weather events would allow for improved economic growth in the region and would reduce the risk and impact on nearby communities and industries. The proposal would restore Jenolan Caves Road to be able to withstand future pressures such as extreme weather events and reinstated road traffic, as is outlined in the *Future Transport Strategy*. The proposal would upgrade the drainage infrastructure near the failures to improve overland flow during rainfall events and minimise the potential for future failures along this section of the road.

Regional NSW Services and Infrastructure Plan

The Regional NSW Services and Infrastructure Plan (Transport, 2018) is the NSW Government's blueprint for transport in regional NSW until 2056. It sets out the government's thinking on the big trends, issues, services and infrastructure needs which do and will continue to shape transport in regional NSW.

The Regional NSW Services and Infrastructure Plan outlines the vision and customer outcomes that the government will use to devise its detailed transport planning in each region and also support its future decision making. The outcomes are designed to respond to what is important to residents of regional NSW and underpin plans for policy, service and infrastructure improvements.

The Regional NSW Services and Infrastructure Plan outlines service and infrastructure initiatives by region. The proposal is within the Oberon LGA, which falls into the Central West and Orana region. The four goals for the Central West and Orana region are:

- The most diverse regional economy in NSW
- A stronger, healthier environment and diverse heritage
- Quality freight, transport and infrastructure networks
- Dynamic, vibrant and healthy communities.

The proposal would contribute to quality transport and infrastructure within the region by improving the safety and performance outcomes of Jenolan Caves Road and its wider road network. Reinstatement of the road would re-open the main access route to the Jenolan Caves precinct from Hampton and Lithgow, supporting the return of more tourists to the region. Improvements in the quality of road infrastructure would be made, which would allow more reliable use of Jenolan Caves Road. This would then contribute to further diversifying the regional economy by increasing visitors to Jenolan Caves and the Jenolan Caves House, which attracted around 230,000 visitors each year prior to the closure of Jenolan Caves Road (Jenolan Caves Reserve Trust, 2012).

2026 Road Safety Action Plan – Toward zero trauma on NSW roads

The *2026 Road Safety Action Plan – Towards zero trauma on NSW roads* (Transport, 2022b) seeks to build on the success of the *Road Safety Plan 2021* with new road trauma reduction targets for 2030, setting NSW on a path towards zero road trauma by 2050. The plan was developed following extensive engagement and community consultation, as well as analysis of trauma trends, best practice approaches and research evidence. The plan aims to halve fatalities on NSW roads and reduce serious injuries by 30 per cent on NSW roads by 2030 through five key priority areas:

- Creating safer country roads and urban places
- Enhancing road safety in local communities
- Increasing the safety of light vehicles, heavy vehicles and protective equipment
- Making safer choices on our roads
- Ensuring the safety of vulnerable and other at-risk road users.

The proposal would upgrade a regional road and improve the resilience of the road to future rainfall events. There would be upgrades to the drainage infrastructure near the failures to improve overland flow during rainfall events and minimise the potential for future failures along this section of the road. This would contribute to each of the priority areas of the plan through safer roads and communities, allowing road users to feel safer on regional NSW roads. The improved resilience of Jenolan Caves Road would contribute to the long-term achievement of these priority areas.

NSW Visitor Economy Strategy 2030

The NSW Visitor Economy Strategy 2030 (NSW Government, 2021b) aims to make NSW the premier visitor economy of the Asia Pacific by 2030. The tourism sector in NSW has been greatly impacted by the 2019/20 bushfires and the COVID-19 pandemic, which has led to this strategy being released to capture a global market after these events.

The strategy is built on five strategic pillars:

- Road to recovery
- Build the brand
- Showcase our strength
- Invest in world-class events
- Facilitate growth.

As part of the 'facilitate growth' pillar, the NSW Government aims to invest in infrastructure and industry resilience to ensure the continued growth and prosperity of the NSW visitor economy. This pillar includes increased public sector investment into visitor infrastructure and improved access to visitor destinations and attractions. The proposal would reinstate Jenolan Caves Road along Five Mile, which would improve access conditions to the Jenolan Caves precinct and the Jenolan Karst Conservation Reserve. Given the precinct and the surrounding reserve are major tourist destinations in regional NSW, the proposal's contribution to improvements in access to these visitor attractions would assist in delivering the overall aims of the visitor economy strategy.

Central West and Orana Regional Plan 2041

The Central West and Orana Regional Plan 2041 (DPE, 2021) is a 20-year regional plan which sets the strategic framework for the region to ensure the region's ongoing prosperity. The plan will guide land use planning decisions in the region by the NSW Government, councils and others to the year 2041.

A focus of the regional plan is on 'people, centres, housing and communities', with people throughout the region noted to enjoy good access to recreation and cultural activities. The regional plan estimates that $12.6 billion of investment in major capital projects is expected in the region over the next five years, which includes road improvements and associated infrastructure that would lead to employment benefits throughout construction. The proposal falls within the Oberon LGA which forms part of the Central West and Orana region. The proposal would see investment into the reinstatement of Jenolan Caves Road, which would contribute to the road infrastructure improvements outlined in the regional plan. This would then improve access to recreational and cultural facilities, which is noted in the regional plan as a priority for the Oberon LGA.

2.1.2 Local policy context

Oberon Council Community Strategic Plan 2019-2040

The Oberon 2019-2040 Community Strategic Plan (Oberon Council, 2019a) outlines the vision and aspirations of the residents of Oberon. The plan is part of a long-term planning framework which guides decisions about the community's future vision. The plan was developed in consultation with community, business and other government agencies providing services in Oberon. The community strategic plan forms part of council's integrated planning and reporting, which combines resourcing, operations and delivery of community initiatives and strategies to deliver community-focused solutions for Oberon.

The community strategic plan involved large community engagement. Some key themes among responses from community members became apparent, which now form the five strategic themes for the community strategic plan:

- Infrastructure
- Environment
- Leadership
- Community wellbeing
- Growth.

The proposal would contribute to the infrastructure and community wellbeing themes through the reinstatement of road infrastructure, which would allow for the safe travel of visitors. The improved road infrastructure and safety within the community would also contribute to the growth of the region through increased support of the tourism sector.

Oberon Council Local Strategic Planning Statement 2040

The Oberon Local Strategic Planning Statement (Oberon Council, 2020) sets out a 20-year vision for land use planning framework for Oberon Council's economic, social and environmental needs. It addresses the planning and development issues of strategic significance to the council through planning priorities and actions, spatial land use direction and guidance. The planning statement has a vision to leverage the area's agricultural, locational, environmental, tourism and manufacturing strengths to generate economic and social growth opportunities. Within this, it recognises that infrastructure is critical to the proper functioning and wellbeing of the community both now and into the future, especially given population and the tourism sector are anticipated to grow. The Jenolan Caves precinct is anticipated to play a role in this growth. The proposal would improve infrastructure within the Oberon LGA, which would improve access to tourist sites such as the Jenolan Caves precinct and the Jenolan Karst Conservation Reserve. This would contribute to the infrastructure improvements recognised in the planning statement as being necessary for future growth in the LGA.

Oberon Council Development Control Plan 2001

The Oberon Council Development Control Plan 2001 (DCP; Oberon Council, 2001) was developed in order to guide development within the Oberon LGA to manage the growth of the region and encourage economic development of the area. The DCP includes a package of design controls and guidelines that are intended to assist in the achievement of the aims and objectives adopted in the Oberon Local Environment Plan (LEP), which is detailed in section 4.1.2 of this REF.

The objectives of the DCP are:

- To provide development controls and guidelines which will assist in achieving the objectives of the Oberon Local Environmental Plan
- To provide development controls and guidelines that are flexible, in order to promote innovative and imaginative building and development that will relate well to its surroundings both man-made and natural
- To promote and encourage a high quality of design and amenity for all developments in the area
- To provide for and require well considered development that is environmentally and economically sustainable.

Under these objectives, a key priority area of the DCP is 'vehicle circulation and parking', which includes the aim of preserving the safety and efficiency of the existing road system as a carrier of through traffic. The proposal would allow for the re-establishment of safe travel to Jenolan Caves and the Jenolan Caves House and would improve safety outcomes of road infrastructure into the future.

Oberon Council Road Response Risk Management Policy and Procedures

Oberon Council's Road Response Risk Management Policy and Procedures (Oberon Council, 2019b) applies risk management policies and principles to identifying, addressing and monitoring road hazards within the LGA. The objectives of the policy are to:

- Apply the principles of Risk Management to treating hazards in the council's road pavement
- Identify hazards in the road pavement through a formal system of inspection and recording of complaints/ service requests from the General Public and Council Staff
- Establish a reasonably practicable time frame for the treatment of identified hazards having regard to the resources available
- Establish a system to document the steps from identification to treatment to allow ongoing monitoring of the pavement maintenance system.

The proposal would restore failures on Jenolan Caves Road, which present a serious hazard to road users, meaning improvement of this road infrastructure would be consistent with the objectives of this policy. Design and construction of the proposal would be consistent with the objectives and reporting requirements of this policy.

Jenolan Caves Draft Grand Arch Precinct Masterplan December 2022

The Jenolan Caves Draft Grand Arch Precinct Masterplan (DPE, 2022b) outlines future plans for the precinct after the NSW Government announced funding to upgrade existing visitor facilities within the Grand Arch Precinct in 2017 and 2019. This funding was given with the aim of supporting the delivery of key upgrades to visitor facilities including a new Gateway Centre, refurbishing Caves House, and significantly improving visitor experiences by improving the quality and accessibility of visitor facilities and accommodation. The masterplan notes the 2019-20 bushfires which created significant damage to the reserve, and the heavy rainfall and floods in 2020 and 2021 which contributed to infrastructure damage. It is noted that work is being carried out to restore services, replace or upgrade damaged stormwater management utilities, and repair visitor infrastructure, including Jenolan Caves Road. The masterplan lists eight objectives, with the following being relevant to the proposal:

- Design guidelines to ensure new developments or alterations are aesthetically compatible with the existing natural character of the precinct
- Achieve long-term sustainability through best practice design, choice of materials, and construction techniques
- Provide new opportunities for fully accessible nature-based experiences.

The proposal would reinstate Jenolan Caves Road, which would increase access to nature-based experiences within the precinct. The reinstatement would be carried out in a way that is not expected to alter the natural environment of the surrounding reserve. It would also be carried out to achieve long-term sustainability through implementing a design which would reduce the chances of future failures occurring along the road. For example, the upgrades to the drainage infrastructure near the failures would improve overland flow during rainfall events and minimise the potential for future failures along this section of the road.

The masterplan also details the need for risk assessment and mitigation for rockfall risk and slope stability, and part of the slope stability recommendations include using discreet passive support treatments. The proposal has been designed in a way that blends the reinstated road with the surrounding environment and which reduces future risks of slope failure, therefore aligning well with the masterplan's objectives and recommendations. The rockfall fence on the upslope side of the road would also improve safety for motorists travelling along the reinstated road.

2.2 Limitations of existing infrastructure

At the site of the main failure and second failure, Jenolan Caves Road is no longer accessible or traversable. Landslides have meant that the roadway has collapsed and needs to be reinstated for vehicles to be able to travel along the Five Mile section of road. No temporary measures to stabilise the road have been put in place as the road and slope are too unstable and the road has been closed to the public.

2.3 Proposal objectives and development criteria

2.3.1 Proposal objectives

The objectives of the proposal are to:

- Stabilise the main and second failures which occurred on Jenolan Caves Road from extreme weather events
- Ensure that the risk of future slope failures is reduced including the risk of debris falling onto Jenolan Caves Road and blocking access
- Improve the safety for road users along this failed section of Jenolan Caves Road
- Enable public vehicular access into the Jenolan Caves precinct to be reinstated to improve overall access to the precinct.

2.3.2 Development criteria

During the development of options, the following development criteria and constraints were considered:

- Construction access constraints due to the limited land located in the vicinity of the failed slope
- Overall cost
- Environmental constraints
- Safety in design.

2.3.3 Urban design objectives

Relevant urban design principles have been derived from 'Beyond the Pavement' (Transport, 2020a). These have set the parameters for proposal-specific strategies and the development of opportunities and constraints. The urban design objectives for the proposal include:

- Fitting within the landform
- Contributing to green infrastructure and responding to natural systems.

Further information on the urban design objectives and strategy of the proposal can be found in Appendix D.

2.4 Alternatives and options considered

2.4.1 Methodology for selection of preferred option

Two multi-criteria analysis (MCA) workshops were held prior to a value management (VM) workshop to shortlist geotechnical/structural solutions to repair the main failure and second failure.

The first workshop was held prior to the second failure occurring, so that it only considered the main failure. The second workshop was carried out to assess suitable geotechnical/structural options for the second failure, but also considered the main failure given the proximity of the two sites.

MCA workshop 1

The first workshop was held across two sessions. The sessions were held on 1 November 2021 and 30 November 2021 with Transport representatives, key stakeholders, and engineering specialists to assess the damage of the resulting slope failure and identify suitable mitigation measures for the Jenolan Caves Road Five Mile main failure.

The MCA workshop assessed seven options (and additional sub options), with the following options being shortlisted and taken forward to the VM workshop:

1. Standalone reinforced soil wall (RSW)
2. Reinforced nail solution with shotcrete
3. Soil/rock nails combined with gravity option (RSW)

Other options either performed poorly overall in the MCA or had characteristics or features which meant they were unsuitable for shortlisting. These features included unacceptable visual impacts and unachievable accessibility requirements (plant and bridge member size). These six options were assessed and were discounted from the VM workshop.

- Gravity walls (standalone option) – reinforced soil wall, reinforced concrete walls, dry block wall/gabion wall, crib wall
- Embedded solutions – cantilever piled wall, soldier pipe wall, sheet pile wall
- Piled wall
- Short span bridge
- Tunnel

- Gondola.

MCA workshop 2

A second MCA workshop was held on 9 November 2022. The workshop was held with key Transport representatives and engineering specialists to assess the damage of the resulting slope failure and identify suitable mitigation measures for Jenolan Caves Road Five Mile second failure.

A similar MCA process was adopted to the first MCA to identify a suitable shortlist of options, utilising the previously agreed upon project objectives, key comparative criteria and available design options.

Given the results from the first MCA, some solutions were not assessed as they were already deemed unsuitable. As a result, a total of five separate options were considered.

The workshop resulted in the following options being shortlisted:

1. Soil/rock nails combined with gravity option (RSW)
2. Reinforced nail solution with shotcrete.

The following options had characteristics or features which meant they were unsuitable for shortlisting:

- Redirect road into slope
- Short span bridge
- Micro piling.

These three options were assessed and discounted from the MCA workshop.

2.4.2 Identified options

The options assessed in the VM workshop were selected based on the previous MCA workshops as well as a re-evaluation of the sites given the changes occurring on site. As a result of this re-evaluation, a new option (Option 4, called 'Frame on Corbels') was introduced and assessed.

The four options assessed at the VM workshop for both failures were:

1. Soil nail foundation with gravity / RSW structure above (shortlisted from previous MCAs)
2. Anchored/nail solution with shotcrete anchored wall (shortlisted from previous MCAs)
3. Reinforced soil wall (shortlisted from previous MCAs)
4. Frame on Corbels (new option)

2.4.3 Analysis of options

The criteria and weightings used to assess the options based on the proposal objectives, key features and constraints are outlined in Table 2-1. A wide range of criteria were considered, but only those critical to the proposal and those that differed across the short-listed options were selected.

Table 2-1 VM criteria and weightings

Criteria	Sub-criteria	Considerations
Function	Short-term (construction phase) function, flexibility and capacity	Ease of constructability (accessibility, plant, equipment and skills availability, etc.)
		Construction duration
	Long-term (operational phase) function, flexibility and capacity	Maintainability (access for maintenance, impacts to traffic during maintenance operations, resilience, etc.)
Environment	Land impact	Impacts to threatened flora and fauna, works footprint and impact to surrounding heritage (temporary and permanent)

Criteria	Sub-criteria	Considerations
	Noise and vibration	Noise and Vibration impact (temporary and permanent)
	Visual impact	Maximises Urban Design outcomes (landscape character)
Socio-economic	Community perception	Risk based on consultation to date – likelihood of community acceptance of project
Cost	Capital cost	Construction cost

A score from one to 10 was assigned to each criterion for each option by the 17 workshop attendees. A score of one represented a poor outcome, while a 10 was a perfect outcome for that option. Weighted scores were then calculated using the scores and the criteria weighting. Option 1 (soil nail foundation with gravity / RSW structure above) scored the highest weighted average score across almost all criteria, with option 2 (anchored/nail solution with shotcrete anchored wall) marginally out-scoring option 1 in only the land impact and visual impact categories. Option 3 (reinforced soil wall) and option 4 (frame on corbels) consistently scored lower than the first two options.

2.5 Preferred option

The recommended option from the value management workshop was Option 1. Option 1 scored the highest weighted average score of the short-listed options and consistently scored the highest for the sensitivity analysis. Compared to the other options, this option was selected as it would:

- Have the shortest duration
- Require minimal access for maintenance
- Maximise urban design outcomes
- Minimise disruption to the community.

This option is described in more detail in Section 3.

2.6 Design refinements

2.6.1 Temporary construction access ramps

Due to the unstable nature of the downslope for both failures, access to the base of the slope would be limited. As such, the construction methodology was refined to include excavation for an access ramp on the northern side of each failure to the downslopes. The extent of slope to be reinstated was increased as a result of this change, increasing the length of the required RSW to the north of each failure. Excavation and RSW construction details are discussed in section 3.2.3.

2.6.2 Drainage infrastructure

Drainage infrastructure refinements have included adjustments to the number of culverts installed throughout the proposal area and changes to the large existing culvert at the northern end of the proposal area to improve drainage in the area and reduce clogging of culverts. Work would occur at eight culverts.

Seven new small culverts would be installed throughout the proposal area, all of which would be connected to a grated table drain that would run along the length of the proposal area on the upslope side. Each culvert would feature an outlet with scour protection on the downslope to prevent erosion and scour which can lead to instability and failure of the surrounding rock or soil structure.

In addition, one large culvert at the northern end of the proposal area is currently blocked and too small to accommodate the volume of water within its catchment. As such, it would increase in size as part of the proposal to accommodate the high volumes of water which needs to be conveyed at that location. The culvert would be installed prior to excavation and reinstatement works on the road failures. This hardstand area would replace an existing damaged hardstand area. Further details on the proposal's drainage infrastructure can be found in section 3.2.3.

3. Description of the proposal

This chapter describes the proposal and provides descriptions of existing conditions, the design parameters including major design features, the construction method and associated infrastructure and activities.

3.1 The proposal

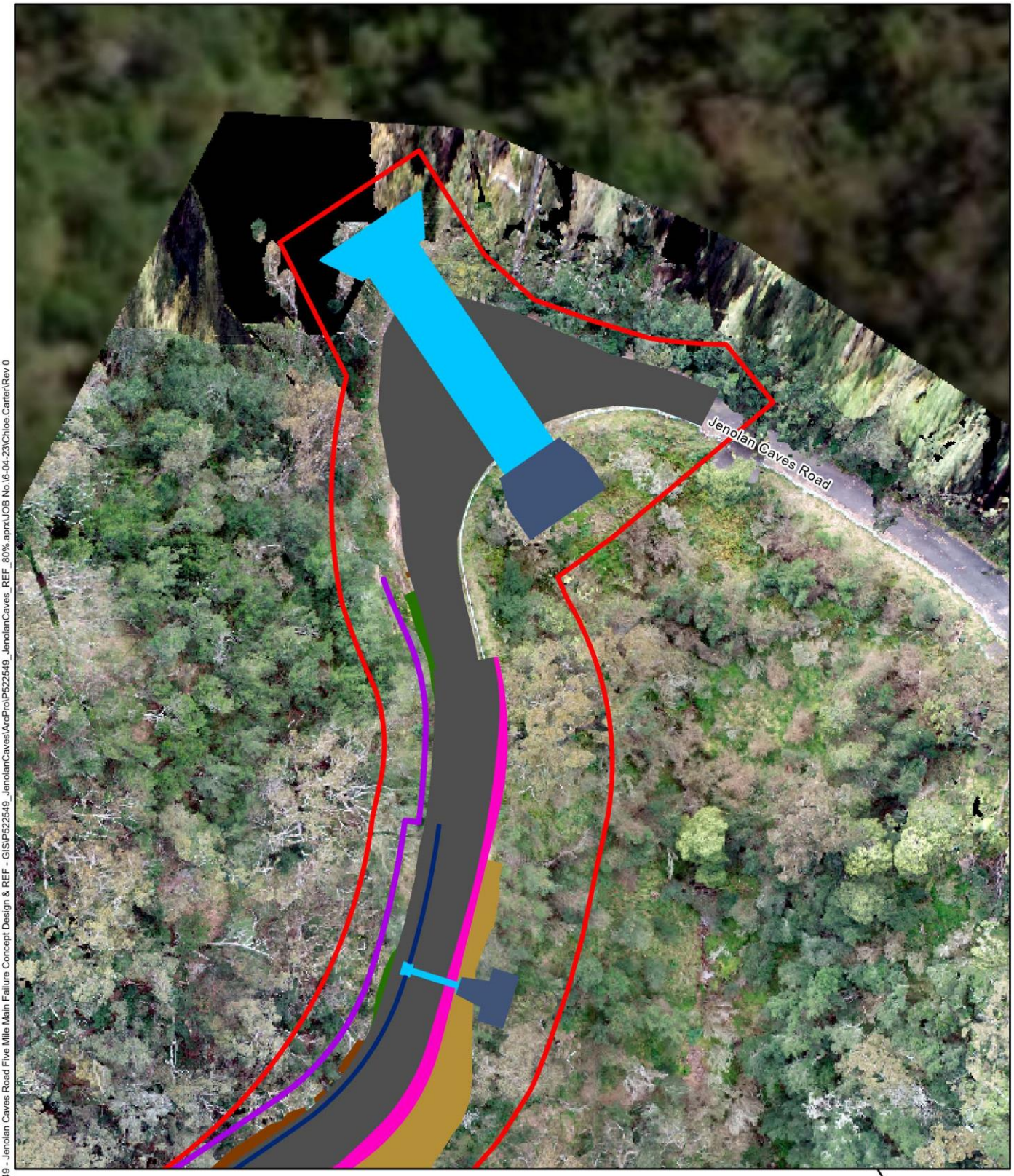
Transport proposes to restore about 500 metres of Jenolan Caves Road at the Five Mile main failure (slope #94244) and nearby second failure (slope #94242) to near pre-failure conditions (the proposal). The proposal is located within the Oberon LGA in Jenolan, New South Wales. The road failures occurred as a result of reduced vegetation from the bushfires in 2019 and subsequent heavy rainfall in 2021 and 2022, that have led to landslides. The work would occur at two slopes, about 1.2 kilometres north (slope #94244) and 1.4 kilometres north (slope #94242) of Jenolan Caves House.

Jenolan Caves Road is a narrow two-way road and is the only access route to Jenolan Caves (from Lithgow in the north and Oberon in the west). It runs from Hampton, past the Jenolan Caves, to the intersection of Edith Road and Kanangra Falls Road, south-west of Jenolan Caves. Jenolan Caves Road is an important connection as it provides access to the Jenolan Caves House and Jenolan Caves, which attract about 230,000 visitors each year. The proposal is a part of an overall Jenolan Caves Road program of works which involves restoration to a 10-kilometre-long section between Lithgow and Jenolan Caves House.

The key features of the proposal include:

- Upslope treatment including stabilisation by pattern bolting and the installation of a rock fall barrier prior to road work to allow safe access for workers to the failure sites
- Reinstatement of Jenolan Caves Road at the two failure locations, including:
  - RSW structures at the two failures, and along the length of the construction access ramps, which would be excavated to reach the bottom of the failures
  - A foundation anchor beam and geogrid reinforcement in each RSW
  - A widened carriageway at the failures for vehicle turns paths
  - New bridge twin rail barriers on the failure side at both failures.
- Provision of new stormwater drainage, including:
  - Kerb and grated table drains at each failure adjacent to the reinstated road
  - Four new culverts underneath the RSW at the main failure
  - Three new culverts underneath the RSW at the second failure
  - Upgrade of one existing culvert north of the RSW at the second failure.
- Installation of a permanent scour protection structure at the base of the RSWs
- Construction activities and ancillary work, including:
  - Establishment of hardstand areas for ancillary facilities.
  - Final roadworks including tie-in work to adjoining sections of Jenolan Caves Road and re-surfacing of sections of Jenolan Caves Road damaged by construction plant and equipment.

Construction is expected to take up to three years to complete, assuming no unforeseen disruptions. The key features of the proposal are shown in Figure 3-1a-b.



REF proposal area

80% Design

Downslope extent of excavations

Grated table drain

Drainage

Drainage scour

Kerb

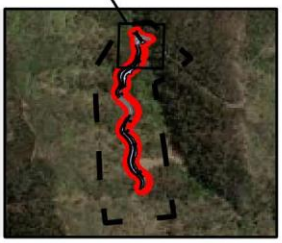
Pavement

Reinforced soil wall

Cut

Fill

Rockfall barrier



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Jenolan Caves Road Five Mile Failure **Review of Environmental Factors**

Projection: GDA2020 MGA Zone 56

Figure 3-1a: Key features

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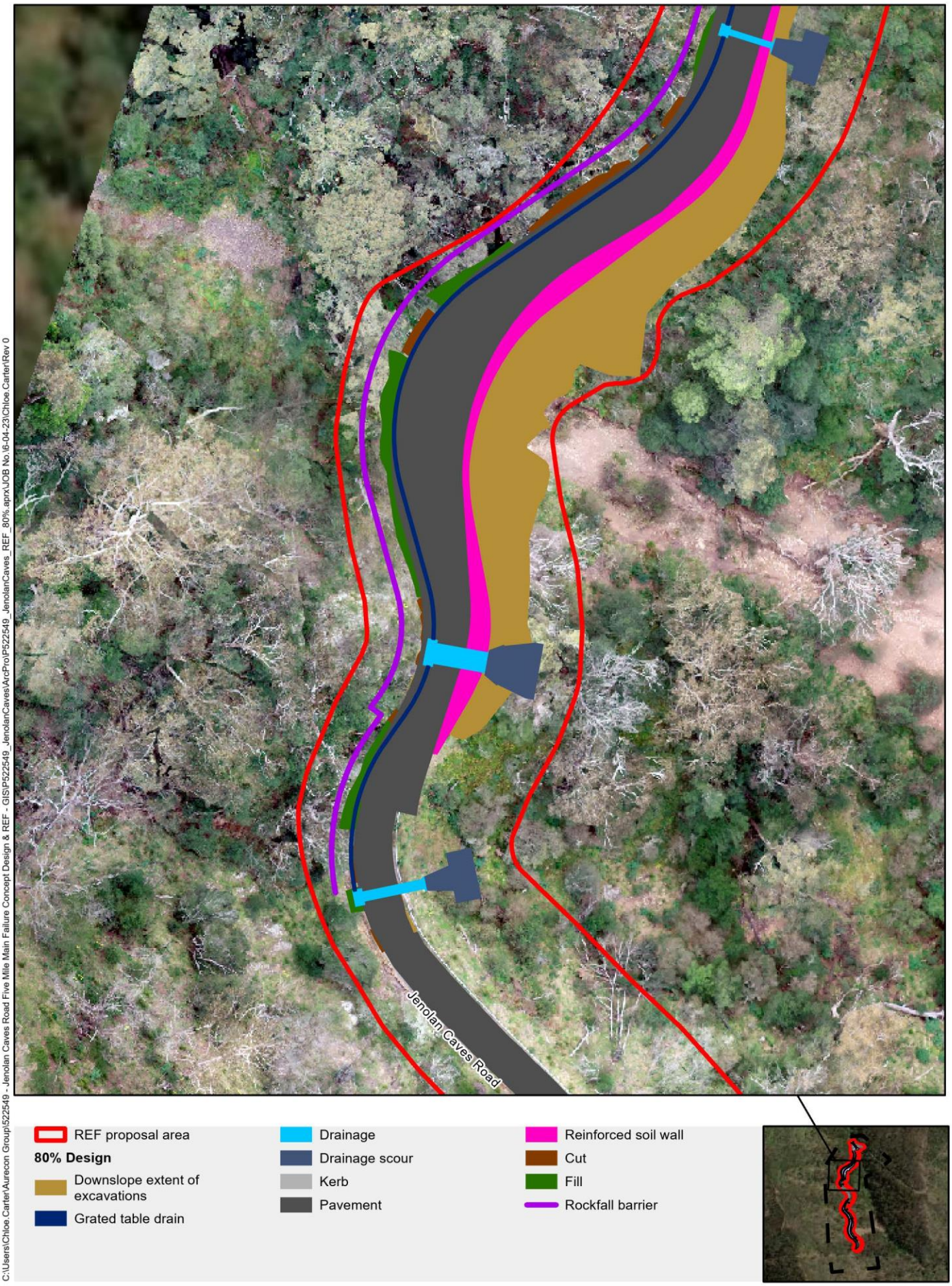

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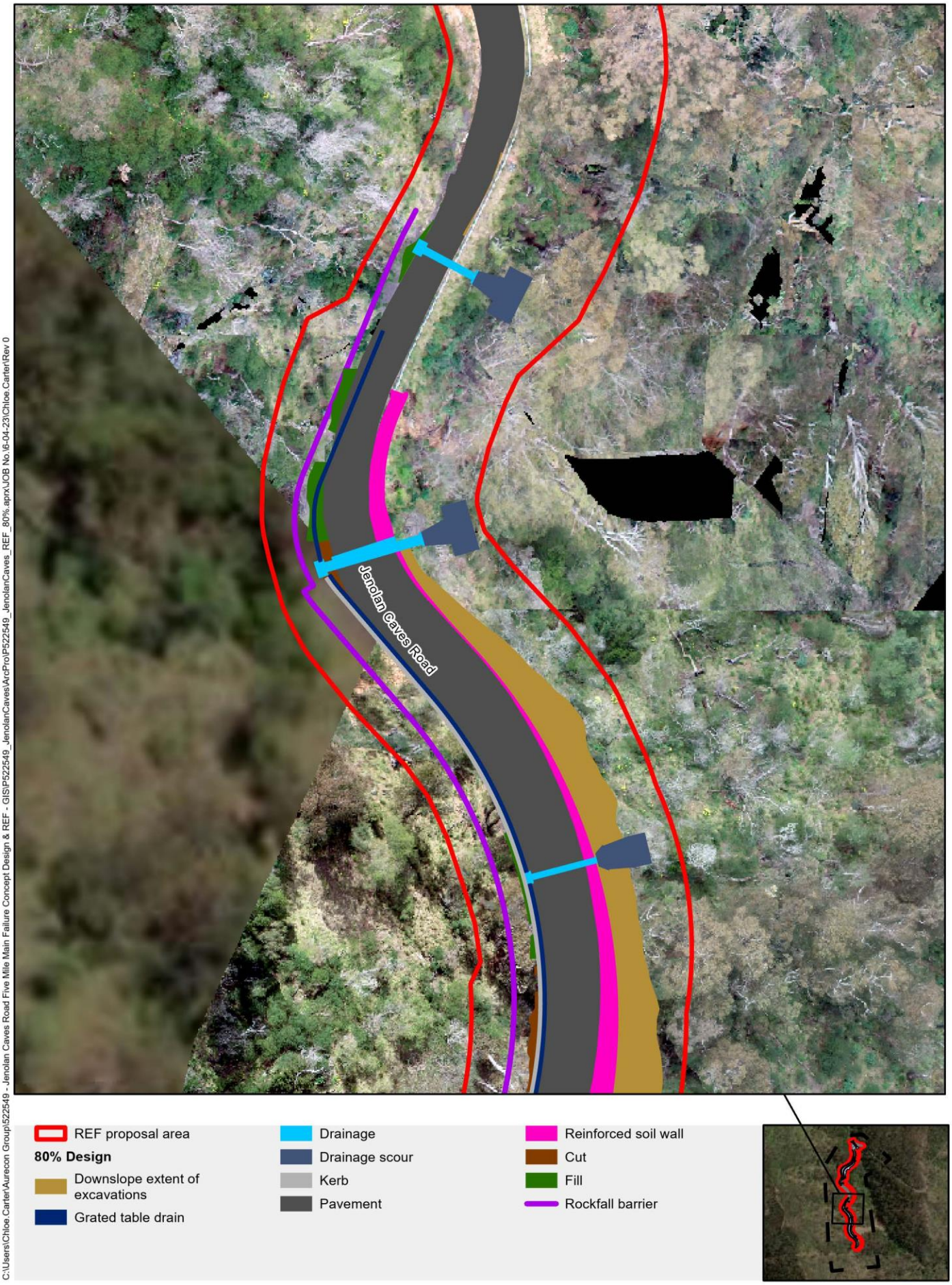
Jenolan Caves Road Five Mile Failure **Review of Environmental Factors**

Projection: GDA2020 MGA Zone 56

Figure 3-1b: Key features



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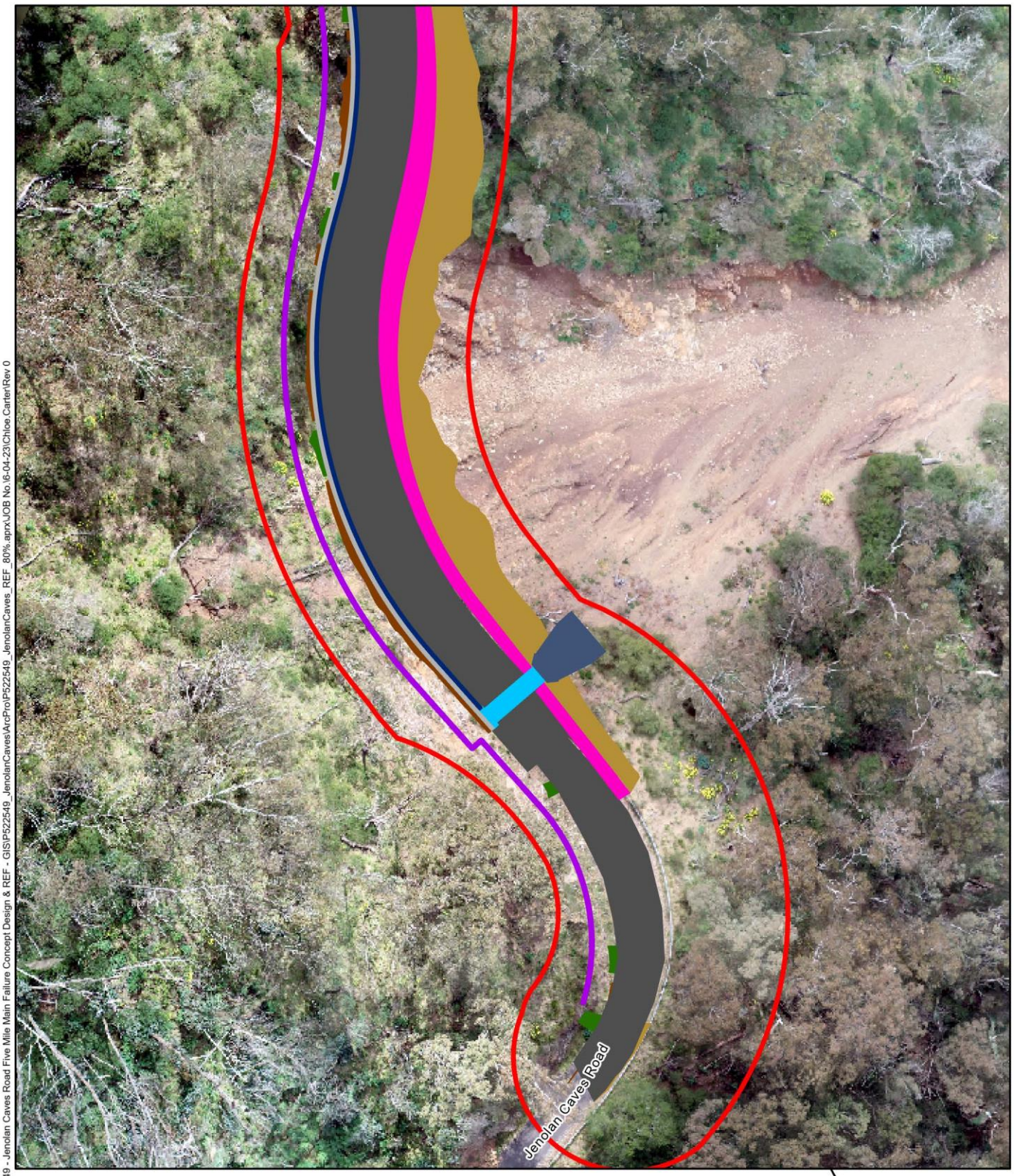
Jenolan Caves Road Five Mile Failure **Review of Environmental Factors**

Projection: GDA2020 MGA Zone 56

Figure 3-1c: Key features



REF proposal area

80% Design

Downslope extent of excavations

Grated table drain

Drainage

Drainage scour

Kerb

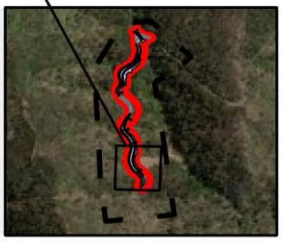
Pavement

Reinforced soil wall

Cut

Fill

Rockfall barrier



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Jenolan Caves Road Five Mile Failure **Review of Environmental Factors**

Projection: GDA2020 MGA Zone 56

Figure 3-1d: Key features

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The proposal area is within the Jenolan Karst Conservation Reserve, which is land reserved under the NPW Act.

While most of the proposal is in the 25-metre-wide road reserve of Jenolan Caves Road (managed by Transport), part of the culvert at the northern end of the proposal area (refer to Figure 3-1a) and ancillary facilities A, B, C, D and E (refer to Figure 3-8) are located outside the road reserve within the Jenolan Karst Conservation Reserve. As noted in Sections 1.2 and 3.6, work outside the road reserve requires authorisation by or under the NPW Act which would need to be issued by NPWS prior to work occurring outside the road reserve. Refer to Section 4.2.2 for further details.

The details of the proposal location within the national park are provided in

Table 3-1.

Table 3-1 National park location details

Proposal location details		
Location description		Jenolan Caves Road Five Mile
Park name		Jenolan Karst Conservation Reserve
Street address		Jenolan Caves Road, Jenolan NSW 2790
Site reference	Main failure	Easting: -33.8115 Northing: 150.0292 MGA zone: 56
	Second failure	Easting: -33.8094 Northing: 150.0290 MGA zone: 56

3.2 Design

3.2.1 Design criteria

The concept design has been prepared in line with the guidelines and standards outlined in Table 3-2. Given the proposal involves reinstating Jenolan Caves Road rather than the construction of a new road, and the restricted land, it would not meet all current design guidelines. Any deviations to the design standards and guidelines would be subject to a review and would be finalised through detailed design.

Table 3-2 Design guidelines and standards

Feature	Standards
Road design	• Transport for NSW Supplements to Austroads Guide to Road Design Part 3 (edition 3.4, Feb 2021) • Austroads Guide to Road Design Part 3 (2017)
Geotechnical design	• QA Specification PS231 – Geotechnical investigation and design, Jenolan Caves 5 Mile Failure (April 2022) • QA Specification PS201 – Professional services for detailed design scope and requirements • Transport for NSW Geotechnical Technical Direction GTD2012/001- Excavation Adjacent to Transport Infrastructure • Transport for NSW Geotechnical Technical Direction GTD2015/001- Use of New Geotechnical Products or Technique on Transport Projects. • Transport for NSW published documents (e.g., Transport Specifications, Technical Directions, Technical Guides Standard Drawings and similar) will take precedence in the case where there are departures on requirements.

Feature	Standards
	• Transport for NSW QA specification R44 Earthworks, Edition 5, Revision 1 (June 2020) • Transport for NSW QA specification R57 Design of Reinforced Soil Walls, Edition 2, Revision 9 (June 2017) • Transport for NSW BTD 2011/08 Testing of cast in place concrete piles (2012) • Transport for NSW QA specification R63 Geotextiles (separation and filtration), Edition 4, Revision 2 (June 2020) • Transport for NSW QA specification R67 High strength geosynthetic reinforcement, Edition 1, Revision 2 (June 2020) • Transport for NSW QA specification B59 Reinforced concrete piles (without permanent casing), Edition 6, Revision 0 (June 2020) • Transport for NSW QA specification B58 Reinforced concrete piles (with permanent casing), Edition 3, Revision 0 (November 2020) • Australian Standard (AS) 1726: Geotechnical Site Investigations, 2017 • AS 5100: Bridge Design, 2017 • AS 2159: Piling –Design and Installation, 2009 • AS 5100:2: Vehicle design loading, 2017 • AS 1597.2: Precast reinforced concrete box culverts, 2013 • AS 1170 - Structural Design Actions, 2007 • Managing Urban Stormwater Soils and Construction Volume 2D, Main Road construction, Department of Environment and Climate Change, NSW, 2008 • British Standard BS8006-1:2016 Code of Practice for Strengthened/Reinforced Soils and Other Fills • Hong Kong Geotechnical Engineering Office - GeoGuide 1 – Guide to Retaining Wall Design, 1993
Drainage design	• Transport for NSW QA Specification PS271 (April 2022) • Australian Rainfall and Runoff – A Guide to Flood Estimation (2019) • Austroads Guide to Road Design – Part 5, 5A (2021) & 5B (2021) • Transport for NSW QA Specification R11 Stormwater Drainage • AS/NZS 3725:2007 Design for Installation of Buried Concrete Pipes • AS/NZS 3500.3:2021 Plumbing and Drainage, Part3: Stormwater Drainage • AS 3996:2019 Access Covers and Grates • AS 4058:2007 Precast Concrete Pipes (Pressure and Non-Pressure) • US Department of Transportation Hydraulic Engineering Circular No.14 Hydraulic Design of Energy Dissipators for Culverts and Channels 2006 – third edition (HEC14)
Signage and road marking	• RMS (Transport for NSW) Guide Signposting Manual (2007) • Transport Supplement to AS1742 Manual of uniform traffic control devices (2013) • AS1742 and AS1743 • Transport for NSW (RTA) Supplements to AS1742 and AS2890 • Transport for NSW QA Specification R143 Signposting • Transport for NSW QA Specification R131 Guideposts • Transport for NSW QA Specification 3400 Manufacture and Delivery of Road Signs • Transport for NSW Delineation Guidelines

Feature	Standards
	• Austroads Guide to Road Design Part 6 (2009) • Transport for NSW Supplement to Austroads Guide to Road Design Part 6 (2010) • AS5100.2 Bridge design, Part 2: Design loads (2017)

The proposal's design criteria are identified in Table 3-3.

Table 3-3 Design criteria

Design element	Criteria
Design speed (kilometres per hour)	50
Posted speed (kilometres per hour)	40
Design vehicle	None
Turn path vehicles	One-way turn path: one 14.5-metre-long rigid bus Two-way turn path: two 5.2-metre-long cars
Road width (metres)	5.5 (min)
Lanes	Two, with no centreline
Nearside (outside) shoulder width (metres)	0.5
Offside shoulder width (metres)	0
Crossfall (traffic lane and shoulders)	3 per cent
Rock cut slope	80 degrees
Superelevation	None
Minimum drainage pipe diameter (metres)	0.375 for longitudinal pipes 0.45 for transverse pipes
Failure side twin rail barrier height (metres)	1.4
Safety rail on top of RSW height (metres)	1.0
Access behind twin rail barrier (metres)	1.0
Pavement type	Road surface: F1 and F2 full depth asphalt Ancillary facility D: R1 concrete hardstand
Drainage design events (minimum annual exceedance probability)	Channels and open drains: 20 per cent annual exceedance probability (AEP) Grated table drain: 1 per cent AEP Structures where surcharge is undesirable: 1 per cent AEP Pavement drainage wearing surface for flow width assessment: 10 per cent AEP

3.2.2 Engineering constraints

The engineering constraints for the design and construction of the proposal are outlined in Table 3-4.

Table 3-4 Engineering constraints

Category	Constraint
Site access	• The main failure can currently only be accessed by light vehicles via Two Mile (Jenolan Caves Road from Oberon). Due to the poor condition of Two Mile and the limited clearance through the Grand Arch at Jenolan Caves, heavy vehicles are not able to use this access. Restoration of the second failure would allow heavy vehicles to access the main failure from the north via Five Mile (Jenolan Caves Road from Hampton). However, there are tight radius curves along this route, which would limit the size of construction vehicles and plant which can access the site • Due to the main failure, the second failure can only be accessed from the north via Five Mile (Jenolan Caves Road from Hampton).
Slope access	• Upslope access to both failures is limited due to steep topography and the risk of further failures • Downslope access is restricted, with access only possible via rope or helicopter. As such, excavation of the existing road would be required for plant to reach the base of where the foundation anchor beam is proposed via temporary access ramps • The access ramp for the main failure would only be excavated once the second failure's access ramp has been excavated, the road has been reinstated and the access ramp rehabilitated at that location • The very steep terrain would require that specialist height rescue plans and provisions are in place.
Limited proposal area	• The proposal area is generally limited to areas which are within 12.5 metres of the centre of the road • The proposal is mostly within the road reserve except at the northern end where the large culvert would be installed. The culvert and drainage infrastructure extend outside the road corridor boundary near ancillary facility D to land which is managed by NPWS. Given the culvert would replace existing drainage infrastructure and NPWS approval would be required prior to work occurring on NPWS estate, this is not anticipated to be a constraint.
Narrow existing roadway	• The existing Jenolan Caves Road is narrow, with limited space for plant and materials. Crane size would be restricted as there would not be space for outriggers to be set up. Ancillary facilities for laydown, compound and turning vehicles around would need to be established away from the failures.
Weather	• The stability of the failures and road access is very sensitive to rainfall, meaning construction access may be limited after heavy rainfall. Construction plant and equipment would not be stored at the slope failures so that heavy rainfall would not affect plant and equipment when not in use • Cold temperatures may limit activities such as pavement sealing • The area is known to be subject to extreme weather events including bushfires, heavy rainfall and snow. These events would require contingency planning and may cause significant delays during construction.
Unknown geotechnical conditions	• Geotechnical conditions at the proposal area are not fully understood due to an inability to access the failure sites for investigations. Conditions are anticipated to be highly variable and would need to be progressively assessed during excavations.

3.2.3 Main design features

The proposal is surrounded by the Jenolan Karst Conservation Reserve. The proposal would reinstate the road to a 5.5 metre minimum width with two lanes of full depth asphalt road pavement. A one-metre-wide access behind the twin rail barrier on the downslope side would also be provided.

Upslope works

The road footprint would be widened by cutting into the upslope side of the road at some locations. The cut slope would be reinforced using rock bolts and soil nails. The rock bolts and soil nails would be between 4.5 metres and six metres long and spaced at two metre intervals vertically and 1.5 metre intervals horizontally. The entire upslope cut surface would be reinforced using mesh or a similar drapery system, except where competent rock is exposed. All cuts would be less than four metres high.

A cross-section of the reinstated road at the main failure is shown in Figure 3-2.

In addition, a rockfall barrier with embedded posts and a mesh drapery treatment would be installed at the top of the upslope cutting along the full length of road works at both failure sites. The barrier would be installed at the start of construction to protect workers and would be left in place during operation to protect road users from potential rock falls. Installation of the barrier would avoid trees where possible, however tree trimming may be required for safety reasons along the upslope cut to install the rock protection fence. The barrier would be about 1.2 metres tall.

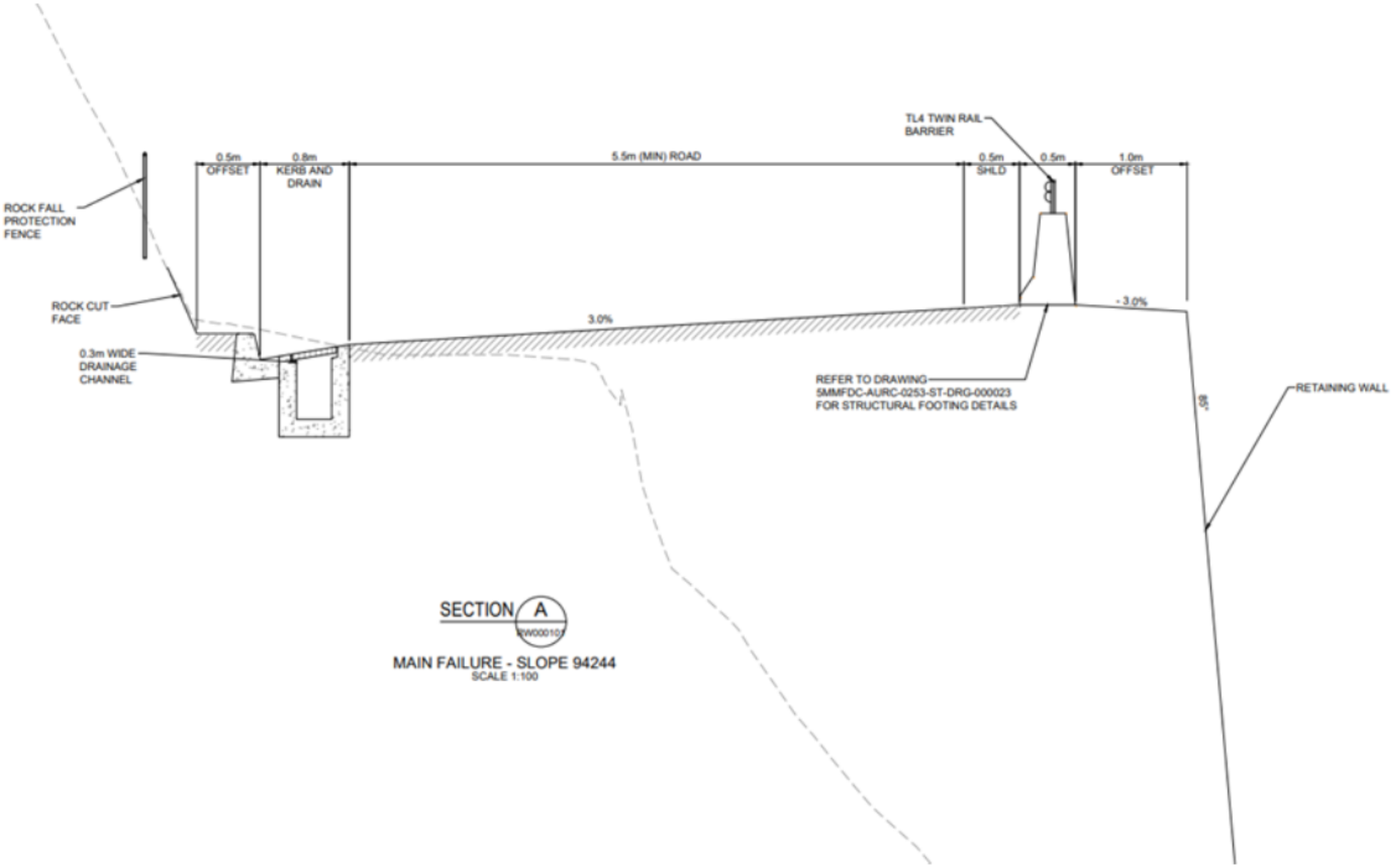


Figure 3-2: Cross section of reinstated road at main failure

Reinforced soil wall and associated excavations

The proposal would install a RSW at each failure location and provide additional width to the road (compared to the pre-failure road width) and stability to the downslopes of the road. The dimensions of each RSW are outlined in Table 3-5.

Table 3-5 RSW dimensions

Failure	Maximum height of RSW (metres)	Length of RSW (metres)
Main failure	10.5	160
Second failure	9	130

The RSWs would be installed on foundation anchor beams, which may require the installation of micropiles, subject to confirmation during detailed design. The beam would be anchored to the ground using tie back anchors, which would provide lateral stability to the beam.

Soil nails have also been designed to be installed in the slope below the RSWs. Similar to those used in the upslope cut, the soil nails would be between 4.5 metres and six metres long and spaced at two metre intervals vertically and 1.5 metre intervals horizontally.

Given the instability of the downslopes of both failures, excavation works would be required for the establishment of access ramps so that construction vehicles would be able to access the lowest point of the foundation anchor beams for construction of the RSWs. This would extend the length of the RSWs to north of each failure beyond the current extent of the failure. Excavation and access ramp details can be found in section 3.3.1.

Indicative visualisations of the RSWs at each failure are shown in Figure 3-3 and Figure 3-4.

Figure 3-3 Reinforced soil wall – main failure

Figure 3-4 Reinforced soil wall – second failure

Stormwater drainage

The location of drainage infrastructure throughout the proposal area is shown in Figure 3-1a-d. Drainage design for the proposal was based on the following objectives:

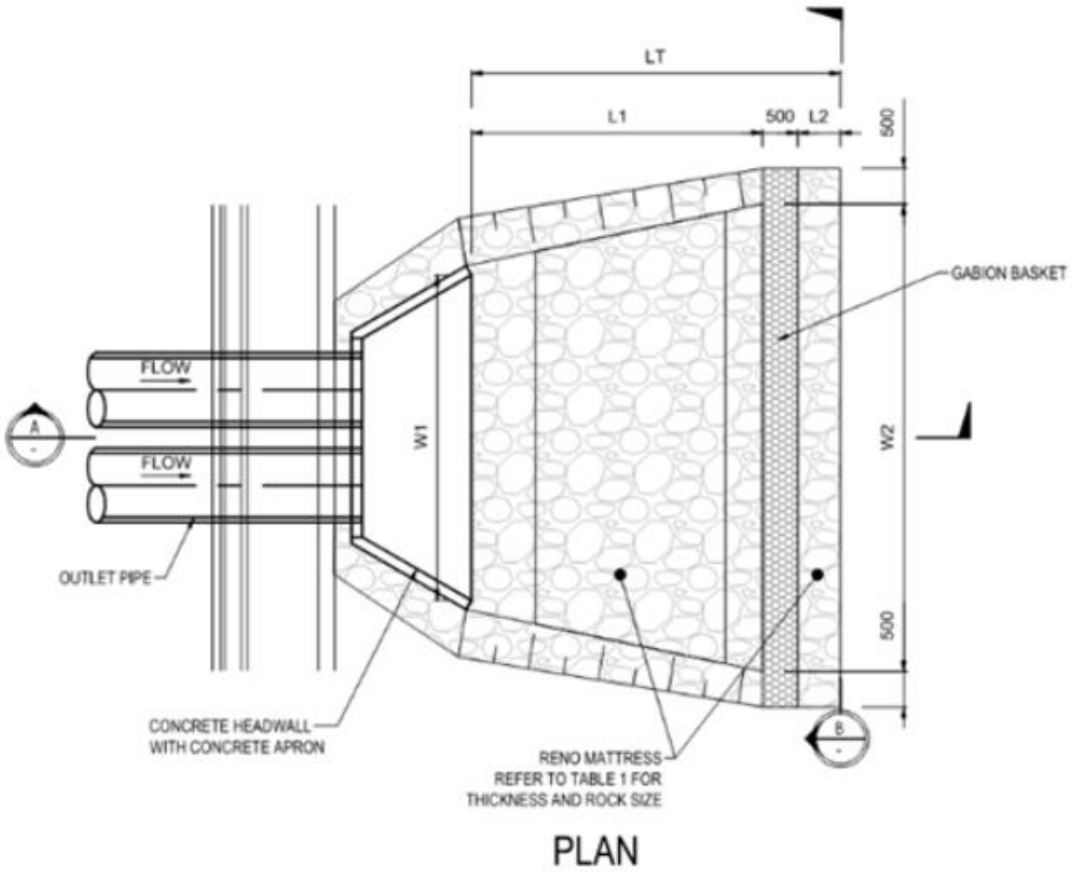
- Minimise flow width encroaching into traffic lanes to improve road safety during wet days
- Convey runoff to appropriate drainage point for safe discharge and minimise overtopping to the downslope
- Install scour protection at the culvert discharge points.

The proposal's stormwater drainage system consists of grated table drains along the road alignment, culverts beneath the reinstated road and culvert outlets. Each of these elements are detailed in Table 3-6. Where stabilisation of the upslope is required in pockets of exposed soft rock (which is anticipated to only be in limited areas), localised areas of shotcrete may be used on the upslope near drainage inlets, however the use of shotcrete would be minimised as much as possible.

Table 3-6 Drainage design

Design feature	Design details
Grated table drain	Full grated table drains would be installed upstream of the proposed culverts on the upslope side of the road corridor. The proposed grated table drains are designed with one per cent AEP capacity (which is the flood event with a 1 in 100 chance of occurring in a year). This has been designed to incorporate a 10 per cent blockage to make sure that runoff would be captured within the drainage system during high storm events and not bypass the system to run over the road to the downslope. The grated trenches would then connect to the grated inlet pits which are the upstream inlet structures of the culverts. There is an existing table drain running along the middle section of the proposal area between the two failures. The proposal would retain and connect to this drain. It would be cleaned and increased in depth where required as no road works would occur in this area.
Culvert design	Seven new small culverts would be installed throughout the proposal area, in addition to an upgrade to a large reinforced concrete box culvert at the northern end of the

Design feature	Design details
	proposal area. The culvert at the northern end would be increased in size due to the large amount of water flow that needs to be captured at that location. The seven smaller culverts would feature grated inlet pits, while the larger culvert would use a headwall inlet structure. The larger culvert is located outside of the road reserve within NPWS estate where there is an existing channel conveying flows from the upslope area to an existing culvert. Culverts near and upstream of the two failures have been designed to convey one per cent AEP flow safely to the downslope. The locations of culverts throughout the proposal area have been selected to avoid the failure locations due to slope instability and to make sure that all upstream flows would be intercepted and would not affect the performance of downstream culverts. Diameters of culverts near the main failure are as follows: • Culvert 262575A: 900 millimetres • Culvert 262576: 900 millimetres • Culvert 262576A: 750 millimetres • Culvert 262577: 750 millimetres. Diameters of culverts near the second failure are as follows: • Culvert 262574 (large culvert): 3000-millimetre by 900-millimetre box culvert • Culvert 262574A: 750 millimetres • Culvert 262574B: 900 millimetres • Culvert 262575: 1200 millimetres.
Culvert outlets	Scour protection would be provided at the culvert outlets to prevent erosion and scour which can lead to instability and failure of the surrounding rock or soil structure. Due to the steep terrain of the downslope area, the culvert outlets have been designed in a way that spreads water flows as much as possible on the downslope prior to returning the flows to natural surface rather than directing concentrated flows in one area. Three arrangements for the outlet structure and corresponding scour protection have been developed for culverts. These are as follows: • Type 1 (culvert 262574): this arrangement uses a concrete headwall with a concrete apron. Given the large amount of one per cent AEP runoff that would be discharged, concrete baffle blocks would be provided within the concrete apron to dissipate energy from outlet flows. A reno mattress would be provided immediately after the headwall for sloping face protection and an additional gabion basket would be provided further downstream to break any flow energy before it is discharged to the natural surface. • Type 2 (culverts 262574A, 262574B, 262576A and 262577): this type is applicable for culverts discharging at the toe of the RSW. A typical headwall arrangement would be provided with a concrete apron before flows run to the downslope. Scour protection comprised of reno mattresses and gabion baskets would be provided immediately after the headwall apron. • Type 3 (culverts 262575, 262575A and 262576): this type applies to culverts discharging at the sloping natural surface. A concrete encasement would be provided at the end of the culvert to provide pipe stability. Immediately after, this type would have a reno mattress depressed at the middle to contain flows while they are being spread. Additional lengths of reno mattresses would be provided downstream of the concave section for additional slope protection. A typical culvert outlet and scour protection arrangement is shown in Figure 3-5.



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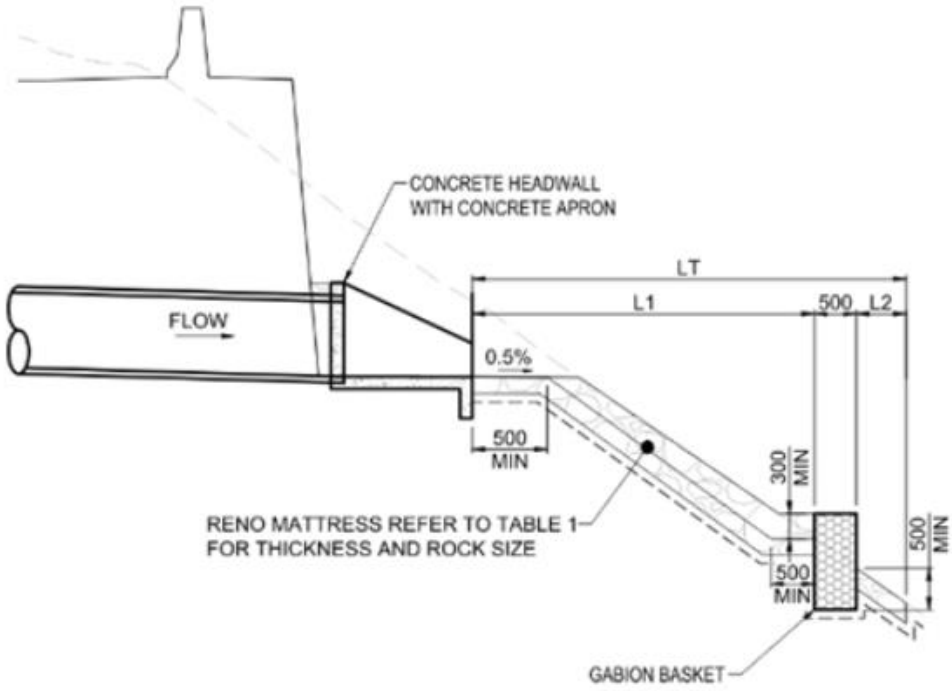

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Figure 3-5: Typical culvert outlet and scour protection arrangement

Road barriers

Twin rail safety barriers would be provided on the failure side along the length of the reinstated road at both failures.

An area between the barrier and RSW face is provided which can be used as maintenance access, as shown in **Error! Reference source not found.**. A handrail (about 1 metre tall) would be added to the top of the RSW to provide protection to maintenance staff from the vertical drop to the downslope.

Supporting infrastructure

Road signage would be installed along the proposal area, including curve warning signs and 35 and 15 kilometre per hour advisory speed signs. Due to the narrow road width, there would be limited road line marking installed, with only the edge lines marked.

3.3 Construction activities

3.3.1 Work methodology

The proposal is expected to involve the following general work sequence:

1. Site establishment at both failures
2. Preliminary work, upslope work, excavations and downslope work at the second failure only
3. Preliminary work, upslope work, excavations and downslope work at the main failure, with access from the north via the reinstated second failure
4. Finishing work at both failures.

The second failure would be reinstated first, to allow access to the main failure from the north via Five Mile. The same construction methodology would be used for each failure. The potential work activities within the proposal area for each stage are listed in Table 3-7.

Construction activities would be carried out in line with a construction environmental management plan (CEMP) to ensure work complies with Transport's commitments and legislative requirements. Construction activities may be carried out in a staggered approach, with some overlap. Detailed work methodologies would be identified by the Managing Contractor. The work methodology may be modified or refined during detailed design due to engineering constraints or to minimise environmental impacts, including:

- Onsite conditions identified during pre-construction activities
- Ongoing refinement of the detailed design
- Outcomes of community consultation, including submissions on the REF.

Table 3-7 Potential pre-construction and construction activities

Stage	Activities within proposal area
Site establishment	• Establish ancillary facilities, including levelling and installation of hardstand areas to be used for vehicles to turn around • Clear the Five Mile section of Jenolan Caves Road between the Bulls Camp Trail intersection and the failures of rockfall debris and fallen trees • Investigate the stability of the existing road to ensure safe access to the failure sites.
Preliminary work	• Install base survey control marks at both failures. • Establish geotechnical monitoring equipment to provide real-time monitoring of ground movement at both failures • Establish erosion and sediment controls progressively as access to the failures is developed. Controls would include catch bunds, sedimentation fences and mulch

Stage	Activities within proposal area
	windrows (refer to section 7.2 for further details). These controls would remain during upslope and downslope works • Install rockfall barriers upslope of the failures. Due to steep upslope access constraints, a helicopter is anticipated to be required with materials winched from a nearby ancillary facility. Ancillary facility C has been identified as a potential loading site for winching materials and ancillary facility B has been identified as a potential helicopter base. This would be confirmed during detailed design. The helicopter is not anticipated to be needed for the entire duration of construction and is expected to only be required for short periods (e.g., during the installation of the rockfall barrier) • Carry out preliminary drainage work to catch and divert surface water flowing across the failures, including: – Clear and re-establish existing surface drainage paths – Installation of temporary catch bunds across the existing pavement to intercept cross pavement flows – Protection of discharge points to prevent downstream scouring • Repair and upgrade of ancillary facility D, including – The installation of permanent drainage infrastructure for the large culvert at the northern end of the proposal area, as well as a temporary diversion pipe to accommodate flows during construction – The installation of a concrete slab over the drainage infrastructure to replace the damaged existing hardstand.
Upslope work	• Establish erosion and sediment controls progressively as access to the failures is developed. Controls would include catch bunds, sedimentation fences and mulch windrows (refer to Section 7.2 for further details) • Excavate upslope rock to accommodate drainage design and minimise height of downslope RSW at each failure (to be completed once the road has been reinstated).
Downslope work	• Excavate the existing road on the northern side of each failure to form a temporary access ramp to the base of each failure. The required access ramps are shown in Figure 3-6 and Figure 3-7. Excavation specifications are as follows: – Access ramps would be excavated at a 1:7 slope, which would allow road going vehicles, such as tipper trucks and concrete agitator trucks, as well as tracked vehicles to access the downslopes – Excavations would need to begin about 160 metres north of the main failure and about 130 metres north of the second failure – The access ramps would follow the existing road and all excavations would be within the downslope extent of excavations shown in Figure 3-1. This would provide a stable and suitable surface area for construction vehicles to travel on – The excavation would be carried out in steps of about two metres at a time to allow excavation to be carried out by the limited size plant and for the progressive installation of soil/rock nails and steel mesh without the need to work at height – Access ramp excavations and road reinstatement at the second failure would need to be carried out prior to the excavations starting for the main failure due to access constraints, as is outlined in section 3.2.2 • Construct foundation anchor beam and its base, including: – Reinforced concrete beam with provisions for rock nailing – Micropiles where the subgrade materials would not provide sufficient foundation capacity.

Stage	Activities within proposal area
	• Construct the RSW. The RSW would be required to reinstate both the failed slopes and the section of road excavated for access ramps. Construction methodology would include: – Backfilling the foundation anchor beam – Rock nailing into the downslope – Placing the RSW blocks in rows with mesh or straps extending into the backfill material – Building back up the existing road along the length of the temporary access ramp • Install stormwater culverts and pipes and outlet scour protection as the RSW at each failure is built.
Finishing work	• Construct pavement and tie-in with the existing road corridor • Install road furniture and signage • Rehabilitate disturbed areas (as required) • Decommission ancillary facilities • Final site clean-up and demobilisation.

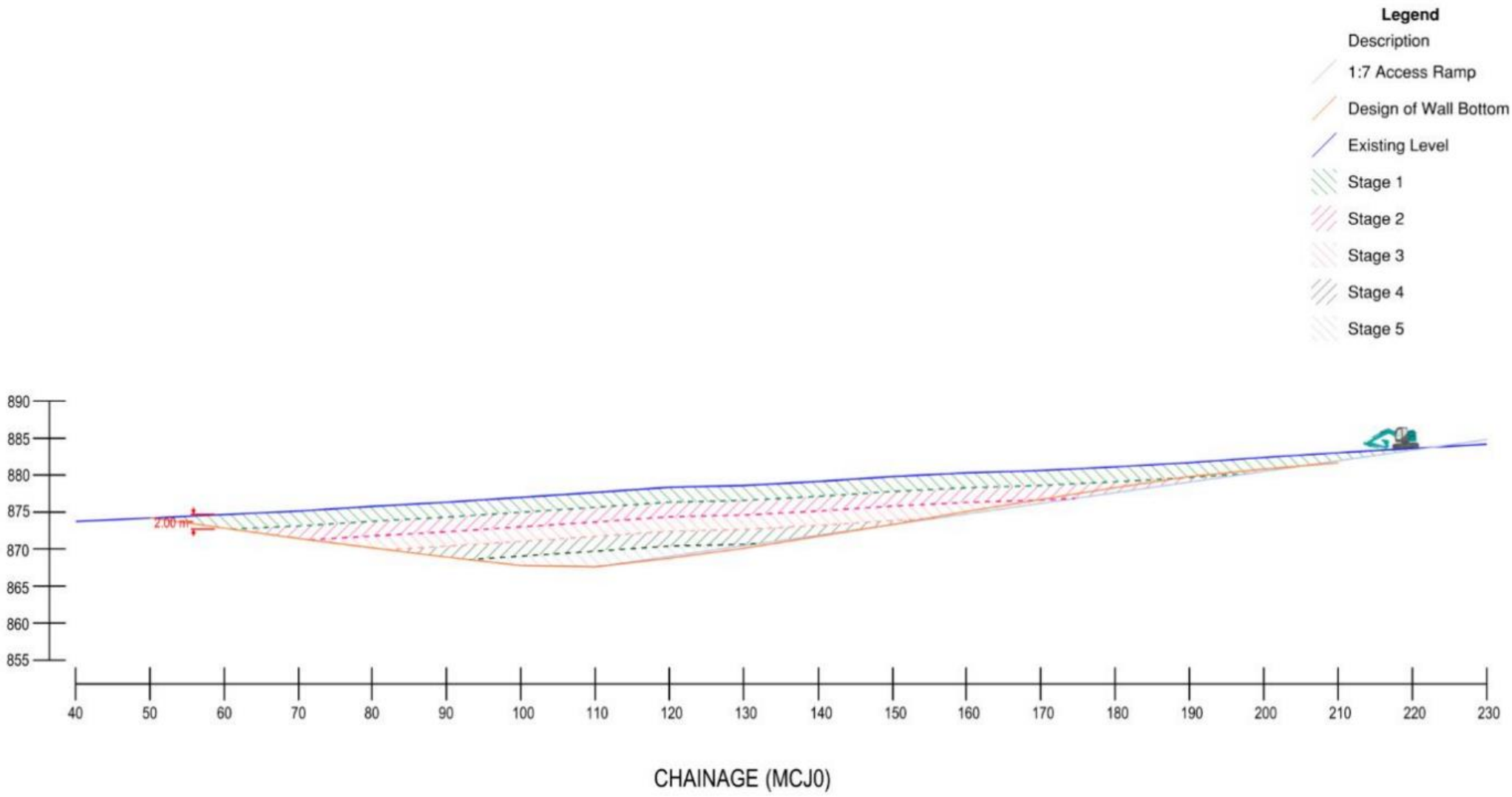


Figure 3-6 Excavations for main failure access ramp

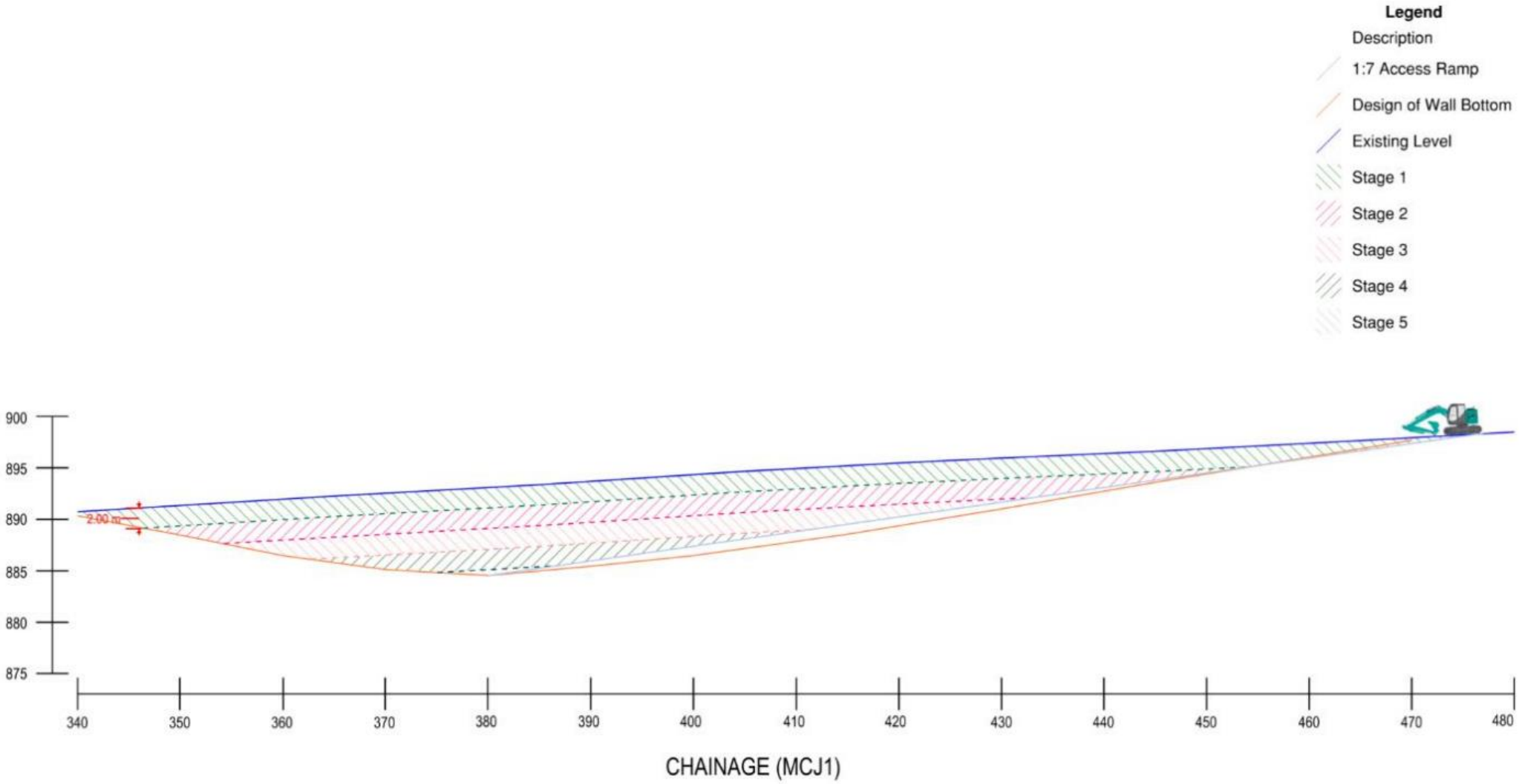


Figure 3-7 Excavations for second failure access ramp

3.3.2 Construction workforce

The construction workforce is expected to change depending on the construction activity, with an expected maximum of about 22 workers per day. The construction workforce requirements would be confirmed by the construction contractor.

3.3.3 Construction hours and duration

Proposed standard working hours

The standard working hours defined in the Interim Construction Noise Guideline (DECC, 2009) (ICNG) are:

- Monday to Friday: 7am to 6pm
- Saturdays: 8am to 1pm
- Sundays and Public Holidays: no work.

It is acknowledged that the proposal is in an isolated area away from sensitive receivers and with extended travel time for workers to and from the site. Once on site, construction activities would need to allow for travel time between ancillary facilities A and B and the failures.

Extended working hours

To maximise productivity and allow Monday to Saturday to be used as full workdays, the proposal would utilise 'extended construction hours'. This would provide additional work hours at the end of each day (Monday to Friday) and on Saturday afternoon. Extended construction hours would apply across the full length of the proposal and would be limited to daylight hours, with potentially shorter working periods throughout winter months. The proposed extended construction hours are:

- Monday to Friday: 6am to 7pm
- Saturday: 8am to 5pm
- Sunday and Public Holidays: no work.

Most construction work would be carried out within these proposed working hours. Anticipated construction noise impacts are outlined in section 6.5.3.

The reasons for the proposed extension of hours, and for out-of-hours work, are presented in the following section.

Night work

Night work would be avoided where possible during construction of the proposal and may be limited to a late-finishing shift with a time-sensitive activity (such as concrete pouring) or to respond to an emergency on site. This is to protect worker safety due to the steep topography and avoid the need for lights to be provided on site. If night work was to occur, it would be carried out in line with the Construction Noise and Vibration Strategy ST-157/4.1 (Transport, 2020b).

Justification of the extended working hours

Transport is investigating opportunities for longer standard construction hours for the proposal to complete the construction of the proposal sooner to restore access to Jenolan Caves Road as soon as possible. Due to the isolated nature of the proposal, it is anticipated that a substantial portion of each work shift would be occupied with travel between ancillary facilities A and B and the failures. Workers' shifts would also need to account for long commutes to site.

By extending standard working hours by two hours every day and four hours on a Saturday, there would be six full working days each week for construction. This would:

- Maximise productivity of construction, allowing Saturday to be used for normal construction activities, rather than being substantially limited due to shorter construction hours

- Potentially bring forward the opening date for the proposal and provide reinstated access to Jenolan Caves via Five Mile earlier than planned
- Reduce the volume of traffic on the roads during peak hours due to construction staff and some construction vehicles travelling to and from the work site outside peak traffic periods.

Longer working days would result in a direct increase in productivity across the proposal, making maximum and most efficient use of existing equipment and resources. This would result in a safer work environment and a more attractive employment proposition.

The proposed extended construction working hours would be unlikely to result in significant impacts on the amenity of affected sensitive receivers. This is because of the location of the proposal in a sparsely populated area. The implementation of management measures identified in Chapter 7 would make sure impacts were limited, including for sensitive receivers to the south of the proposal.

The proposed construction hours and consideration of the effects would be discussed with the community and potentially affected receivers before construction. The assessment of construction noise is presented in Section 6.5.3.

Consultation proposed for the extended working hours

Section 2.3 of the ICNG indicates construction activities are permissible outside of standard hours for public infrastructure works that shorten the length of the project and are supported by affected stakeholders. In accordance with the ICNG, consultation about the extended working hours has been carried out during the development of this REF. Transport would continue to consult with Jenolan Caves Reserve Trust and NPWS about the proposed extended working hours and how these would allow for the operational integrity of Jenolan Caves Road to be reinstated, as is outlined in the ICNG.

Feedback received would inform the final adopted working hours for the proposal.

Construction duration

Construction of the proposal is expected to commence early 2024 and last for about three years.

3.3.4 Plant and equipment

The plant and equipment which may be used during construction includes:

- Light vehicles
- Chainsaws
- Hand and power tools
- Flat-bed and semi-trailer trucks
- Generator
- Air compressor
- 16t excavators with digging buckets, rock hammers and rock saws
- Tracked dumper
- Front end loader
- Tipper trucks
- Plate compactors
- 8t roller
- Track mounted rock drilling rig
- Rope access rock drilling rig
- Water pumps
- Hydraulic power packs
- Elevating work platforms
- Helicopter (Bell 412 or equivalent)
- Small all-terrain crane
- Concrete pump
- Concrete agitator trucks
- Concrete vibrator
- Bitumen sprayer
- Aggregate spreader trucks
- Asphalt paver
- Line marking trucks
- Shotcrete rig.

Final selection of plant and equipment would need to consider the:

- Narrow work area along the existing road
- Narrow work area along the construction access ramps
- Limited opportunities for plant to turn around
- Tight radius curves along the access road.

Plant and equipment would be confirmed during detailed design.

3.3.5 Earthworks

The proposal would require upslope cuttings and downslope fill as part of the RSW at each failure. Table 3-8 outlines the maximum rock cut wall and RSW heights at both failures. Further details are provided in Section 3.2.3.

Table 3-8 Rock cut wall and RSW maximum heights

Type	Location	Maximum height (metres)
Rock cut wall (upslope side)	Main failure	3.1
	Second failure	3.7
RSW (downslope side)	Main failure	10.5
	Second failure	9

Earthworks required for the proposal include excavations for temporary access ramps, excavations to the upslope to establish the final road width, and fill behind the RSW. Earthworks volumes for each of these components are outlined in Table 3-9. The final earthwork requirements would be confirmed during detail design.

Table 3-9 Earthworks

Type	Location	Bulk earthworks (cubic metres)
Excavation (cut) volumes for temporary access ramps	Main failure	6380
	Second failure	5780
	Total	**12160**
Excavation (cut) volumes upslope to establish the final road width	Main failure	80
	Second failure	20
	Total	**100**
Fill volumes behind the RSW	Main failure	4959
	Second failure	3733
	Total	**8692**

It is assumed that rock excavated during construction would be exported from site for testing to confirm whether it is suitable for re-use. While some material is not expected to be suitable for re-use, if material is identified as suitable for re-use, it would be in line with Environment Fact Sheet EFS-709 Re-use of waste off-site (Transport. 2017).

Surplus material that cannot be used on-site or on nearby projects would be classified in line with the *NSW EPA Waste Classification Guidelines* (EPA, 2014) and disposed of at an approved materials recycling or waste disposal facility.

3.3.6 Source and quantity of materials

About 387 cubic metres of asphalt and 3234 cubic metres of concrete (both in situ and pre-cast) would be required for the proposal.

Other materials that would be required include steel (for drainage infrastructure), soil nails and road furniture. The quantities of these materials required would be confirmed during detailed design. Materials would be sourced from appropriately licensed commercial suppliers in nearby areas. The materials proposed to be used are not considered to be in short supply.

The amount of water that would be required during construction is unknown at this stage, however it would be obtained from an offsite facility. The amount would depend on material sources and methodologies applied by the contractor.

3.3.7 Traffic management and access

Access to the site

Jenolan Caves Road is currently closed between the Jenolan Caves Road / Bulls Camp Trail intersection and Jenolan Caves due to the failures. The proposal area and the section of Five Mile (Jenolan Caves Road from Hampton) to the north, which connects the proposal area with ancillary facilities A, B, C and D, is in an area currently inaccessible to public traffic movements.

As per the existing scenario, the road would remain closed to public traffic between the Jenolan Caves Road / Bulls Camp Trail intersection and Jenolan Caves until the completion of construction. All plant and equipment and most light vehicles would access the proposal area from the north via Five Mile as there is limited clearance through the Grand Arch at Jenolan Caves.

Some light vehicles may access the proposal area from the south (for example, from ancillary facility E at Jenolan Caves) via Two Mile, however these vehicles would not require additional traffic control along the current publicly accessible section of Jenolan Caves Road. These vehicles would follow existing provisions currently in place along Two Mile, which includes an escort vehicle.

It is anticipated that a total of 46 light vehicle movements and 46 heavy vehicle movements would occur per day, where a vehicle entering and leaving site is two movements. There would be higher frequencies of movements during specific construction activities. This would result in a large increase in vehicle movements in the area, however given the road is currently closed between the Jenolan Caves Road / Bulls Camp Trail intersection and Jenolan Caves, this would not result in a substantial change in the traffic conditions of the surrounding area. There would be minimal additional traffic disruptions, with no additional road closures, detours, altered traffic arrangements and delays to traffic anticipated during construction compared to the current scenario.

There are no public walking trails within the proposal area. However, there are walking trails near ancillary facilities A, B and E, and to the west of the proposal area. The Six Foot Track is also about 200 metres west of the proposal area. Access to these trails would be maintained during construction, with detours or alternate access routes provided if required. Signage would also be installed to notify community members using these trails of nearby construction work, where required. In accordance with Safeguard TT1, the Traffic Management Plan would include procedures for notification and approval of these detours, alternate access routes and signage by NPWS where they occur on NPWS estate.

Emergency access to the Jenolan Caves precinct is currently via Two Mile as vehicles cannot pass through Five Mile due to the two failures. The proposal would not change these existing emergency access arrangements during construction.

Traffic management within the site

Within the proposal area and the section of Five Mile (Jenolan Caves Road from Hampton) to the north, which connects the proposal area with ancillary facilities A, B, C and D, a construction speed limit of 40 kilometres per hour would be established.

There is no provision to turn around heavy vehicles south of ancillary facility B. Plant and equipment delivery would be limited to tilt-tray trucks, and larger plant would need to drive to site along the existing Jenolan Caves Road on the plant's own tracks or wheels south of this location. Ancillary facilities C and D are the only two suitable locations for vehicles which travel south of ancillary facility B to turn around. As such, plant that can rotate at least 180 degrees and avoid the need to turn around would be selected where possible.

Air traffic management

As noted in Section 3.3.1, a helicopter is anticipated to be required with materials winched from a nearby ancillary facility. The helicopter would travel to site by air. Ancillary facility B has been identified as a potential helicopter base and ancillary facility C has been identified as a potential loading site for winching materials. This would be confirmed during detailed design.

When helicopters are operational at ancillary facility B, rotor downwash may pose a safety risk to motorists and pedestrians in adjacent publicly accessible areas and to construction workers and items within the ancillary facility. These risks would be minimised in accordance with the proposal's Helicopter Management Plan, which would include provision for establishing and enforcing exclusion zones near helicopter operations.

All helicopter movements would be managed in accordance with Civil Aviation Safety Authority guidelines. The use of a helicopter is not anticipated to cause disruptions to other local air traffic.

3.4 Ancillary facilities

A range of ancillary facilities would be required to support construction, including:

- Site compounds that incorporate site offices, car parking, sheds, workshops and storage
- Areas for the delivery and storage of materials
- Stockpile sites for materials and spoil
- Turn around areas to allow entry to and egress from the proposal area from the north (via Five Mile).

Five potential ancillary facilities have been identified that could be used by construction contractors. These sites were identified in areas that maximised the use of existing vacant land. These facilities are as follows:

- Ancillary facility A – Jenolan Caves Road at Binoomea Ridge Trail
- Ancillary facility B – Jenolan Caves Road at Bulls Camp Trail
- Ancillary facility C – Jenolan Caves Road at Mount Inspiration Lookout
- Ancillary facility D – Jenolan Caves Road about 200 metres north of the second failure
- Ancillary facility E – Carpark No. 1 at Jenolan Caves.

These ancillary facilities are all located on land reserved under the NPW Act. Refer to Figure 4-2 in Section 4.2.2 for details on land tenure. No alternate potential ancillary facilities that are not located on land reserved under the NPW Act have been identified within proximity of the failures.

Further details about these ancillary facilities are outlined in

Table 3-10 and their locations are shown in Figure 3-8a-e.

Due to constrained access and limited ancillary facility options near the failures, delivery of material would occur in a staged manner. It is anticipated that there would be a shuttle for most materials travelling between ancillary facilities A and/or B and D. For example, most material delivered to site would initially be delivered to and stored at ancillary facilities A and B and subsequently transported separately to ancillary facility D for storage prior to use. Material to be removed from the work area would be initially stored at ancillary facility D before being transferred to ancillary facilities A and B ahead of removal from site altogether. All stockpiles would be designed, established, operated and decommissioned in line with the Transport's Stockpile Management Procedures (in accordance with Safeguard SW7).

Initial work at the ancillary facilities would be required at the start of construction and could include installation of environmental controls (including erosion and sediment control measures in accordance with Safeguard SW1 and SW4) and levelling of hardstand areas. Site specific management plans would be developed in consultation with National Parks and Wildlife Service and Jenolan Caves Reserve Trust for the use of identified ancillary facility locations, including requirements to maintain access to publicly accessible trails near ancillary facilities (in accordance with Safeguard O5). For ancillary facility A, this includes requirements for NPWS access to Binooma Ridge Trail to be maintained at all times.

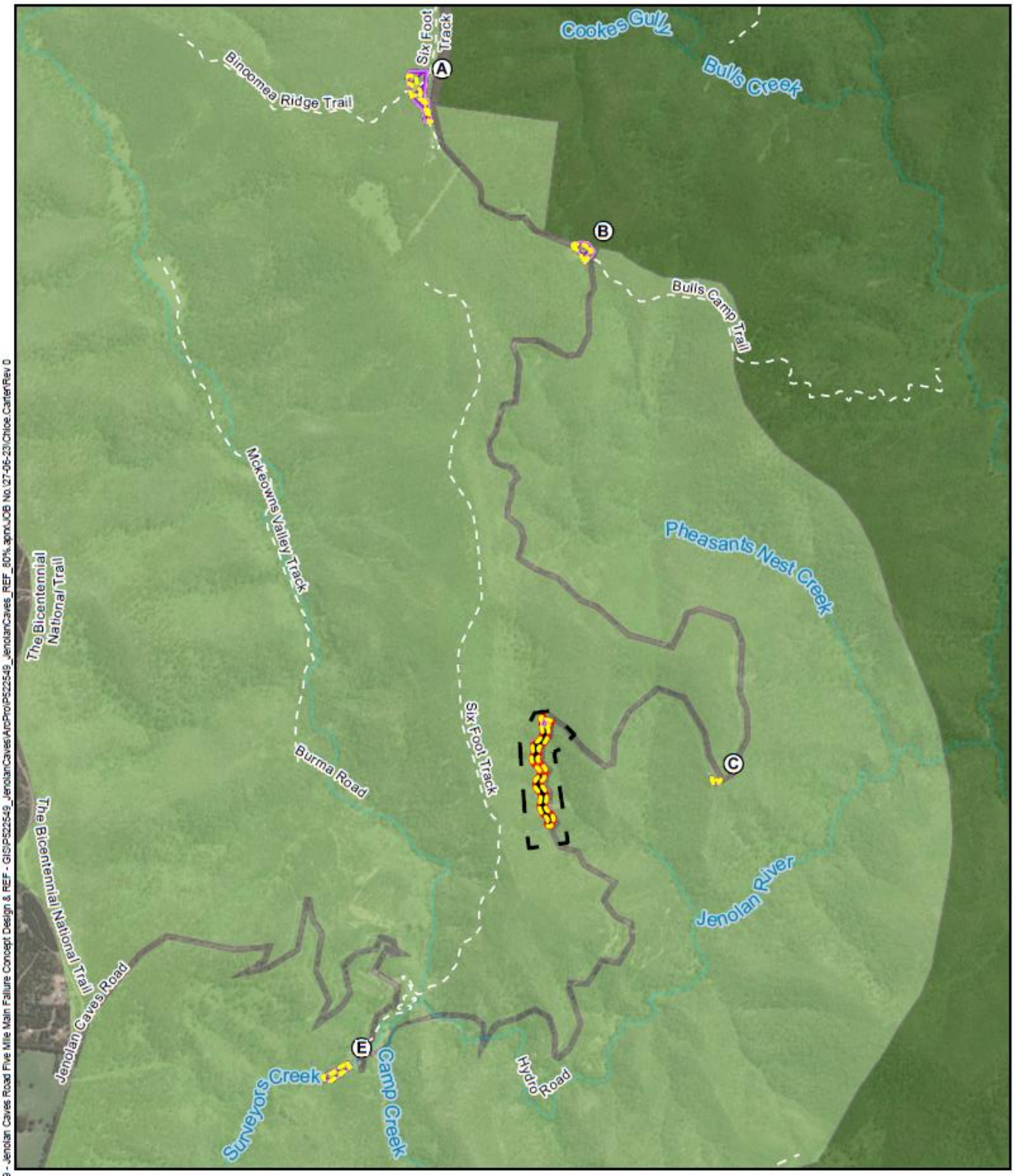
All work at ancillary facilities outside the proposal area (A, B, C and E) would occur in cleared areas and not require removal of native vegetation (in accordance with Safeguard B4). These areas are shown as the 'work footprint at ancillary facilities' boundary in Figure 3-8a-e. Refer to Section 0 for further details.

The use of ancillary facilities on NPWS estate would be subject to completion of a condition report and repair of any resulting damage to ensure the sites are returned to a condition agreed upon with NPWS (refer to Safeguard GEN5). Upon completion of construction, all ancillary facilities (except for ancillary facility D) would be remediated to their existing condition (as captured in the condition report). As ancillary facility D would be resurfaced as part of the proposal, this ancillary facility would be remediated through removal of all construction equipment and materials and ensuring that the ground surface is intact in accordance with the proposal design.

The construction contractor would confirm which ancillary facilities would be used prior to construction.

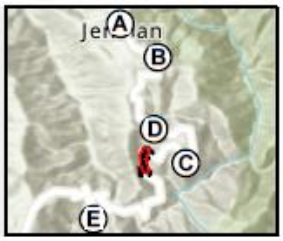
Table 3-10 Proposed ancillary facilities

Ancillary facility	Description	Potential use (to be confirmed by the contractor prior to construction)
A	• Large off-road cleared area that has previously been used as an ancillary facility for other Transport projects • About 250 metres north of the Jenolan Caves Cottages commercial receiver	• Site offices, sheds, workshop and storage • Toilets, car parking and meal areas • Areas for the delivery and storage of materials to site prior to it being transported to ancillary facility D • Areas for the storage of material prior to removal from site after it is delivered from ancillary facility D
B	• Large, cleared pull-over bay • Near the intersection of Jenolan Caves Road and Bulls Camp Trail	• Site offices, sheds, workshop and storage • Toilets, car parking and meal areas • Areas for the delivery and storage of materials to site prior to it being transported to ancillary facility D • Areas for the storage of material prior to removal from site after it is delivered from ancillary facility D • Potential helicopter base
C	• Small pull-over bay (Mount Inspiration Lookout)	• Vehicle turn around area • Potential helicopter winch site
D	• Small pull-over bay • Likely to be used as a vehicle turn around area • During preliminary work, a concrete slab would need to be laid down to replace the existing damaged hardstand area as part of the culvert upgrade at this location.	• Vehicle turn around area • Stockpile location for material delivered from ancillary facilities A and/or B, prior to use on site • Holding area for material to be removed from site prior to transportation to ancillary facilities A and/or B
E	• Located within the Jenolan Caves Precinct, about 100 metres southwest of the Jenolan Caves House • Carpark No. 1 would need to be partially closed for the duration of construction	• Car parking (light vehicles only) • Plant and heavy vehicles would not use this ancillary facility due to access limitations along Two Mile and through the Grand Arch to the failures



REF study area
REF proposal area
Proposed ancillary facility
Design

Jenolan Karst Conservation Reserve
Kanangra-Boyd National Park
Work footprint at ancillary facilities



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Projection: GDA2020 MGA Zone 56

Jenolan Caves Road Five Mile Failure **Review of Environmental Factors**

Figure 3-8a: Ancillary facilities

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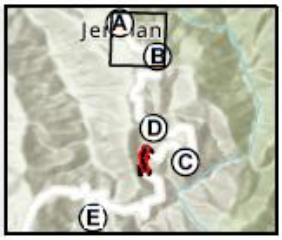
Proposed ancillary facility

Jenolan Karst Conservation Reserve

Kanangra-Boyd National Park

Work footprint at ancillary facilities



1:5,330

0 50 100m

Jenolan Caves Road Five Mile Failure **Review of Environmental Factors**

Projection: GDA2020 MGA Zone 56

Figure 3-8b: Ancillary facilities

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Proposed ancillary facility

Jenolan Karst Conservation Reserve

Work footprint at ancillary facilities

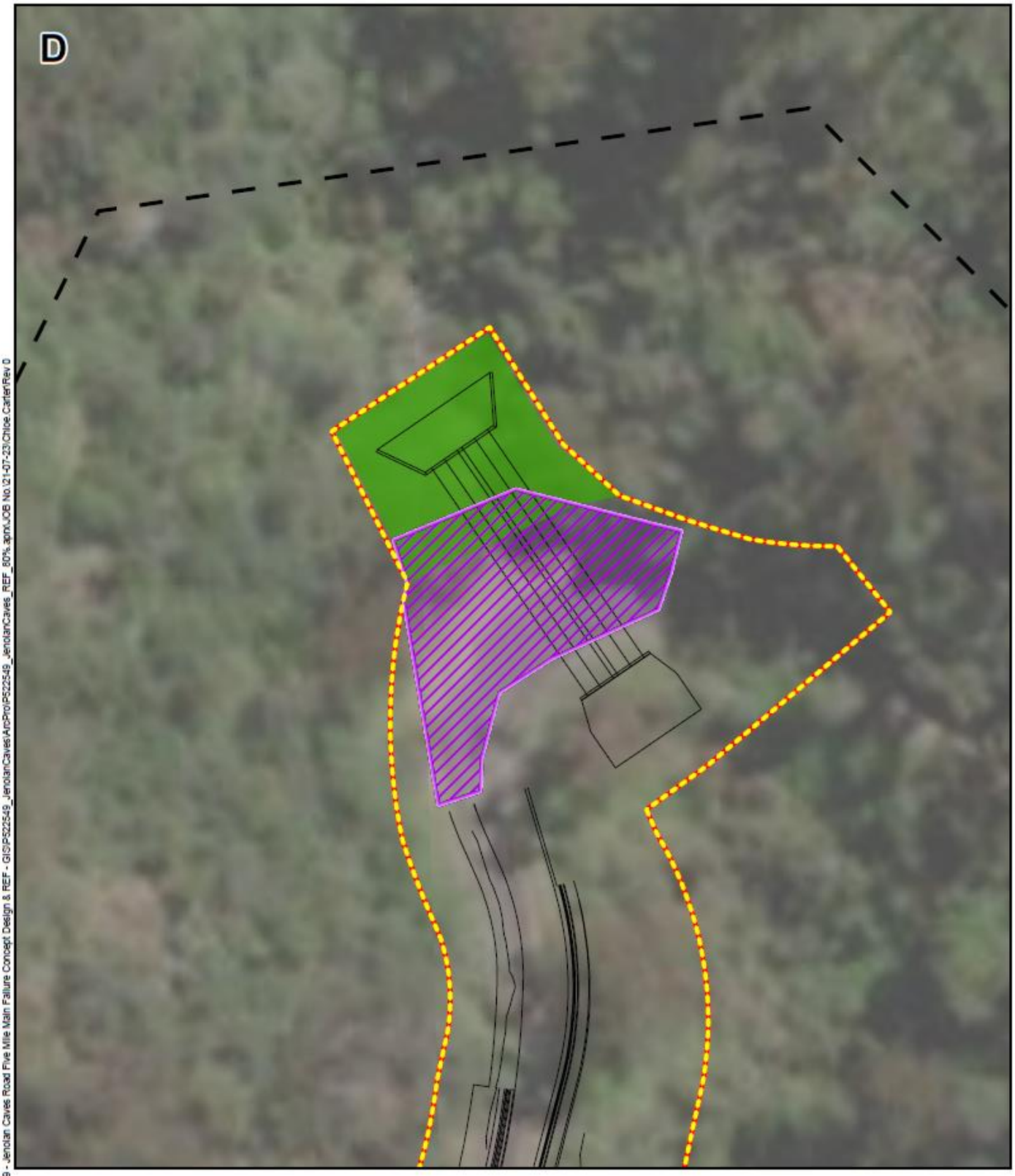
1:600

0 7 13m

Jenolan Caves Road Five Mile Failure **Review of Environmental Factors**

Projection: GDA2020 MGA Zone 56

Figure 3-8c: Ancillary facilities



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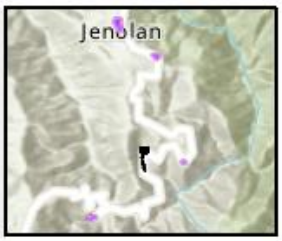
REF study area
REF proposal area
Proposed ancillary facility
Design

Work footprint at ancillary facilities
Section of the proposal on land managed by NPWS



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0 6 12m

Jenolan Caves Road Five Mile Failure **Review of Environmental Factors**

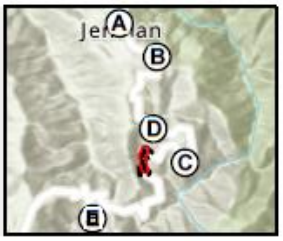
Projection: GDA2020 MGA Zone 56

Figure 3-8d: Ancillary facilities

Proposed ancillary facility

Jenolan Karst Conservation Reserve

Work footprint at ancillary facilities



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0 10 20m

Jenolan Caves Road Five Mile Failure **Review of Environmental Factors**

Projection: GDA2020 MGA Zone 56

Figure 3-8e: Ancillary facilities

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3.5 Public utility adjustment

The proposal would not require public utility adjustment as there are no existing or proposed utilities within the proposal area.

3.6 Property acquisition

While no property acquisition would be required for the proposal, temporary leases would be required during construction. This consists of areas on NPWS estate to be used for ancillary facilities. Table 3-11Table 3-11 outlines temporary leases required for the proposal.

Table 3-11 Proposed temporary leases

Lot and DP	Required use	Agreement required	Current owner	Land use zone (LEP)
Lot 49 DP728898	Ancillary facility A, B	Lease	NPWS	SP3 Tourist RU1 Primary Production
Lot 49 DP728898	Ancillary facility C, D, E, including work associated with the culvert near ancillary facility D	Lease	NPWS	SP3 Tourist

There are historical discrepancies between the mapped cadastral boundaries and the existing road corridor through the Jenolan Karst Conservation Reserve. To rectify this issue, NPWS and Transport have agreed that there is a need to modify the road corridor to align with the proposal area. As such, the two failures would be reinstated entirely within what would be designated the future cadastral boundary of the road corridor.

While most of the proposal is in the 25-metre-wide road reserve of Jenolan Caves Road (managed by Transport), the proposal is partially located outside the road reserve on land reserved under the NPW Act, being the Jenolan Karst Conservation Reserve. This includes work associated with the culvert at the northern end of the proposal area below ancillary facility D.

Work outside the road reserve requires authorisation by or under the NPW Act. This authorisation would need to be issued by NPWS prior to work occurring outside the road reserve. Refer to Section 4.2.2 for further details.

4. Statutory and planning framework

4.1 Environmental Planning and Assessment Act 1979

The *Environmental Planning and Assessment Act 1979* (EP&A Act) provides a statutory basis for planning and environmental assessment in NSW. The EP&A Act provides a framework for environmental planning and development approvals and includes provisions to ensure that the potential environmental impacts of a development are assessed and considered in the proposal approval process. The proposal is subject to assessment under Division 5.1 of the EP&A Act.

4.1.1 State Environmental Planning Policies

State Environmental Planning Policy (Transport and Infrastructure) 2021

Chapter 2 (Infrastructure) of State Environmental Planning Policy (Transport and Infrastructure) 2021 (Transport and Infrastructure SEPP) aims to facilitate the effective delivery of infrastructure across the State.

Section 2.109 of the Transport and Infrastructure SEPP 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 proposal is for a road and is to be carried out by Transport, it can be assessed under Division 5.1 of the EP&A Act. Development consent from council is not required.

The proposal does not require development consent or approval under:

- State Environmental Planning Policy (Resilience and Hazards) 2021
- State Environmental Planning Policy (Planning Systems) 2021
- State Environmental Planning Policy (Precincts – Central River City)
- State Environmental Planning Policy (Precincts – Eastern Harbour City)
- State Environmental Planning Policy (Precincts – Regional) 2021
- State Environmental Planning Policy (Precincts – Western Parkland City) 2021

While most of the proposal is located in the 25-metre-wide road reserve of Jenolan Caves Road (managed by Transport), parts of the proposal are located on land reserved under the *National Parks and Wildlife Act 1974* (NPW Act). This includes:

- Ancillary facilities A, B, C, D and E
- Some work associated with the culvert below ancillary facility D.

Work outside the road reserve cannot be determined by Transport in this REF and requires authorisation by NPWS under the NPW Act. Refer to section 4.2.2 for further details.

The activity is not designated development under Schedule 3 of the EP&A Regulation.

Sections 2.10 to 2.15 of the Transport and Infrastructure SEPP contain 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 this SEPP (where applicable), is discussed in section 5.3 of this REF.

State Environmental Planning Policy (Biodiversity and Conservation) 2021

Chapter 6 (Water Catchments) of the State Environmental Planning Policy (Biodiversity and Conservation) 2021 relates to the use of land within the Sydney drinking water catchment. Part 6.5 of the SEPP requires consideration of whether or not an activity to which Division 5.1 of the EP&A Act applies will have a neutral or beneficial effect on water quality before carrying out the activity.

The proposal is located within the Mid Coxs River sub-catchment of the Sydney Drinking Water Catchment, meaning a neutral or beneficial effect assessment is required. This is included in Appendix C. The assessment concludes that the proposal would achieve a neutral effect on water quality throughout its construction phase and a beneficial effect on water quality throughout its operational phase.

4.1.2 Local Environmental Plans

Oberon Local Environment Plan 2013

The proposal would be located within the Oberon LGA and development within this area is controlled by Oberon Council under the Oberon Local Environment Plan (LEP) 2013. The proposal is located on land zoned SP3 – Tourist, as outlined in

Figure 4-1.

Clause 2.109 of the Transport and Infrastructure SEPP 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. The proposal is therefore permitted without consent from Oberon Council. As noted in Section 4.1.1, work outside the road reserve requires authorisation by or under the NPWS Act which would be achieved by NPWS authorising work to take place on land reserved under the NPW Act, and Transport determining this REF. Refer to section 4.2.2 for further details.

The proposal would, however, be broadly consistent with the objectives for SP3 – Tourist (being located on the Jenolan Karst Conservation Reserve). The objectives of this zone are as follows:

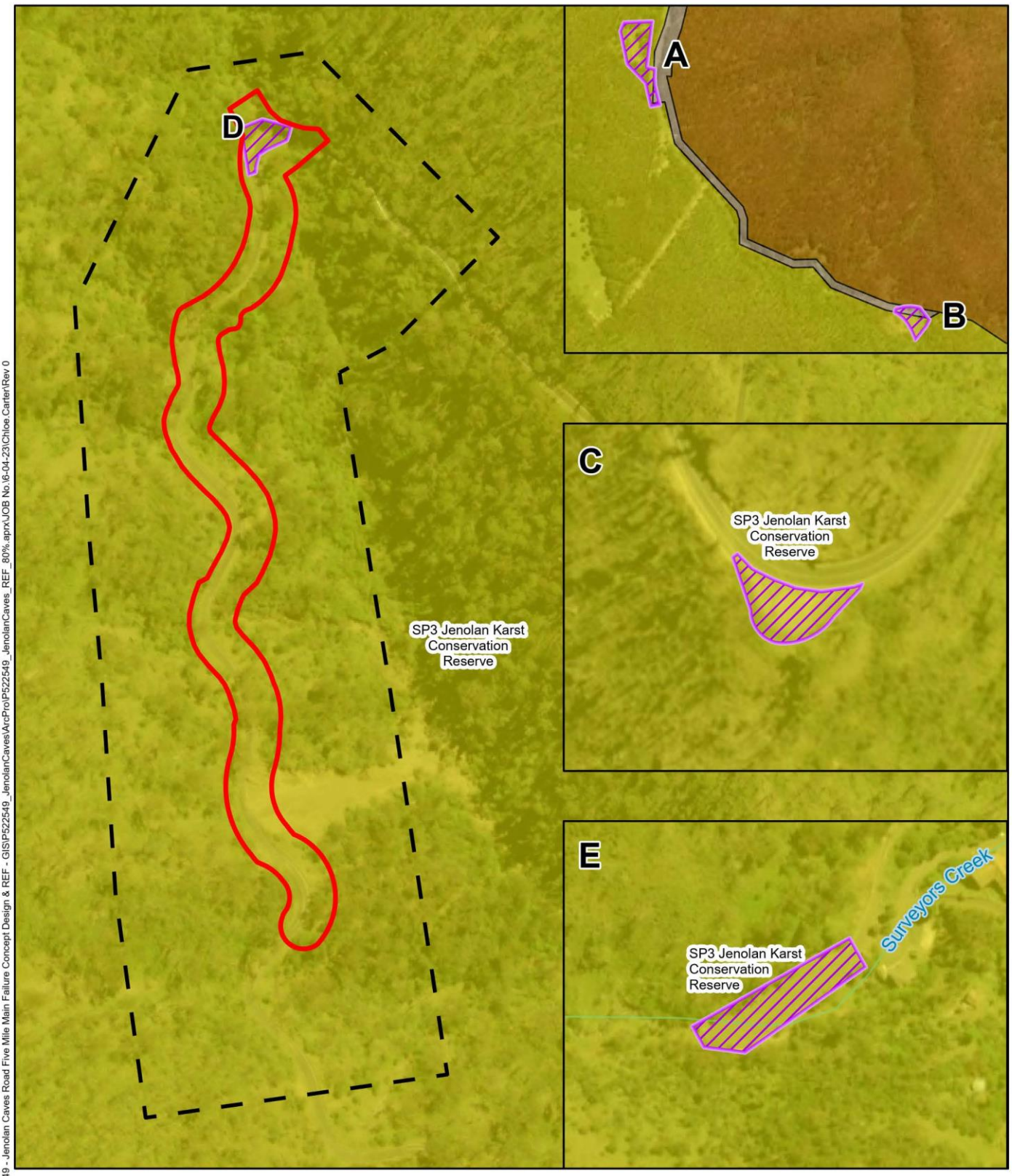
- To provide for a variety of tourist-oriented development and related uses
- To ensure that development occurs in a manner that maintains and enhances the scenic quality, the ecological and geological systems and the heritage significance of the Jenolan Caves Reserve.

The proposal, while not directly considered tourist-oriented development, would reinstate the main access route to the Jenolan Caves precinct from Hampton and Lithgow and allow its ongoing access to be maintained. The proposal seeks to minimise the risk of further landslips by upgrading the drainage infrastructure which may result in access to Jenolan Caves being lost. The impacts on biodiversity and heritage are outlined in further detail in sections 0 and 6.2, respectively.

Section 5.10 of the Oberon LEP relates to heritage items. The proposal area is located near the following areas considered to have heritage significance under the Oberon LEP:

- Jenolan Caves
- Jenolan Caves House
- Limestone Bridge (near Grand Arch)
- The Six Foot Track.

Impacts on these heritage items are discussed in section 6.2.



REF study area

REF proposal area

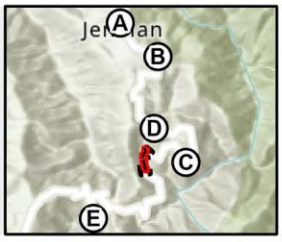
Proposed ancillary facility

Land zoning

C1 - National Parks and Nature Reserves

RU1 - Primary Production

SP3 - Tourist



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Jenolan Caves Road Five Mile Failure **Review of Environmental Factors**

Projection: GDA2020 MGA Zone 56

Figure 4-1: Land zoning

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4.2 Other relevant NSW legislation

4.2.1 Protection of the Environment Operations Act 1997

The *Protection of the Environment Operations Act 1997* (POEO Act) regulates land, air, noise and water pollution in NSW. It also aims to provide opportunity for increased public involvement and access to information regarding environmental protection.

An environment protection licence (EPL) is required for scheduled activities or scheduled development work outlined in Schedule 1 of the POEO Act. A road project is classified as a scheduled activity if it results in one or more of the following:

a) The extraction or processing (over the life of the construction) of more than:
   i) 50,000 tonnes of materials in the case of premises in the regulated area or in the local government areas of Bega Valley, Eurobadalla, Goulburn Mulwaree, Queanbeyan-Palerang Regional or Snowy Monaro Regional, or
   ii) 150,000 tonnes of material in any other case

b) The existence of 4 or more traffic lanes (other than bicycle lanes or lanes used for entry or exit) for a continuous length of at least
   i) 1 kilometre – where the road is in a metropolitan area and is classified, or proposed to be classified, as a freeway or tollway under the Roads Act, or
   ii) 3 kilometres – where the road is in a metropolitan area and is classified, or proposed to be classified, as a main road (but not a freeway or tollway) under the Roads Act, or
   iii) 5 kilometres – where the road is not in a metropolitan area and is classified, or proposed to be classified, as a main road, freeway or tollway under the Roads Act.

In addition, helicopter-related activities could also be classified as a scheduled activity if the activity:

a) Has an intended use of more than 30 flight movements per week (where take-off and landing are separate flight movements), and
b) Is conducted within 1 kilometre of a dwelling not associated with the landing, taking-off or parking of helicopters

The proposal does not meet any of the trigger criteria for an EPL. Therefore, an EPL would not be required for the proposal.

4.2.2 National Parks and Wildlife Act 1974

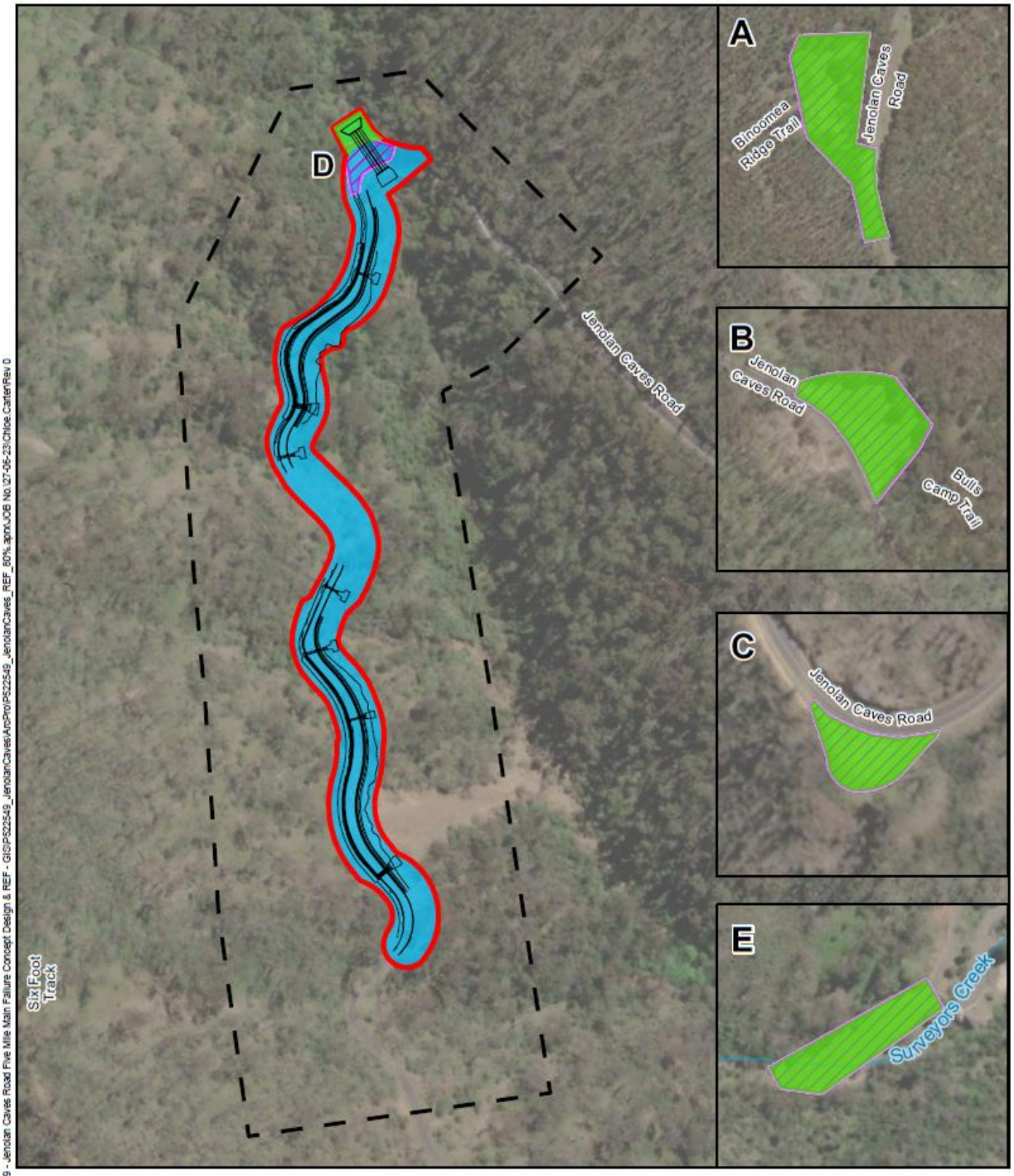
While most of the proposal is in the 25-metre-wide road reserve of Jenolan Caves Road (managed by Transport), the proposal is partially located outside the road reserve on land reserved under the NPW Act, being the Jenolan Karst Conservation Reserve. This includes:

- Ancillary facilities A, B, C, D and E
- Work associated with the culvert at the northern end of the proposal area below ancillary facility D.

No alternate potential ancillary facilities that are not located on land reserved under the NPW Act have been identified within proximity of the failures.

Work outside the road reserve cannot be determined by Transport in this REF and requires authorisation by NPWS under the NPW Act. No construction, access to or temporary work on land reserved under the NPW Act is to occur as part of this proposal unless authorisation is granted by NPWS under the NPW Act. Refer to Figure 4-2 for details on land tenure.

The proposal is permissible under the NPW Act in line with Section 39 of the Act which states that the reservation of land does not impact the uses permitted under existing interest and Section 58S of the Act, which provides that the provisions of Section 39 of the Act apply to karst conservation reserves. Given the road, upslope cutting and drainage infrastructure are considered existing interests, the proposal is therefore considered permissible under the NPW Act.



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Jenolan Caves Road Five Mile Failure **Review of Environmental Factors**

Projection: GDA2020 MGA Zone 56

Figure 4-2: Land tenure - authorisation of the proposal

Table 4-1 outlines the consistency of the proposal with the objects of the NPW Act (Section 2A of the NPW Act), while Table 4-2 outlines the consistency of the proposal against the management principles for a karst conservation area (Section 30I of the NPW Act). The proposal is considered to be consistent with both the objects of the NPW Act and the management principles for a karst conservation area.

In line with Section 81(4) of the NPW Act, all works within National Parks estate must be in line with the plan of management for the relevant park or reserve. The proposal is considered to be consistent with the Jenolan Karst Conservation Reserve Plan of Management. It identifies Jenolan Caves Road as the main public access into the park and therefore work to maintain this road (i.e., the proposal, including work at all ancillary facilities) is considered permissible.

This REF has been prepared with consideration of *Development adjacent to National Parks and Wildlife Service lands: Guidelines for consent and planning authorities* (NPWS 2020). In addition, a Jenolan Karst Conservation Reserve Management Framework would be prepared to collate and manage potential impacts of the proposal to the reserve (refer to Safeguard GEN4).

Table 4-1 Proposal consistency with the objects of the NPW Act

Object	Consistency with object
(a) the conservation of nature, including, but not limited to, the conservation of —	
(i) habitat, ecosystems and ecosystem processes, and	Impacts on native vegetation in the proposal area would be minimised. Where possible, impacts are proposed to be limited to the slope failure locations (which are largely cleared of any vegetation), along the access ramps at each failure and upslope of each failure. Some additional vegetation would need to be cleared for the excavation of access ramps on the downslope side, however this clearance is needed to repair the failures and would be minimised as much as possible during detailed design. Vegetation clearance would not be required at ancillary facilities outside of the proposal area (ancillary facilities A, B, C and E). Impacts on biodiversity and safeguards to minimise these impacts are discussed further in section 6.4.
(ii) biological diversity at the community, species and genetic levels, and	The proposal is not considered likely to reduce the biodiversity diversity in the locality with impacts likely to be limited to areas that are already disturbed as a result of the slope failures, adjacent upslope areas and along the access ramps at each failure. The removal of native vegetation is unlikely to affect threatened fauna with habitat within the proposal area as they are highly mobile and extensive areas of habitat exist in the surrounding area. Requirements for vegetation clearance would be minimised during detailed design to further minimise these impacts. The proposal would have negligible impacts on biological diversity at ancillary facilities outside of the proposal area (ancillary facilities A, B, C and E) as vegetation clearance would not be required at these locations. Impacts on biodiversity and safeguards to minimise these impacts are discussed further in section 6.4.
(iii) landforms of significance, including geological features and processes, and	While the proposal is within a karst conservation reserve (which is an outstanding cave area), the proposal area and ancillary facilities are not considered to contain any landforms of significance. It would not affect cave areas within the broader area. Regardless, the proposal seeks to stabilise the existing slope which has been subject to slope failure and poses further risk for additional failure in the surrounding areas.
(iv) landscapes and natural features of significance including wilderness and wild rivers,	While the proposal (including ancillary facilities) is within a karst conservation reserve (which is an outstanding cave area), the proposal is not in an area declared to be wilderness or wild river. It would not affect cave areas within the broader area.
(b) the conservation of objects, places or features (including biological diversity) of cultural value within the landscape, including, but not limited to —	

Object	Consistency with object
(i) places, objects and features of significance to Aboriginal people, and	As outlined in section 6.6, the likelihood of Aboriginal heritage items within the proposal area is considered limited largely due to the historical disturbance of the site from road construction and also through the recent slope failures. Transport's *Unexpected Heritage Items Procedure* (Transport, 2022c) would be followed in the event that an unknown or potential Aboriginal object/s, including skeletal remains, is found during construction.
(ii) places of social value to the people of New South Wales, and	The Jenolan Karst Conservation Reserve is considered a place of social value to the people of NSW. It contains sites such as the Jenolan Caves precinct with high tourism and recreational value. The proposal would reinstate the main access road to this precinct which would prevent further degradation at the two failures and allow for ongoing conservation and enjoyment of the social values at the Jenolan Caves precinct. Use of the proposed ancillary facilities located on NPWS estate is essential to completing the proposal.
(iii) places of historic, architectural or scientific significance,	The proposal area is located on road reserve and heritage curtilage which is within the World Heritage Listed Greater Blue Mountains Area and the State Heritage Listed Jenolan Caves Reserve. Impacts to these heritage listed items would include negligible to minor adverse direct impacts and negligible visual impacts to highly localised areas of the Jenolan Caves Reserve due to: • Upslope and downslope excavations • The removal of a remnant stone embankment wall on the downslope • Potential erosion to the reserve during the construction phase • Reconstruction of two RSWs. Due to the nature and scope of the work being localised at the failures on Five Mile and in the identified potential ancillary facilities, the proposal would largely have a neutral impact on the heritage significance of the Jenolan Karst Conservation Reserve as a whole. To minimise these impacts, a Non-Aboriginal Heritage Management Plan (NAHMP) would be prepared and implemented as part of the CEMP. It would provide specific guidance on measures and controls to be implemented to avoid and mitigate impacts to non-Aboriginal heritage. Transport's *Unexpected Heritage Items Procedure* (Transport, 2022c) would also be followed in the event that any unexpected heritage items, archaeological remains or potential relics of non-Aboriginal origin are encountered. The impacts on these listings are discussed in greater detail in section 6.2 and in Appendix E.
(c) fostering public appreciation, understanding and enjoyment of nature and cultural heritage and their conservation,	The proposal would restore the main access to the Jenolan Caves precinct from Hampton and Lithgow. Use of the proposed ancillary facilities located on NPWS estate is essential to completing the proposal. As such, it would provide the public the opportunity to appreciate, understand and enjoy the natural and cultural heritage of the Jenolan Caves area once again.
(d) providing for the management of land reserved under this Act in accordance with the management principles applicable for each type of reservation.	The consistency of the proposal with the management principles for a karst conservation area (as outlined in clause 30I of the NPW Act) are detailed in Table 4-2.

Table 4-2 Proposal consistency with management principles for a karst conservation area

Management principles	Consistency with principles
(a) the conservation of the karst environment, including the protection of catchment values,	The proposal would stabilise the failed slopes and improve drainage infrastructure which currently present a potential risk for further slips. It would have a neutral effect on water quality throughout its construction phase and a beneficial effect on water quality in

Management principles	Consistency with principles
such as hydrological processes and water quality,	operation (refer to Appendix C). Any impacts to water quality are anticipated to be minimal and manageable with the implementation of safeguards and management measures including the implementation of a Soil and Water Management Plan during construction (refer to Section 7.2). Overall, the proposal (during both construction and operation) would conserve the karst environment and provide long-term beneficial impacts to the catchment values. Use of the proposed ancillary facilities located on NPWS estate is essential to completing the proposal.
(b) the conservation of cultural values,	The proposal would result in negligible Aboriginal heritage impacts as the proposal area is considered to be heavily disturbed due to the construction of the road and the recent slope failures. The proposal is located within the road reserve and heritage curtilage of the Jenolan Caves Reserve State Heritage Listing. The proposal has been designed to minimise the impacts on this listing. This is discussed further in section 6.2.
(c) the protection of natural water movement and air movement regimes and processes within the karst environment,	The proposal would protect natural water movement near the proposal by improving the drainage infrastructure within the proposal area. This would capture water moving through the proposal area. While water would be slowed down at culvert outlets, it would still be allowed to infiltrate into the ground and to existing surface water flow paths to maintain existing hydrological processes. Work at ancillary facilities would be temporary and not result in permanent changes to hydrological processes. In addition, the proposal (including work at ancillary facilities) would not impact air movements regimes and processes within the karst environment.
(d) the conservation of biodiversity, the maintenance of ecosystem function, the protection of the geological and geomorphological features and natural phenomena and the maintenance of natural landscapes, cave formations and fossil deposits,	Impacts on native vegetation in the proposal area would be minimised. Where possible, impacts are proposed to be limited to the areas subject to slope failure which are largely cleared of any vegetation. Some additional vegetation would need to be cleared for the excavation of access ramps on the downslope side, however this clearance is needed to repair the failures and would be minimised as much as possible. Vegetation clearance would not be required at ancillary facilities outside of the proposal area (ancillary facilities A, B, C and E). Impacts on biodiversity are discussed further in section 0. The proposal would also reduce the risk of further slips in the area through provision of upgraded drainage infrastructure which has the potential to impact vegetation. This would prevent additional damage to the geology and geomorphology at the failures and minimise risk of damage to ecosystem function compared to the existing scenario where the disturbed ground at the failures may further disturb surrounding ecosystems.
(e) provision for research and monitoring,	The proposal involves the stabilisation of existing slopes which provide access into the Jenolan Caves and thus reopening this road would improve access to the Jenolan Caves precinct and broader reserve for research and monitoring purposes. Use of the proposed ancillary facilities located on NPWS estate is essential to completing the proposal.
(f) the promotion of public appreciation and understanding of the karst conservation reserve's natural and cultural values,	The proposal would provide access into the Jenolan Caves precinct which would allow the ongoing public appreciation of the natural values of the Jenolan Caves precinct and the broader reserve, including walking trails, through existing tourist facilities located in the precinct. Access into the Jenolan Karst Conservation Reserve would also promote public appreciation of the Aboriginal cultural heritage associated with the reserve, including flora and fauna. Use of the proposed ancillary facilities located on NPWS estate is essential to completing the proposal.

Management principles	Consistency with principles
(g) provision for sustainable visitor or tourist use and enjoyment that is compatible with the karst conservation reserve's natural and cultural values,	The proposal would not alter the tourist facilities currently provided at Jenolan Caves. The proposal would, however, reinstate the main vehicular access into the precinct from Hampton and Lithgow. Use of the proposed ancillary facilities located on NPWS estate is essential to completing the proposal.
(h) provision for sustainable use (including adaptive reuse) of any buildings or structures or modified natural areas having regard to the conservation of the karst conservation reserve's natural and cultural values,	The proposal would not alter the tourist facilities currently provided at Jenolan Caves.
(i) provision for the carrying out of development in any part of a special area (within the meaning of the Hunter Water Act 1991) in the karst conservation reserve that is permitted under section 185A having regard to the conservation of the karst conservation reserve's natural and cultural values.	The proposal is not located within a special area.

Authorisation of works encroaching onto National Parks estate

Where works are located on National Parks estate, authorisation from NPWS in line with the NPW Act is required to be obtained prior to works commencing. NPWS are required to assess the proposal against the sustainability criteria outlined in section 151B of the NPW Act. An assessment of the proposal against the criteria outlined in section 151B of the NPW Act is outlined in Table 4-3.

Table 4-3 Proposal consistency with matters for consideration under Section 151B of the NPW Act

Criteria	Consistency with criteria
1. Site suitability and compatibility with natural and cultural values	The proposal is considered to be suitable for the site as it would seek to stabilise an existing slope which has been subject to slope failures and reinstate the existing road asset (managed by Transport). The upgrade to the culvert at the northern end of the proposal area would provide fit-for-purpose drainage infrastructure to accommodate surface water runoff. Work at ancillary facilities A, B, C, D and E would also occur outside the road reserve and temporarily use existing cleared areas to support construction of the proposal (refer to Section 3.4 for further details). These activities would be carried out in a manner that seeks to maintain natural values. Additionally, Aboriginal cultural values associated with the Jenolan Karst Conservation Reserve would not be negatively impacted by the proposal. As is outlined in section 6.6, the proposal area did contain landscape features that indicated the presence of Aboriginal objects. However, a PACHCI Stage 1 has been completed as per DPE's *Due diligence Code of Practice for the Protection of Aboriginal objects in NSW* and the RMS procedure, which indicated that the proposal would be unlikely to harm known Aboriginal objects or places. As such, the proposal would maintain the cultural values of the area.
2. Sustainable resource use	The construction and operation of the proposal is considered to sustainably use resources. The proposal is not expected to use any substantial volumes of water or electricity. Construction activities at ancillary facilities would be temporary (as outlined in Section 3.4). Where possible, items brought to site such as fencing, site offices and plant would be used on other construction sites following completion of construction in an effort to sustainably use and re-use resources.

Criteria	Consistency with criteria
	In addition, while some material is not expected to be suitable for re-use, if material is identified as suitable for re-use (through off-site testing), it would be used by Transport on another nearby project, if possible.
3. Appropriate built form and scale	The development of the proposal, as detailed in section 2.4, has considered selecting a preferred option which has an appropriate built form for the highly sensitive environment and which blends the new wall into the surrounding landscape and minimises surrounding environmental impacts as much as possible. Construction activities at ancillary facilities would be temporary (as outlined in Section 3.4). There would be no operational design elements at ancillary facilities outside the proposal area. The use of ancillary facilities on NPWS estate would be subject to completion of a condition report and repair of any resulting damage to ensure the sites are returned to a condition agreed upon with NPWS (refer to Safeguard GEN5).

NPWS would provide approval for the proposal to proceed via authorisation under the NPW Act.

Consistency with NPWS policy

As work would occur within NPWS estate, the proposal has been developed with consideration of relevant NPWS policies, including:

- Landslides and rockfalls policy
- Vehicle access policy
- Visitor safety policy.

Table 4-4 outlines the consistency of the proposal with these policies.

Table 4-4 Proposal consistency with NPWS policies

NPWS policy	Proposal consistency
Landslides and rockfalls policy	Transport is seeking to stabilise slopes along Jenolan Caves Road where two slope failures have occurred. The stabilisation of the slopes is considered to be consistent with this policy as it would assist NPWS to meet their joint duty of care with Transport to minimise the risks of landslide to people using the reserve and accessing the Jenolan Caves precinct. The stabilisation of these slopes and installation of new drainage infrastructure would reduce the risk of any further slope failure both within the impacted areas and in nearby areas, therefore reducing the risk to both life and the natural and cultural values of the area. Additionally, the proposal would involve the installation of rockfall barriers on the upslope of the proposal area. This would minimise the risk of rockfall events onto Jenolan Caves Road, which would fulfil the NPWS duty of care to people travelling through the reserve.
Vehicle access policy	The proposal is considered to be consistent with the vehicle access policy as it would reinstate the main vehicular access into the Jenolan Caves precinct from Hampton and Lithgow which would ensure that access can once again meet the precinct requirements. The proposed new RSWs have been designed to take into account the sensitivity of the surrounding landscape from both a natural landscape and heritage viewpoint, which is also consistent with the policy.
Visitor safety policy	The proposal would generally be consistent with this policy as it would provide safe vehicular access into the reserve, particularly through the installation of the upslope rockfall barrier. The stabilisation of the slopes is considered to be within the duty of care of NPWS.

Consistency with environmental performance standards and indicators for leases and licences

Appendix B of the Jenolan Karst Conservation Reserve Plan of Management outlines the performance standards and indicators applicable to leases and licences for the reserve. As is noted within the plan of management, Section 151D of the National Parks and Wildlife Act requires the Minister to include in any lease or licence of lands within a karst conservation reserve conditions which require the lessee or licensee to comply with the relevant environmental performance standards set out in the plan of management for the reserve. It also requires the environmental performance of any lessee or licensee (in relation to the lands leased or licensed) to be measured against the environmental indicators set out in the plan of management. The performance standards and indicators for leases and licences and the compliance of the proposal with these performance standards is outlined in Table 4-5.

Table 4-5 Environmental performance standards and indicators for leases and licences, as outlined in the Jenolan Karst Conservation Reserve Plan of Management

Theme	Performance indicator	Performance standard	Compliance of the proposal with performance standard
Biodiversity	Extent of native vegetation cover	No adverse change in the extent of native vegetation cover	The proposal would minimise the removal of vegetation as much as possible. Vegetation would only be removed within the proposal area near the failures and would not be removed near ancillary facilities. The proposal would not result in the removal of any threatened ecological communities. Measures to minimise the removal of native vegetation are included in section 6.4.4.
	Abundance, condition and distribution of native vegetation species and communities	No adverse change in the abundance, condition and distribution of native vegetation species and communities	The proposal would minimise the removal of vegetation as much as possible. Vegetation would only be removed within the proposal area near the failures and would not be removed near ancillary facilities. The proposal would not result in the removal of any threatened ecological communities. Measures to minimise the removal of native vegetation are included in section 6.4.4.
	Abundance, health and distribution of native fauna species and populations.	No adverse change in the viability of native fauna populations	The proposal would result in the loss of potential foraging habitat for highly mobile threatened bats, birds and mammals. Key habitat features affected by the proposal would include the loss of two hollow-bearing trees with a diameter of around 10 centimetres that form potential breeding habitat for threatened species. As impacts would be restricted to the existing road corridor and immediate surrounds, the removal of native vegetation is unlikely to affect listed threatened species, particularly as they are highly mobile and extensive areas of habitat exist in the surrounding area. Measures to minimise impacts to native fauna are included in section 6.4.4.
Pests and weeds	Abundance, type and distribution of pest animals	Progressive reduction in the abundance, type and distribution of pest animals	The proposal is unlikely to introduce other pest fauna or increase the spread of pest species. Pest species would be managed in line with Safeguard B20.
		Progressive reduction in the extent of native fauna habitat damaged by pest animals	The proposal is unlikely to introduce other pest fauna or increase the spread of pest species. Pest species and their impacts on native fauna habitat would be managed in line with Safeguard B20.
	Extent of weed cover	Progressive reduction in the extent of weed cover	There is a moderate risk that the clearing of native vegetation and soil disturbance, as well as the use of areas of ancillary facilities, may lead to the invasion and spread of additional

Theme	Performance indicator	Performance standard	Compliance of the proposal with performance standard
			weed species into the area. However, the risk of invasion and spread of weeds can be successfully managed through the implementation Safeguard B19.
	Abundance and type of weed species	Progressive reduction in the abundance and type of weed species	There is a moderate risk that the clearing of native vegetation and soil disturbance, as well as the use of areas of ancillary facilities, may lead to the invasion and spread of additional weed species into the area. However, the risk of invasion and spread of weeds can be successfully managed through the implementation Safeguard B19.
Geodiversity	Condition of geological and geomorphological features in caves	No discernible change in the condition of geological and geomorphological features in caves, including to their physical structure and surface appearance	The proposal would not impact the condition of the Jenolan Caves.
		Compliance with the requirements of the National Parks and Wildlife Act 1974 (and associated Regulation) and relevant licence conditions	The proposal would not impact the condition of the Jenolan Caves.
	Condition of geological and geomorphological features on the land surface	No discernible change in the condition of geological and geomorphological features on the land surface, including to their physical structure and surface appearance	The proposal would result in excavations and the installation of RSWs on the downslopes of the two failures and cuttings to the upslopes. While these works would result in a discernible change to the geological features on the land surface, they are considered necessary to stabilise the slope and allow restored access to the Jenolan Karst Conservation Reserve. Extreme weather conditions have resulted in the current landslips, meaning the geological condition of the proposal area has already been significantly altered and is required to be reinstated.
		Compliance with the requirements of the National Parks and Wildlife Act 1974 (and associated Regulation) and relevant lease and licence conditions	Compliance with the NPW Act is outlined in Table 4-1.
Water	Quality, volume and flow of surface and subterranean waters	No adverse change in the quality of water entering and leaving the leased and licensed areas	Discharges from the construction phase have the potential to cause turbidity and other impacts in receiving waterways if polluted or sediment-laden water is discharged. Mitigation of these impacts would include measures such as minimising offsite discharges, testing water before discharging to ensure compliance with relevant criteria, and using multiple discharge points, rather than a single discharge point, to avoid concentrated erosion impacts.

Theme	Performance indicator	Performance standard	Compliance of the proposal with performance standard
			Additionally, a soil and water management plan (SWMP) would be developed and would include requirements for erosion and sediment controls to be implemented and maintained throughout the construction phase. Additionally, a more specific Erosion and Sedimentation Management Report (ESMR) and Erosion and Sedimentation Control Plans (ESCP) would be implemented during the construction phase to minimise these impacts. Mitigation measures relating to water and soils are included in section 6.3.4. It should also be noted that the operation of the proposal has been assessed as having a beneficial effect on water quality through the reinstatement of the failed slopes, as is outlined in Appendix C.
		No adverse change in the natural volume and seasonal flow of water entering and leaving the leased and licensed areas	Drainage infrastructure, including a grated table drain and seven new culverts, would be installed as part of the proposal to reduce the impacts of water movement over the road surface. Scour protection would be installed at the outlet of each culvert to prevent erosion and scour which can lead to instability and failure of the surrounding rock or soil structure. Due to the steep terrain of the downslope area, the culvert outlets have been designed in a way that spreads water flows as much as possible on the downslope prior to returning the flows to natural surface. Further details of drainage infrastructure, including scour protection, can be found in section 3.2.3.
		Compliance with the requirements of the Jenolan Environment Protection License 1962 (JEPL); *Protection of the Environment Operations Act 1997*; and relevant lease and license conditions	The JEPL relates to the Sewage Treatment Plant. It is anticipated that the proposal would not affect sewage treatment operations. Compliance with the *Protection of the Environment Operations Act 1997* is outlined in section 4.2.1.
		Progressive reduction in the number and severity of erosion hazards	The proposal would reinstate Jenolan Caves Road through the installation of RSWs on the downslopes. The proposal would also install improved drainage infrastructure, including seven new culverts and scour protection on the downslope. This would reduce the potential for future erosion at the failure sites, including during extreme weather events.
Air	Quality of air above the land surface	No discernible difference in the ambient quality of air between the leased area and greater Reserve	Potential impacts to air quality from disturbed topsoil, removal of vegetation and construction of the proposal would be minor. While dirt may also be disturbed from helicopter rotor downwash, these impacts would be temporary as they would only occur when a helicopter is operational nearby. Potential dust and emissions from trucks and plant machinery are considered likely during

Theme	Performance indicator	Performance standard	Compliance of the proposal with performance standard
			construction, although the impacts would be minor and short-term. Impacts to air quality would be minimised in line with Safeguard O1.
		Type, level and duration of emissions comply with the requirements of the *Protection of the Environment Operations Act 1997*, the *Protection of the Environment Operations (Clean Air) Regulation 2010*, other industry standards and relevant lease and license conditions	As is outlined in section 6.9.1, impacts to air quality would be minor and short-term. As such, any emissions, including from construction vehicles, are anticipated to comply with the relevant legislation, regulations and license conditions.
		All burning is undertaken in accordance with the requirements of the *Protection of the Environment Operations Act 1997*, the *Protection of the Environment Operations (Clean Air) Regulation 2010* and relevant lease and license conditions	No burning is anticipated to take place as part of the proposal.
		No complaints arising from lease or licence activities	Given the minor nature of any air quality impacts and the distance to nearby sensitive receivers, it is anticipated that no complaints would be received. Any complaints would be handled through the communication plan, as outlined in Safeguard SE1.
	Quality of air in caves	Air quality parameters for carbon dioxide, temperature and relative humidity are conducive to natural cave development processes and visitor safety (based on past characterisation studies)	No impacts to carbon dioxide levels, air temperature or relative humidity are anticipated as a result of the proposal. Additionally, no impacts to the air quality of the Jenolan Caves would occur as a result of the proposal.
		No storage of pollution-generating materials or substances in caves	There would be no storage of pollution-generating materials or substances in the Jenolan Caves as part of the proposal.
		Suitable protocols for undertaking pollution generating activities are in place	Any air pollution impacts would be managed in line with Safeguard O1.
Noise	Duration and intensity of noise	Compliance with the requirements of the *Protection of the Environment Operations Act 1997*; the *Protection of the Environment Operations (Noise Control) Regulation 2008*; *NSW Industrial Noise Policy 2000* and	The noise and vibration impacts of the proposal are outlined in section 6.5.3. It is anticipated that noise would be generated from construction vehicles, from earthworks and roadworks, and from the use of the helicopter. Noise impacts from the proposal area are anticipated to be negligible given the distance to nearby sensitive receivers. Walking trails, including the Binoomea Ridge Trail and Bulls Camp Trail, would experience

Theme	Performance indicator	Performance standard	Compliance of the proposal with performance standard
		relevant lease and license conditions	minor noise impacts at the beginning of the trails due to the presence of ancillary facilities A and B. Given impacts would only be experienced at the beginning of these trails, they are anticipated to be negligible for users of the trails. As such, the proposal is expected to comply with relevant noise provisions within legislation, regulations and licenses. Safeguards to minimise noise and vibration impacts are outlined in section 6.5.4.
		No complaints arising from lease or license activities	Given the minor nature of any noise and vibration impacts and the distance to nearby sensitive receivers, it is anticipated that no complaints would be received. Any complaints would be handled through the communication plan, as outlined in Safeguard SE1.
Waste	Type, quantity and distribution of waste	Efficient recycling and management of waste materials	Potential impacts from waste relate to contamination of the surrounding environment (such as pollution of waterways, attracting pest fauna) through improper waste handling, storage and transport practices. The significance of these impacts is predicted to be low, as proposed safeguards and management measures, as outlined in section 6.9.2, would manage potential impact pathways into the surrounding environment. Waste produced during construction would be managed in line with the waste management hierarchy principles of the *Waste Avoidance and Resource Recovery Act 2001*.
		Minimal, or no litter, within leased and licensed areas	Potential impacts from waste relate to contamination of the surrounding environment (such as pollution of waterways, attracting pest fauna) through improper waste handling, storage and transport practices. The significance of these impacts is predicted to be low, as proposed safeguards and management measures, as outlined in section 6.9.2, would manage potential impact pathways into the surrounding environment. Waste produced during construction would be managed in line with the waste management hierarchy principles of the *Waste Avoidance and Resource Recovery Act 2001*.
		No complaints in relation to excessive litter or waste	Given the minor nature of any waste impacts, it is anticipated that no complaints would be received. Any complaints would be handled through the communication plan, as outlined in Safeguard SE1.

Aboriginal heritage

The NPW Act sets out permits and consent requirements should Aboriginal heritage items and/or places be affected. There are no known Aboriginal heritage items located near the proposal area. Refer to Section 6.6 for assessment of Aboriginal heritage. The assessment concluded that the proposal would be unlikely to impact Aboriginal cultural heritage values and that an Aboriginal heritage impact permit would not be required.

4.2.3 Roads Act 1993

The *Roads Act 1993* (Roads Act) provides guidance on the use and access of public roads, including procedures regarding the opening and closure of public roads. The Act also classifies roads and identifies the functions of road authorities.

The Roads Act states that a road authority may carry out road work on any public road for which it is the road's authority and on any other land under its control (Division 1, Clause 71). If the road is not under the control of the authority carrying out the works, then consent is required.

The proposal is located on a classified road that is managed by Transport. An emergency road occupancy licence (ROL) is currently in place for traffic control on Jenolan Caves Road due to the failures. When works commence as part of the proposal, a ROL will also be required.

4.2.4 Biodiversity Conservation Act 2016 (BC Act)

The Biodiversity Conservation Act 2016 (BC Act) seeks to conserve biological diversity, promote ecologically sustainable development (ESD), prevent extinction and promote the recovery of threatened species, populations and ecological communities and to protect areas of outstanding biodiversity value.

Section 7.3 of the BC Act and Part 7A of the FM Act require that the significance of the impact on threatened species, and endangered ecological communities is assessed using a five-part test. Where a significant impact is likely to occur, a species impact statement (SIS) must be prepared by an accredited assessor in line with the Biodiversity Assessment Method (BAM) (DPIE, 2020). As discussed in section 0 and in the Biodiversity Assessment Report (Appendix H), 0.995 hectares of native vegetation which is considered threatened fauna habitat would be removed as part of the proposal. This, however, would have minimal impacts on threatened species given there is substantial habitat in the areas surrounding the proposal for threatened fauna. As such, a SIS is not required. In addition, as the proposal is not state significant development or state significant infrastructure, a biodiversity development assessment report (BDAR) is not required.

4.2.5 Heritage Act 1977

The Heritage Act 1977 (Heritage Act) provides protection for items of State heritage significance that are listed on the State Heritage Register, as well as for unlisted archaeological relics. Section 57 of the Heritage Act requires that works proposed for items protected by the Heritage Act are approved by the Heritage Council of NSW or its delegates, as appropriate. The proposal is located within the road reserve and heritage curtilage (at ancillary facilities) of the Jenolan Karst Conservation Reserve which is listed on the State Heritage Register under the Heritage Act. Impacts to this heritage listed item would include impacts to heritage curtilage through upslope and downslope excavations, the removal of a remnant stone embankment wall on the downslope, potential soil and erosion impacts to the reserve during the construction phase, and minor operational impacts to views of the surrounding reserve.

An approval under section 57 of the Heritage Act is required due to the proposal being located within the State Heritage curtilage. Therefore, a section 60 application is to be submitted for the proposal.

4.3 Commonwealth legislation

4.3.1 Environment Protection and Biodiversity Conservation Act 1999

Under *The Environment Protection and Biodiversity Conservation Act 1999* (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 A and section 6 of the REF.

A referral is not required for proposed road activities 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 section 0 of the REF and Appendix H.

Findings – matters of national environmental significance

The assessment of the proposal's impact on matters of national environmental significance and the environment of Commonwealth land found that there is unlikely to be a significant impact on relevant matters of national environmental significance or on Commonwealth land. Accordingly, the proposal has not been referred to the Australian Government Department of Climate Change, Energy, the Environment and Water under the EPBC Act.

Findings – nationally listed biodiversity matters (where the strategic assessment applies)

The assessment of the proposal's impact on nationally listed threatened species, endangered ecological communities and migratory species found that there is unlikely to be a significant impact on relevant matters of national environmental significance. Section 6.4.4 of the REF describes the safeguards and management measures to be applied to minimise impacts of the proposal on biodiversity.

4.3.2 Native Title Act 1993

The Native Title Act 1993 recognises and protects native title. The Act covers actions affecting native title and the processes for determining whether native title exists and compensation for actions affecting native title. It establishes the Native Title Registrar, the National Native Title Tribunal, the Register of Native Title Claims and the Register of Indigenous Land Use Agreements, and the National Native Title Register. Under the Act, a future act includes proposed public infrastructure on land or waters that affects native title rights or interest.

A search of the Native Title Tribunal Native Title Vision website was carried out on 19 June 2023, with no Native Title holders/claimants identified.

4.4 Confirmation of statutory position

The proposal is categorised as development for the purpose of a road and is being carried out by or on behalf of a public authority. Under Section 2.109 of the Transport and Infrastructure SEPP the proposal is permissible without consent. The proposal is not State significant infrastructure or State significant development. The proposal can be assessed under Division 5.1 of the EP&A Act and the NPW Act.

Transport is the determining authority for the proposal outside of the Jenolan Karst Conservation Reserve. This REF fulfils Transport's obligation under section 5.5 of the EP&A Act, including 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.

Authorisation from NPWS is required for the works within the reserve. The proposal is permissible under the NPW Act and is in accordance with the Jenolan Karst Conservation Reserve Plan of Management and the National Parks and Wildlife Services Policy.

5. Consultation

This section discusses the consultation carried out to date for the proposal and the consultation proposed for the future.

5.1 Consultation strategy

Community consultation about the proposal has been carried out in the form of public community updates on Transport's West Region Jenolan Caves Road project webpage. Community updates are outlined in Table 5-1.

Table 5-1 Jenolan Caves Road community updates

Community update	Key points
March 2021	• Details of significant impacts to Jenolan Caves Road • Information on assessments carried out by geotechnical and road specialists • Road closure details.
April 2021	• Damage and remediation details for Jenolan Caves Road, including expected timeframes for road reopening at the Hampton, Two Mile and Five Mile sections of road • Details on Transport's investigation into constructing a bypass through the state forest in order to alleviate pressure on the freight industry (option not pursued).
May 2021	• Information on the reopening of Jenolan Caves Road • Details of future anticipated lane closures and reduced speed limits at this section of road • Details of complex and severe impacts at Five Mile leading to the need for further geotechnical investigations.
September 2021	• Details of an anticipated tender for a slope remediation at the Two Mile section of road • Information on the completed works on the upslope at Hampton and the anticipated tender for the downslope works at this location • Details of the extensive slope failures on the Five Mile. The community update makes clear that a road failure to this extent had not been encountered in NSW before and that all available resources are committed to finding a solution.
November 2021	• Details of the second failure at the Five Mile and how this failure would need to be remediated first in order to fully reopen Jenolan Caves Road via the Five Mile • Details of the main failure at the Five Mile, including the engagement of Aurecon to carry out technical investigations and the development of design options • Further details on the Two Mile slope remediation, including heritage assessments
May 2022	• Details of the preferred retaining wall option selected to reinstate Jenolan Caves Road at the Five Mile, including the use of drones and LiDAR technology for slope modelling
December 2022	• Details of the closure of access to the Jenolan Caves precinct via the Two Mile due to a rain event in October 2022 and the need to urgently reinstate this section of road
January 2023	• Information on the reopening of Jenolan Caves Road via Two Mile following emergency works

Community update	Key points
	• Details of traffic management and traffic escorts remaining in place once visitor access is reinstated from 20 January 2023.
March 2023	• Details of a temporary night time road closure and detour of Jenolan Caves Road at Hampton from 27 March 2023 (expected to last three nights).

It is anticipated that these updates would continue to be published as the proposal progresses.

5.2 Aboriginal community involvement

The proposal has been considered against the requirements of the Procedure for Aboriginal Cultural Heritage Consultation and Investigation (PACHCI) (Roads and Maritime Services, 2011). This procedure is generally consistent with the Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010 (Department of Environment, Climate Change and Water, 2010). A clearance letter was prepared on 24 January 2023 by Transport's Aboriginal Cultural Heritage Advisor.

Based on the Stage 1 PACHCI preliminary assessment results for the Jenolan Caves Road Five Mile remediation, the proposal is unlikely to have an impact on Aboriginal cultural heritage. No consultation with the Aboriginal community is required.

The proposal is within the Gundungurra Area Agreement (NI2014/001) Indigenous Land Use Agreement. Although no consultation with the Aboriginal community is required based on the outcomes of Stage 1 PACHCI, Transport consulted with the Gundungurra people in May 2023. No issues were raised about the proposal.

5.3 SEPP (Transport and Infrastructure) consultation

NPWS has been consulted about the proposal as per the requirements of section 2.15 of the Transport and Infrastructure SEPP on 25 May 2023. Appendix B contains a consultation checklist that documents how the Transport and Infrastructure SEPP consultation requirements have been considered. NPWS has reviewed the draft REF and comments have been incorporated into the final version. No further comments were received from NPWS through the Transport and Infrastructure SEPP consultation. A summary of comments received by NPWS and how they are addressed in this REF is included in Table 5-2.

Table 5-2 TISEPP consultation with NPWS

Category	Comments	Where addressed in REF
General	• Construction safety measure recommendations, including at ancillary facilities	• Additional construction safety measures have been included in Safeguard GEN4
	• Recommendations for National Park remediation	• Section 3 of the REF details the proposal design, which includes the reinstatement of the road through the installation of RSWs. Revegetation strategies have been included in Safeguards V2 and V3.
	• Recommendations for issues to be included in the CEMP.	• Safeguard GEN1 has been updated to include NPWS recommendations.
Encroachments into National Park and authorisation of works	• Request for additional detail on the temporary nature of material stockpiles	• Table 4-3 has been updated to include this information
	• Request for the inclusion of the performance standards and indicators	• Discussion about the performance standards and indicators has been included in section 4.2.2.

Category	Comments	Where addressed in REF
	applicable to leases and licences outlined in the Jenolan Karst Conservation Reserve Plan of Management • Clarifications about REF determination and lands subject to NPWS authorisation	• REF determination to be carried out by Transport and authorisation for works encroaching on National Parks land to be carried out by NPWS. Noted throughout the REF, including in section 4.2.2. Safeguard GEN4 has been revised to ensure clear direction is provided to workers about restrictions on work outside of authorised areas.
Legislative setting and planning pathway	• Recommendations for additional information on the permissibility of works at ancillary facilities given these would largely be located on NPWS land.	• Ancillary facility locations have been chosen within the Jenolan Karst Conservation Reserve due to the lack of availability of sites adjacent to the reserve. Section 4.2.2 outlines which land is subject to authorisation by NPWS, including that ancillary facilities which are located on NPWS land would be subject to this authorisation.
Temporary construction compounds	• Request for more detail of the use of each ancillary facility. • Request for any ancillary facility to be subject to a condition report and repair of any damage. • Request for impacts to walking trails to be assessed and for ongoing NPWS access to Binoomea Ridge Trail for continued park management	• Section 3.4 outlines the potential uses for each ancillary facility (subject to refinement). • Ancillary facility condition and repair provisions are included in Safeguard GEN5. • Section 6.8.3 addresses potential impacts to walking trails. Binoomea Ridge Trail would remain accessible for NPWS staff, as is outlined in Safeguard O5.
Aboriginal cultural heritage	• Request for reference to be made to the Gundungurra Indigenous Land Use Agreement (including that Native Title has been recognised through this agreement). • Recommendation to include the Gundungurra people in any consultation relating to Aboriginal cultural heritage.	• The Gundungurra Indigenous Land Use Agreement has been included in section 5.2 and section 6.6.2. • Section 5.2 notes that consultation has been carried out with the Gundungurra people in May 2023 regarding the proposal.
Helicopter use	• Request for consultation with NPWS and Jenolan Caves Reserve Trust to be carried out during the development of the Helicopter Management Plan.	• This is included in Safeguard TT2.

Category	Comments	Where addressed in REF
Visitor amenity and safety	• Request for consultation to be carried out with Jenolan Caves Reserve Trust regarding impacts of the proposal on visitor amenity and safety. • Request for information about any proposed detours, alternate access routes and signage	• Requirements for consultation with Jenolan Caves Reserve Trust have been included in Safeguard SE2. • Section 3.3.7 includes information on traffic access and management. Additionally, Safeguard TT1 specifies the need to inform NPWS of this information.
Stormwater / erosion and sediment control	• Request for information about stormwater flows, stormwater dissipation measures and anticipated impacts of water runoff on flora and fauna. • Request for adequate erosion and sediment control to be utilised to limit the movement of sediment across the National Park interface. • Request for no works to be carried out near the National Park during wet weather events.	• Information about the proposed drainage infrastructure is included in section 3.2.3. The anticipated impacts of the proposal on water quality are outlined in Appendix C (NorBE assessment). • Erosion and sediment control measures are included in Safeguard SW4. • Heavy rainfall management requirements are included in Safeguard SW12.
Tree protection and felling techniques	• Recommendation for pre-clearing surveys to be carried out prior to vegetation removal. • Preference for fallen timber to be relocated outside the excavation and works area but to also be retained onsite to minimise loss or damage to native habitat. • Request for tree protection to be utilised on the National Park interface.	• Pre-clearing surveys are specified in Safeguard B5. • Fallen timber management is included in Safeguard B6. • Safeguard GEN4 includes tree protection provisions.
Hygiene protocols	• Request for hygiene protocols to be established for materials, machinery and equipment.	• Hygiene protocols have been included in Safeguard B2.
Bushfire	• Consideration of the high bushfire risk of the proposal area and recommendations for works which could result in the ignition of a fire not to be carried out.	• A bushfire management plan has been included in Safeguard O2.

5.4 Government agency and stakeholder involvement

Consultation with Government agencies and key stakeholders for the proposal has largely focused on discussions with NPWS and Jenolan Caves Reserve Trust (JCRT).

Consultation with NPWS has been in relation to the proposed options considered in the development of the proposal and the proposed concept design. Consultation is ongoing with NPWS around options, potential impacts and approval pathways.

Consultation with JCRT occurred in the form of a meeting between Transport and JCRT on 14 June 2023. Key issues discussed included:

- The feasibility and impacts of excavations for access ramps
- The future involvement of JCRT in revegetation strategies
- The extent of certain design elements
- Logistics associated with helicopter use
- Program dates
- Ongoing consultation between Transport and JCRT
- Engagement with first nations groups.

The JCRT has also reviewed the draft REF and comments have been incorporated into the final version. The JCRT would continue to be consulted with as the proposal progresses. A summary of JCRT comments and how these have been addressed in the REF is included in

Table 5-3 JCRT comments on REF

Category	Comments	Where addressed in REF
Upslope treatment	• Request for the use of shotcrete should be minimised as much as possible on the upslope.	• The use of shotcrete in the final design would be minimised as much as possible, as is outlined in section 3.2.3.
Road classification	• Request for more information to be included about Jenolan Caves Road in addition to the road being restored as part of the proposal.	• Jenolan Caves Road is specified as both a service and emergency access road in sections 2.1 and 6.7.2.
Aboriginal cultural heritage consultation	• Request to understand which Aboriginal group had been consulted with about the proposal.	• The Gundungurra people have been consulted with about the proposal. This is noted in section 5.2.

Transport would also engage with Oberon Council, Heritage NSW and the Heritage Council of NSW prior to construction.

5.5 Ongoing or future consultation

Ongoing consultation would be carried out by Transport and would involve notification of:

- Design development and construction activities associated with the proposal
- Road closures which would be put in place, if any, for the proposal as well as other works in the locality, including with any property owners who would be in the closed sections of road once confirmed
- Measures put in place to maintain access to the Jenolan Caves precinct when the precinct is open.

All consultation and notification to the community would be carried out in advance of works occurring.

5.5.1 Consultation during the construction period

A communication plan would be prepared as part of the project development period which will guide consultation activities to be carried out during the construction period. The communication plan would detail consultation requirements to be carried out with the following:

- NPWS
- JCRT
- Oberon Council
- The community and landholders impacted by the works
- Heritage NSW
- Heritage Council.

The consultation would generally be carried out via the following methods:

- Regular updates to the community throughout the remainder of the planning and construction phases
- Development and maintenance of a comprehensive communications register
- Project signage
- A toll-free community information line
- A Transport email address
- The Transport project website.

6. Environmental assessment

This section of the REF provides a detailed description of the potential environmental impacts associated with the construction and operation of the proposal. All aspects of the environment potentially impacted upon by the proposal are considered. This includes consideration of:

- Potential impacts on matters of national environmental significance under the EPBC Act
- The factors specified in the guidelines Guideline for Division 5.1 assessments (DPE 2022a) and as required under section 171(1) of the Environmental Planning and Assessment Regulation 2021 and the *Roads and Related Facilities EIS Guideline* (DUAP 1996). The factors specified in section 171(2) of the Environmental Planning and Assessment Regulation 2021 are also considered in Appendix A.

The proposal is mostly located within the road corridor on Jenolan Caves Road (managed by Transport) except at the northern end of the proposal area, where the culvert below ancillary facility D would encroach on the Jenolan Karst Conservation Reserve. As such, impacts to the surrounding reserve have been considered in this chapter. Site-specific safeguards and management measures are provided to minimise the identified potential impacts.

6.1 Landscape character and visual impacts

This section describes the landscape character and visual impacts from the proposal. This section summarises the *Landscape Character and Visual Impact Assessment* (LCVIA) prepared by Scape design, provided in Appendix D.

6.1.1 Methodology

The assessment was carried out in accordance with the *Environmental impact assessment practice note EIA-N04* (Transport for NSW, 2020). It defines the methodology that was used to assess the likely changes to landscape, proposal specific strategies and subsequent opportunities and constraints. The assessment also considered the proposal's urban design objectives (refer to section 2.3.3). The methodology for the LCVIA involved:

- Identifying the distinct landscape character zones (LCZs), which identify areas of similar character within and surrounding the proposal area
- Determining the representative viewpoints
- Determining the sensitivity of the view and the potential magnitude of change from construction and operation of the proposal, by considering the scale, nature and duration of change, and existing built form in the landscape and how closely the proposal matches this in bulk, scale and form
- Assessing the potential impacts for each LCZ and viewpoint, using level of sensitivity and magnitude of change (refer to Table 6-1 for this matrix)
- Recommend mitigation measures to minimise potential landscape character and visual impacts identified.

Table 6-1 Landscape character and visual impact assessment matrix

Sensitivity	Magnitude				
		High	Moderate	Low	Negligible
	High	High	High-moderate	Moderate	Negligible
	Moderate	High-moderate	Moderate	Moderate-low	Negligible
	Low	Moderate	Moderate-low	Low	Negligible
	Negligible	Negligible	Negligible	Negligible	Negligible

6.1.2 Existing environment

Regional context

The proposal is located in Jenolan, New South Wales within the Oberon LGA. Jenolan Caves is part of the Greater Blue Mountains UNESCO World Heritage Area and is included in the National Heritage List, NSW State Heritage Register and Oberon LGA heritage list. The proposal is about 130 kilometres west of the Sydney CBD and is within a key transport corridor linking the Jenolan Karst Conservation Reserve, Jenolan State Forest, Kanangra-Boyd National Park and the Blue Mountains National Park. The Oberon LGA has a growing population and is an employment growth area.

Local context

The proposal area is within the curtilage of land zoned SP3 – Tourist and is located near land zoned C1 – National Parks and Nature Reserves, as outlined in Figure 4-1. Ancillary facilities which would be used for the proposal and are all located on land zoned SP3, with ancillary facilities A and B also located on land which is zoned RU1 – Primary Production and which borders land zoned C1 – National Parks and Nature Reserves. The National Park areas contain bushwalking trails and campgrounds, with ancillary facilities A and B located at the beginning of the Binoomea Ridge Trail and the Bulls Camp Trail, respectively.

Access and circulation

There are three existing lookouts within the Jenolan Karst Conservation Reserve (Mount Trickett, Mount Inspiration and Katoomba View Lookout) which have vehicular access along either Kanangara Walls Road or Jenolan Caves Road.

The reserve contains caves both accessible and non-accessible to the public. Currently only two caves are open to the public for viewing. The Six Foot Track connects walkers from the Jenolan Caves precinct through the Kanangara-Boyd National Park and is a popular three day hike that passes close to the proposal area. The track is separated from the proposal area by a major ridgeline.

Landform, vegetation and drainage

The natural landscape surrounding the proposal area is characterised by steep valleys, ridgelines and escarpments. The two valleys of the Jenolan River are to the south-east and west of the proposal area. The western valley is, however, visually obscured from the proposal area by the ridgeline to the west on which the Six Foot Track runs. The valleys and hillsides are heavily wooded with natural vegetation, however as the slope failures have shown, it is vital to stabilise the slopes and prevent runoff from the road, which has the potential to de-stabilise slopes, collecting sediment and discharging this into natural waterways such as the Jenolan River.

There are two plant community types identified within and near the proposal area, including:

- PCT 821 - Eurabbie - stringybark shrubby woodland on limestone in the Jenolan Caves area, Sydney Basin Bioregion
- PCT 963 - Narrow-leaved Peppermint - Mountain Gum - Brown Barrel moist open forest on high altitude ranges, northern South Eastern Highlands Bioregion.

Further information on biodiversity within and near the proposal area can be found in section 6.4.2

Landscape character zones

Four landscape character zones (LCZs) were identified during desktop studies near the proposal area:

- LCZ 1: Residential/staff accommodation
- LCZ 2: Tourism
- LCZ 3: Existing road corridor
- LCZ 4: Natural landscape.

Each LCZ is represented in Table 6-2 and Figure 6-1.

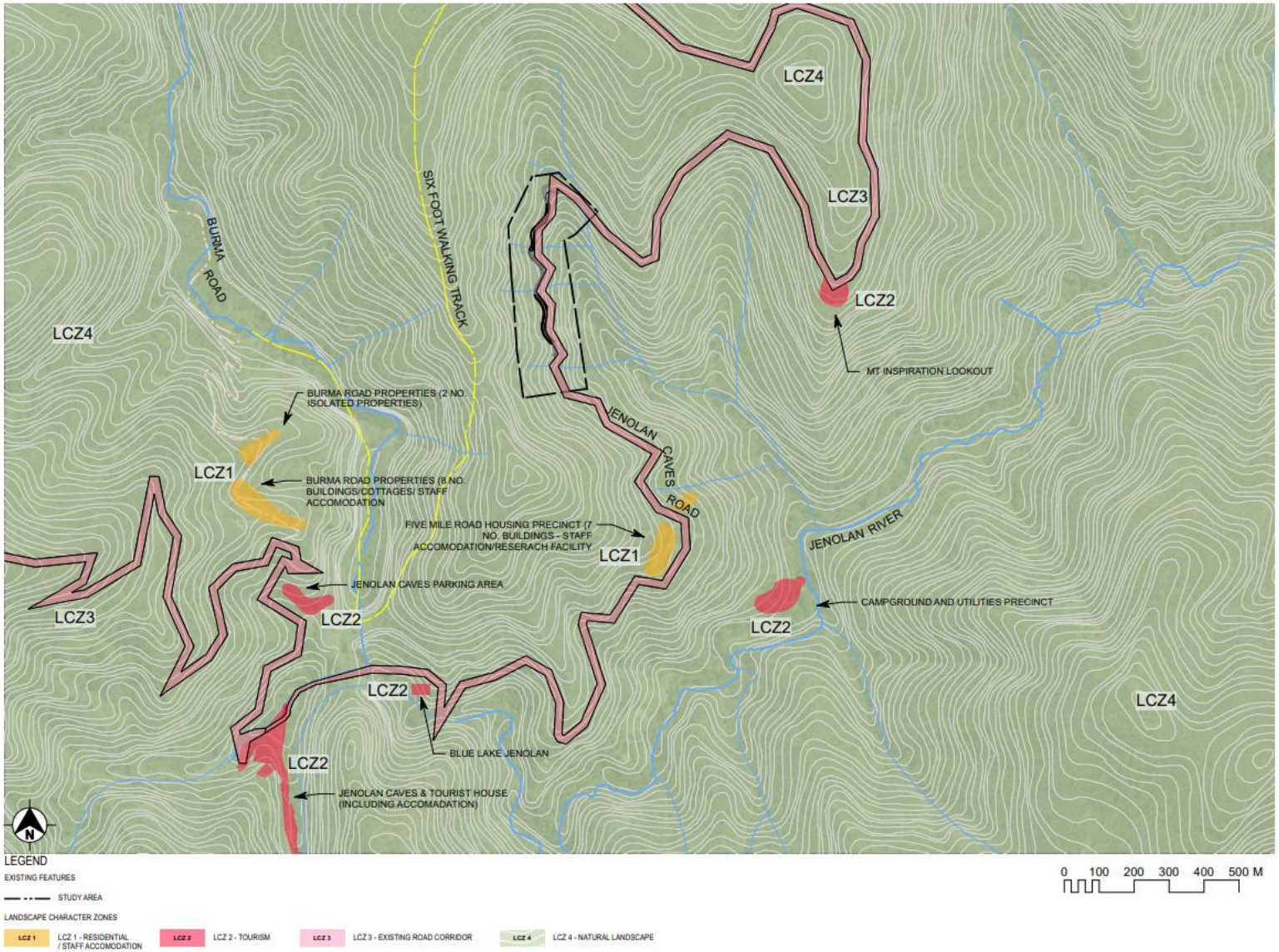


Figure 6-1 Landscape character zones

Table 6-2 Landscape character zones

LCZ	Description
LCZ 1: Residential/staff accommodation 	This zone includes isolated properties, comprising cottage buildings, outbuildings and a research facility, concentrated near the Five Mile and on Burma Road, Jenolan. The Five Mile section of road has some buildings from the early part of the 19th century such as a former Police Station, as well as a number of buildings from the 1950s. The Burma Road precinct has typically timber cottages dating from the 1940s and 1950s.
LCZ 2: Tourism 	This zone is characterised by several tourist destinations. The Jenolan Caves precinct is the main attraction, which includes the Grand Arch, the Jenolan Caves, Jenolan Caves House and associated parking facilities. The Blue Lake of Jenolan (which comprises a natural geological formation) is a less developed attraction near the caves. The Mount Inspiration Lookout is located about 700 metres east of the proposal area and is characterised by a hardstand area off Jenolan Caves Road. Some other tourist accommodation areas are located nearby, however none are in close proximity to the proposal area. These include the Jenolan Lodge, Oakley campground, an old campground at the base of the Jenolan River and the Jenolan Caves Cottages.
LCZ 3: Existing road corridor 	This zone comprises the narrow two-way road that winds through the hillside in the locality of the proposal area. The road is tightly bounded on the upslope side by the existing hillside, often comprising rock outcrops or naturally wooded slopes. The downslope side of the road is characterised by vegetation stands that partly obscure the view to the valley beyond, but mostly with open views out across the wooded valley and the expansive surrounding natural landscape.
LCZ 4: Natural landscape	This zone comprises natural wooded hillsides and valleys that are mostly undisturbed. The vegetation largely comprises of eucalyptus species of sclerophyll forest plant communities, some remnants of which can be found immediately next to the road corridor at the top of the downslope.

LCZ	Description
	

Visual receptors and viewpoints

Viewpoints selected to assess potential visual impacts include road user views from the existing road and views from drones near the failures on Jenolan Caves Road. Views from drones were used in this assessment as the proposal is generally in a remote area with few long-distance views of it from the road corridor. The locations and directions of selected viewpoints are representative of the range of locations both within and beyond the road corridor. The viewpoints include:

- Viewpoint 1 – existing view from Jenolan Caves Road at the main failure
- Viewpoint 2 – existing view from a drone at the main failure
- Viewpoint 3 – existing view from Jenolan Caves Road at the second failure
- Viewpoint 4 – existing view from a drone at the second failure.

The locations of the viewpoints are outlined in Figure 6-2 and each viewpoint is shown in Figure 6-3 to Figure 6-6.

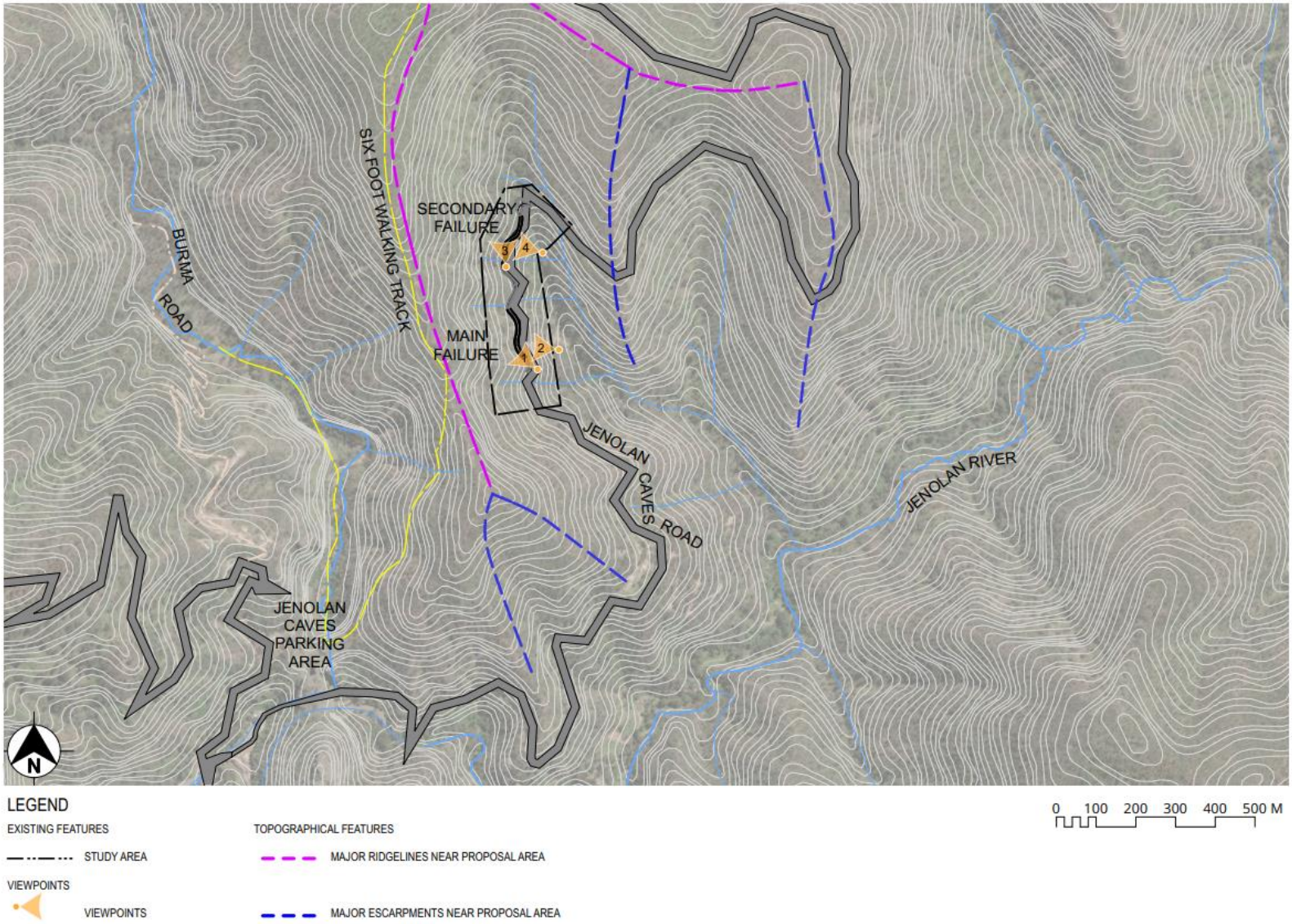


Figure 6-2 Viewpoints used for the visual impact assessment

Figure 6-3 Viewpoint 1 – existing view from Jenolan Caves Road at the main failure

Figure 6-4 Viewpoint 2 – existing view from a drone at the main failure

Figure 6-5 Viewpoint 3 - existing view from Jenolan Caves Road at the second failure

Figure 6-6 Viewpoint 4 - existing view from a drone at the second failure

6.1.3 Potential impacts

Construction

General construction activities would result in temporary visual impacts on nearby views. These include the movement and operation of machinery, light and heavy vehicles, and the use of construction ancillary facilities.

Given Jenolan Caves Road would be closed to the public between the Jenolan Caves Road / Bulls Camp Trail intersection and the Jenolan Caves, visual impacts associated with the proposal area would be negligible during construction. Users of Binoomea Ridge Trail and Bulls Camp Trail would experience visual impacts from ancillary facilities A and B, respectively. These impacts would be localised at the beginning of the trails, meaning impacts are anticipated to be minor. Ancillary facilities C and D would be located within the closed section of Jenolan Caves Road, so these would not cause visual impacts due to the lack of receivers during construction. Ancillary facility E would be located in a carpark in the Jenolan Caves precinct, meaning temporary and minor landscape character alterations would occur within the precinct.

Overall construction visual and landscape character impacts are anticipated to be minor and only concentrated at ancillary facilities A, B and E.

Operation

This section outlines the operational landscape character and visual impacts of the proposal.

Landscape character assessment

A summary of the landscape character assessment is included in Table 6-3.

Table 6-3 Landscape character assessment

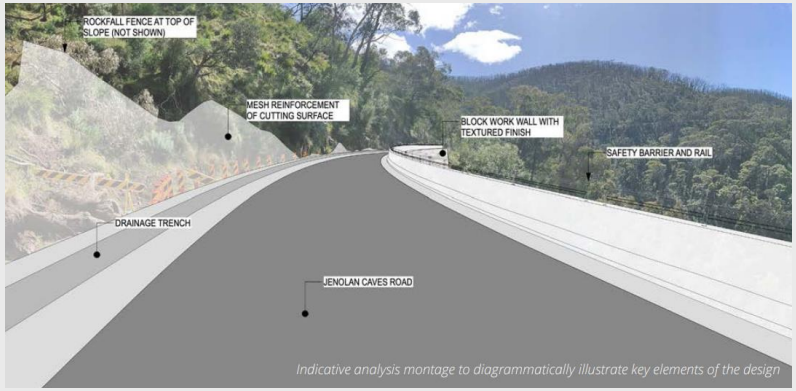
Character definition	Sensitivity	Magnitude	Overall impact rating
LCZ 1 – Residential / staff accommodation	**High** While the housing along the Five Mile section of road is directly accessed off Jenolan Caves Road, it is outside the proposal area. The properties are located either above or below the road. The sensitivity is considered high based on the remoteness of these small properties surrounded by natural landscapes.	**Negligible** The proposal would not have any direct impacts on this character zone. Only minor indirect impacts would be felt from the travel experience to access these properties.	**Negligible** The overall impact is considered negligible based on the remoteness and lack of direct impacts on this LCZ.
LCZ 2 – Tourism	**High** This zone is characterised by two distinct character areas, being the developed tourist attraction of Jenolan Caves and the undeveloped tourist attractions of the Blue Lake and Mount Inspiration lookout. The sensitivity of this area as a whole is regarded as high.	**Negligible** The proposal would not have any direct impacts on this LCZ. Only minor indirect impacts would be felt from the travel experience to access these tourist attractions, particularly the arrival experience to Mount Inspiration lookout.	**Negligible** The overall impact is considered negligible based on the remoteness and lack of direct impacts on this LCZ.
LCZ 3 – Existing road corridor	**Moderate** This zone includes the existing road and surrounding vegetation. This disturbed corridor surrounded by natural landscape leads to a	**Moderate** The proposal would result in localised cutting back of the existing upslope to reconstruct the road with mesh reinforcement and limited shotcrete installation (if required) to stabilise the	**Moderate** The overall impact is considered moderate based on the sensitivity and magnitudes of the localised impacts on the existing rural and

Character definition	Sensitivity	Magnitude	Overall impact rating
	moderate sensitivity to change.	upslope. The proposal would, however, also result in the installation of a permanent vertical wall to stabilise the failure of the downslopes that have currently experienced natural landslide vegetation removal. The installation of these vertical walls would have the greatest impact on the existing road character.	undisturbed character of the existing road corridor.
LCZ 4 – Natural vegetation	**High** There is no development in this LCZ, leading to a high sensitivity to change.	**Low** The impacts of the proposal are considered low given the relatively small proportion of the natural landscape being impacted.	**Moderate** The sensitivity to change of the natural landscape is considered high and the magnitude of the proposed changes is considered low based on the localised impacts, leading to an overall moderate impact.

Visual impact assessment

Four viewpoints were identified within or near the proposal. The impacts of the proposal on these viewpoints are outlined in Table 6-4.

Table 6-4 Visual impact assessment

Viewpoint	Visualisation	Sensitivity	Magnitude	Overall impact rating
1		**Moderate** The sensitivity of the view is considered moderate. The existing road currently constitutes part of the view, but the existing naturally vegetated upslope is also very prominent, together with the open views to the west.	**Moderate** The new reconstructed road combined with a new prominent road safety barrier would locally dominate the view at this location. The magnitude of the impact is considered moderate in comparison with the impact of the existing road on the current view.	**Moderate**
2		**High** The sensitivity of the view is considered high. The existing road currently only impacts slightly on the view since it traverses the hillside along existing contours and there is no current modification of the existing up and down slopes.	**High** The magnitude of the impact is considered high based on the visual impact of downslope modifications. This section of road is also highly visible at this location, based on the openness of the view (and lack of nearby existing vegetation).	**High**

Viewpoint	Visualisation	Sensitivity	Magnitude	Overall impact rating
3		**Moderate** The sensitivity of the view is considered moderate. The existing road currently constitutes part of the view, but the existing naturally vegetated upslope and downslope are also very prominent.	**High** The magnitude of the impact is considered high based on the visual impact of the downslope modifications. The tight curve of the road results in the RSW being highly visible at this location.	**Moderate-high**
4		**High** The sensitivity of the view is considered high. The existing road currently only impacts slightly on the view since it traverses the hillside along existing contours and there is no current modification of the existing upslope and downslope, apart from the current loose spill. The heavily wooded existing vegetation is the main compositional element to the view.	**High** The magnitude of the impact is considered high. While the visibility of this section of road is reduced by the existing vegetation, the removal of this vegetation to construct the new RSW and road safety barrier, combined with the vertical height and horizontal extent of the wall, would result in these elements of the proposal being highly visible.	**High**

National park

Construction of the proposal would result in visual impacts to the Jenolan Karst Conservation Reserve mainly at ancillary facilities. The presence of plant and equipment and temporary buildings at these facilities would alter viewpoints for passing vehicles and tourists within the reserve and the Jenolan Caves precinct. Visual impacts are anticipated to be minor given impacts would be localised and would not impact views or the landscape beyond the beginning of walking trails. Ancillary facility C would be located at the Mount Inspiration Lookout. This lookout is used by tourists to view the Jenolan Karst Conservation Reserve, however access to this facility would be restricted during construction given Jenolan Caves Road would be closed between the Jenolan Caves Road / Bulls Camp Trail intersection and Jenolan Caves due to the failures (as per the existing scenario). As such, views from this lookout would not be impacted by the ancillary facility. Ancillary facility E is located in a carpark in the Jenolan Caves precinct. The presence of construction vehicles and equipment at this location would impact the viewpoints within and landscape character of the precinct given tourists would be able to access the precinct via the Two Mile section of road.

In addition, take-off and landing of the helicopter (at ancillary facility B) would result in minor visual impacts to motorists and pedestrians using publicly accessible areas near the ancillary facility. When the helicopter is in use, it may also be visible from public walking trails within the Jenolan Karst Conservation Reserve. However, the helicopter is expected to only be used for a short duration of the overall construction program. These impacts would be minor and would not impact the overall viewpoints or landscape character of the reserve.

Other landscape character and visual impacts to the Jenolan Karst Conservation Reserve would occur at the two failures. As has been detailed in section 6.1.3, the overall landscape character impact to the reserve near the proposal area is anticipated to be moderate and impacts on views in the reserve within and near the failures would be moderate-high. The installation of the RSW and upslope modifications would locally alter the landscape character and views of the reserve, however these visual impacts would occur as a result of works necessary to reinstate access to the reserve and the Jenolan Caves precinct via the Five Mile. As such, the benefits of the proposal would outweigh any adverse visual impacts to the reserve.

Views of the proposal area are possible from the Mount Inspiration Lookout. During the operation of the proposal, tourists would be able to access this lookout and be able to view the reinstated sections of Jenolan Caves Road. The proposal would therefore impact these views within the reserve. However, these impacts would be localised at this location and would not affect views of the wider reserve from the lookout, meaning these impacts are anticipated to be negligible.

6.1.4 Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing
Landscape character and visual impact	An Urban Design Plan would continue to be developed throughout detailed design. Urban design would be integrated into proposal development processes to make sure the proposal aligns with the urban design objectives. The following policy/guidelines would guide future design development of the proposal: • Transport Urban Design Policy (Beyond the Pavement) • Transport Urban Design Guidelines • The urban design objectives, principles and concept design strategy presented in the urban design report for the proposal (refer to Appendix D).	Contractor	Detailed design

Impact	Environmental safeguards	Responsibility	Timing
Revegetation	Revegetation would be carried out in line with the landscaping principles, urban design concept outlined in the LCVIA and Transport's Biodiversity Guidelines. Revegetation strategies would include (but not be limited to): • Selecting plant species such as shrub species and native grasses that, once established, would help to reduce the visual bulk of the proposal • Tubestock planting works in soft soil pockets above the upslope modifications and rockfall barrier where vegetation has been removed • Tubestock planting works to the downslope in soft soil pockets and over-seeding prior to the construction of the RSW where existing vegetation has been removed • Making sure that any new planting adheres to proposed species lists compiled in the urban design strategy with reference to existing species on site • Selecting plant species in consultation with the Jenolan Caves Trust • Carrying out seed collection where possible to provide reproduction of existing endemic species for over-seeding or tubestock propagation • Revegetation should take place throughout the construction phase when access allows.	Contractor	Construction
Design elements	Material selection should include the colour and texture selections for the RSW. Darker colours would be more recessive to the bushland setting.	Contractor	Detailed design / construction
	Where isolated pockets of shotcrete are required to stabilise soft rock areas, this should be sensitively coloured and textured to replicate natural rock outcrops.	Contractor	Detailed design / construction
	Safety barriers would be selected to minimise visual impacts and maintain views through the barrier.	Contractor	Detailed design
	Use local materials and resources where possible.	Contractor	Construction
Drainage infrastructure	Stormwater discharge design would continue to be developed throughout detailed design to integrate the proposal with natural systems and reduce erosion.	Contractor	Detailed design / construction

6.2 Non-Aboriginal heritage

The potential impacts on non-Aboriginal heritage during construction and operation of the proposal have been assessed as part of the *Statement of Heritage Impact* (SOHI) (Artefact, 2023), provided in Appendix E.

6.2.1 Methodology

The methodology for the SOHI included:

- Background research, including a search of statutory and non-statutory registers, and a review of the available history of the proposal area to determine if any listed items may be impacted by the proposal
- A preliminary assessment of archaeological potential and the location of heritage items and heritage significant fabric within and near the proposal area
- A site inspection, which was carried out on 14 November 2022 and 15 November 2022 to visually inspect the proposal area and all heritage items
- Assessment of heritage impacts of the proposal to evaluate and explain how the proposal would affect the heritage value of the proposal area and its surrounds
- Conclusions and recommendations being made to mitigate the potential impact of the proposal on listed heritage items.

6.2.2 Existing environment

Jenolan Karst Conservation Reserve is one of the most important areas of natural history in Australia. The area includes one of the largest interconnected cave systems in Australia and is an outstanding site of geological interest. While the primary significance of the landscape lies in the karst system and its flora and fauna, the cultural landscape of walking tracks, access roads, buildings and archives contribute to its significance. Jenolan Caves House is a dominant building in this landscape, which, due to the steep terrain and topography, is highly visible from multiple vantage points.

The Jenolan Karst Conservation Reserve is located within the World Heritage and National Heritage Listed 'Greater Blue Mountains Area'. It is also listed on the State Heritage Register, as well as being locally heritage listed.

The Jenolan Caves Reserve has heritage significance at the State and Local level for its historic, associative, aesthetic, and social values, as well as for its rarity. It is of National and World heritage significance for its rarity, research (scientific) and events values, and its ability to show principal characteristics of a class of places.

The heritage listings associated with and near the proposal area are included in Table 6-5.

Table 6-5 Summary of heritage listings associated with and in close proximity to the proposal

Register	Area/item
Statutory	
UNESCO World Heritage List	• Greater Blue Mountains Area (WHL #106242)
National Heritage List	• Jenolan Caves (NHL #106242 – nominated only) • The Greater Blue Mountains Area (NHL #105999) • The Greater Blue Mountains Area – Additional Values and Areas (NHL #105696)
State Heritage Register	• Jenolan Caves Reserve (SHR #01698) • Blue Mountains Walking tracks (SHR #00980)

Register	Area/item
Section 170 Registers (National Parks and Wildlife Service)	• Jenolan Caves Reserve (SHI #3902263)
Oberon LEP 2013	• Jenolan Caves (LEP #I1) • Jenolan Caves House (LEP #I11) • Limestone Bridge (near Grand Arch) (LEP #I12) • The Six Foot Track (LEP #I18)
Non-statutory	
Register of the National Estate (RNE)	• Jenolan Caves and Reserve (RNE #890) • The Greater Blue Mountains Area (RNE #14147 Indicative Place)
National Trust of Australia (NT) NSW Register	• Jenolan Caves Conservation Area (NT #3164)

Individual elements of the proposal area have been assessed for heritage significance. The grading of significance for each element of the proposal area is included in Table 6-6. 'High' significance is assigned to elements which are assessed as making a considerable contribution to the overall significance of the place and as exhibiting a considerable degree of intactness. 'Little' significance is assigned to elements which are assessed as making a minor contribution to the overall significance of the place, particularly compared with other elements. These elements may exhibit extensive alterations or degradations which impact their significance.

Table 6-6 Grading of significance for individual elements of the proposal area

Component	Assessment	Grading
Overall	The Five Mile is part of Jenolan Caves Road, an original road formed from the steep rock face leading down from Hartley to Jenolan Caves. The road was declared Main Road no. 253 on 8 August 1928 under the Main Roads Act of 1924 as a road which was partially or completely funded by the State Government through the Main Roads Board (now Transport). The road is the main vehicular and tourist access to Jenolan Caves.	High
Rock cutting	The rock cutting is part of the original formation of Jenolan Caves Road through the steep decline into the Jenolan Caves site.	High
Mortar bedded rubble wall	The mortar bedded rubble wall is part of the original formation of Jenolan Caves Road. Remnants of the retaining wall remain and are in good condition.	High
Rock embankment wall	The rock embankment wall is part of the original formation of Jenolan Caves Road. Remnants of the embankment wall remain, however due to recent and previous land slips the embankment wall is in poor condition and unlikely to be salvageable.	High
Road surface	The road, while part of the original formation of Jenolan Caves Road, has a contemporary bitumen surface. The surface is in good condition where it has not been impacted by the failure.	Little
Culverts	The existing culverts are contemporary drainage utilities that are not original.	Little
Guard rails	The guard rails are a contemporary safety measure and are not original. Where they have not been impacted by the failure they remain in good condition.	Little

Archaeological assessment

'Archaeological potential' refers to the likelihood that an area contains physical remains associated with an earlier phase of occupation, activity or development of that area. The Conservation Management Plan (CMP) for the Jenolan Karst Conservation Reserve (2009) provides a summary of historical archaeological resources within the reserve. None of these known or potential archaeological remains are associated with the Five Mile or its construction and operation.

Based on the review of the information obtained from historical sources, previous archaeological works in the surrounding area and the current condition of the site, it can be concluded that the proposal area and ancillary facilities have nil to low archaeological potential.

It is unlikely that there would be archaeological remains associated with 19th and early 20th century road construction beyond extant retaining walls. It is also unlikely that former road surfaces would be present below the extant asphalt surface, given the considerable damage caused by severe weather events within the proposal area. Areas immediately next to the road which have remained undeveloped have nil potential to contain archaeological resources, including structural remains or relics. The ancillary facilities also present nil potential for archaeological resources, having remained undeveloped and also having been subject to erosion and damage from weather events.

As there is nil to low potential for archaeological remains, no formal archaeological significance assessment has been prepared. Should any unexpected finds be encountered during works, a full archaeological significance assessment should be prepared to inform their management.

6.2.3 Potential impacts

Construction

Potential non-Aboriginal heritage impacts of the proposal during the construction phase are outlined in Table 6-7.

Table 6-7 Non-Aboriginal heritage construction impacts

Construction element	Potential impacts
Downslope/road stabilisation works	Stabilisation works to the road foundations would involve the excavation of access ramps and the installation of a reinforced soil wall. These works would disturb and ultimately replace the existing fabric of the downslope, including a remnant stone embankment wall present at points along the downslope. This stone embankment wall, which is a remnant of an earlier phase of the road, is in poor condition and has been highly compromised by past weather events. The wall is not visible to the public and does not contribute materially to the overall significance of the Jenolan Karst Conservation Reserve. The removal of this wall is necessary for the reinstatement of the road's foundations. The benefits of the stabilisation of the road and improved road resilience as a result of the proposal would outweigh the low significance of the remnant stone embankment wall. Access ramp excavations would result in minor adverse impacts to localised areas of the Jenolan Karst Conservation Reserve. The proposed access ramps would require localised removal of downslope vegetation to facilitate the construction of the RSW. Overall, the proposed stabilisation works to the road's foundation and the downslope would result in a negligible physical impact to the significance of Jenolan Caves Road and a minor adverse physical impact to the surrounding Jenolan Karst Conservation Reserve.
Upslope works	Stabilisation of the upslope would involve excavation to widen the carriageway at the failures as well as upslope treatment, including pattern bolting and the installation of a rockfall barrier prior to road widening to allow safe access for workers. These upslope works are not anticipated to impact the overall significance of the Jenolan Karst Conservation Reserve. Rather, the works would allow for the safe and timely reopening of access to the World Heritage Listed site.
Drainage infrastructure	As is detailed in section 3.2.3, the proposal would involve the installation of 7 new culverts beneath the reinstated road and the upgrade of one existing culvert, along with grated table drains running alongside the road on the upslope side. The installation of drainage infrastructure has been assessed as having a negligible impact to the heritage significance of the road and a minor adverse impact to the

Construction element	Potential impacts
	surrounding reserve. The culverts are necessary to restore the safety and functionality of Jenolan Caves Road. The installation of the culverts would enable the reopening of the Jenolan Karst Conservation Reserve via the Five Mile and would prolong the lifespan of the road, reducing the likelihood of future remediation works following severe weather events. Minor adverse potential impacts to the heritage listed Jenolan Karst Conservation Reserve may result from stormwater drainage being directed to the base of the slope. Although design features have been implemented to prevent this potential impact (as outlined in Table 3-6), high volumes of water runoff during extreme weather events may result in localised damage to trees, shrubs, and wildlife in the vicinity of the culvert outlets. The culvert outlets and scour treatments have been designed to minimise impacts to the surrounding flora and fauna. Potential impacts would be localised and minor when compared to both the overall curtilage of the Jenolan Karst Conservation Reserve and the benefits of the improved drainage to the public accessibility of the heritage item.
Ancillary facilities	As outlined in section 0, the proposal would utilise five ancillary facilities. Physical works within these ancillary facilities would be limited, with only ancillary facility D requiring the provision of a new concrete hardstand. No vegetation would be cleared at ancillary facilities. At the ancillary facilities where helicopter winching or landing is required (ancillary facilities B and C), limited excavation of around 1 metre squared for the installation of footings for a pole and windsock would be required. Outside of ancillary facility establishment, potential adverse impacts may result from activities carried out the ancillary facilities. The proximity of ancillary facility E to Jenolan Caves House and the Grand Arch places these sites at risk of accidental damage by contractors or increased vehicular traffic. In addition, ancillary facility E has the potential to result in visual impacts to Jenolan Caves House during the construction phase as a result of the presence of vehicular traffic and construction materials. However, it should be noted that ancillary facility E would be located in an existing carpark near Jenolan Caves House which is already subject to vehicular traffic, meaning visual impacts would be minor adverse. It should also be noted that low-flying helicopters attempting to land or hover at ancillary facilities B and C have the potential to damage tree canopies and foliage as a result of wind and/or impact from helicopter blades, although these impacts are anticipated to be minimal (as is outlined in section 0). Activities related to the ancillary facilities may result in minor adverse potential impacts to the significance of the Jenolan Karst Conservation Reserve (particularly the Jenolan Caves House, Grand Arch, and areas of vegetation near ancillary facilities B and C).

Archaeological impacts

The proposal area retains nil to low potential for archaeological remains. Given the ground disturbance associated with the road failure, it is unlikely that archaeological resources would remain in situ in the areas in need of repair. Ancillary facilities have remained undeveloped and would be unlikely to contain archaeological resources. As such, the proposal would have a negligible effect on potential archaeological resources.

Operation

The proposed stabilisation works to the downslope would involve the installation of a RSW with a magnum stone block wall finish. The magnum stone block wall would be consistent with the historic stone embankment wall's original form and colour, where possible. The proposed downslope works would have a negligible operational impact on the significance of Jenolan Caves Road and the surrounding reserve.

Operational impacts as a result of upslope works would be minimal. The upslope excavations and rockfall barrier would have a minor adverse operational impact on the heritage values of Jenolan Caves Road and a negligible operational impact on the heritage significance of the Jenolan Karst Conservation Reserve.

While the seven proposed culverts and upgraded existing culvert are expected to have low-nil visibility from the roadside, the culverts would be visible from the Mount Inspiration Lookout. Culverts are a common and unimposing piece of road infrastructure that would not substantially change the overall character of the area and would not be visually disturbing when viewed from the Mount Inspiration Lookout. The culverts would result in a negligible to minor adverse operational impact on views from the Mount Inspiration Lookout. While

the erosion and scour protection may be visible from the roadway, these areas are not expected to be visually intrusive. The culverts and associated erosion and scour protection would result in a negligible to minor adverse operational impact to Jenolan Caves Road and the significance of the Jenolan Karst Conservation Reserve.

National park

The heritage significance of the Jenolan Karst Conservation Reserve is outlined in section 3.4 of the Jenolan Karst Conservation Reserve Plan of Management, which notes the historic, associative, aesthetic, social, research and rarity values of the reserve which contribute to its state heritage listing.

Due to the nature and scope of the works being localised at the failures on Five Mile, the proposal would largely have a negligible impact on the heritage significance of the Jenolan Karst Conservation Reserve. This negligible impact would align with the management principles for karst conservation reserves outlined in section 30I(2) of the NPW Act, which includes the promotion of public appreciation and understanding of the reserve's natural and cultural values, as well as the provision for sustainable use of modified natural areas having regard to the conservation of the karst conservation reserve's natural and cultural values (refer to Section 4.2.2).

The heritage assessment outlined in the previous sections included potential impacts to the surrounding world heritage listed National Park.

6.2.4 Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing
Non-Aboriginal heritage	A Non-Aboriginal Heritage Management Plan (NAHMP) would be prepared and implemented as part of the CEMP. It would provide specific guidance on measures and controls to be implemented to avoid and mitigate impacts to non-Aboriginal heritage. The NAHMP would be prepared in consultation with the Department of Planning and Environment.	Contractor	Detailed design / pre-construction
	The *EMF-HE-PR-0076 Unexpected Heritage Items Procedure* (Transport, 2022c) would be followed in the event that any unexpected heritage items, archaeological remains or potential relics of non-Aboriginal origin are encountered. Work would only re-commence once the requirements of that procedure have been satisfied.	Contractor	Detailed design / pre-construction
	All contractors involved in the proposal, including design professionals, helicopter operators and tradespeople, should receive a site-specific heritage induction prior to the commencement of works outlining the significance of the area, the locations of any heritage items, and the unexpected finds procedure.	Contractor	Pre-construction
	A Photographic Archival Record (PAR) of the Jenolan Caves Road failures and the stone embankment wall would be carried out prior to works commencing. This recording must be in line with the NSW Heritage Division publication *Photographic Recording of Heritage Items using Film or Digital Capture* (2006). A digital copy of the archival record should be provided to Heritage NSW.	Contractor	Pre-construction

Impact	Environmental safeguards	Responsibility	Timing
Impacts to heritage curtilage	A section 60 application would be prepared for impacts of the proposal on the heritage curtilage of the Jenolan Caves Reserve.	Transport	Detailed design
Heritage impacts at ancillary facilities	The establishment of ancillary facilities, particularly at ancillary facility E, has the potential to result in incidental contractor damage to heritage fabric. Mitigation measures for the protection of heritage items, including Jenolan Caves House and the wider reserve, will be covered in the heritage induction.	Contractor	Pre-construction / construction
Heritage impacts to the surrounding environment	To reduce construction impacts to other areas of Jenolan Caves Road, other embankments and other areas of the Jenolan Karst Conservation Reserve, regular monitoring of vibration levels during construction for the existing roadway, rock cutting and stone embankment wall should be implemented.	Contractor	Pre-construction / construction

6.3 Water and soils

The potential impacts on water quality and soils during construction and operation of the proposal have been assessed as part of the *Jenolan Caves Road: Five Mile Failure Preliminary Erosion and Sedimentation Assessment* (SEEC, 2023a) (provided in Appendix F) and the *Jenolan Caves Road: Five Mile Failure Water Quality Assessment* (SEEC, 2023b) (provided in Appendix G).

6.3.1 Methodology

The assessment for impacts to water quality as a result of the proposal included:

- A review of the existing proposal area conditions, such as topography, soils and salinity
- A review of the existing soil and water environment, including catchments, drainage, flooding potential and groundwater conditions
- An assessment of the potential impacts to the receiving water environment as a result of the construction and operation of the proposal
- A neutral or beneficial effect (NorBE) assessment (refer to Appendix C), as required in part 6.5 of State Environmental Planning Policy (Biodiversity and Conservation) 2021 for developments within the Sydney Drinking Water Catchment.

The methodology for the soil impact assessment included:

- Background research including a desktop review of the existing environment in relation to soil, geology, contamination, erosion risk
- A review of previous assessments including the geotechnical interpretive report and geotechnical design statement report
- An assessment of potential impacts on soils within the proposal area and in the surrounding Jenolan Karst Conservation Reserve
- Recommendation of additional management measures to mitigate potential impacts.

In addition, a number of reports were produced to support the assessment of the potential water quality and soil impacts of the proposal. This included a Preliminary Erosion and Sedimentation Assessment (PESA), which was required to determine if the proposal area poses a high risk for erosion and sedimentation control. The PESA involved a sub-catchment sediment basin assessment to determine whether the installation of sediment basins would be feasible in the proposal area. Given the topographic and space constraints associated with the proposal area, alternate erosion and sediment control measures were deemed necessary. The PESA then included an erosion and sedimentation assessment, which determined that the location of the proposal within the Jenolan Karst Conservation Reserve and the Sydney Drinking Water Catchment, as well as the steep topography of the proposal area, meant that the proposal is high risk and would require an Erosion and Sedimentation Management Report (ESMR).

The ESMR is being developed, which has involved:

- Background research including a desktop review
- A site inspection conducted on 18 November 2022 to confirm soil and topographical conditions and how they might influence erosion and sediment control during construction
- An assessment of various erosion and sediment controls to determine their feasibility for the proposal area
- The development of erosion and sediment control plans based on the recommendations.

6.3.2 Existing environment

Topography and geology

The proposal area runs for around 500 metres along Jenolan Caves Road. Topography is very steep, and the road sits on a midslope position, carved into an east-facing hillside. Slope gradients are around 40 to 100 per cent, with occasional rock outcropping forming broken escarpments that are close to vertical. Topography presents a significant constraint for the design and construction of the proposal.

Topography is not expected to be a significant constraint for the ancillary facilities.

Due to the two failures, there are large volumes of exposed sediment that may be displaced into receiving waters due to the unstable, highly eroded, steep lands during rainfall events.

For the main failure, the upslope is cut into the hillside on the corner where the failure has occurred. In the centre of the gully where the failure has occurred, there is no outcrop on the upslope. For the secondary failure, similarly to the main failure, the upslope is cut into the hillside on the corner where the failure has occurred. The valley containing the second failure, however, is slightly steeper than that of the main failure.

The geological setting of both sites is similar and underlain by predominantly interbedded siltstone / sandstone and massive quartzo-feldspathic sandstone strata of the Upper Silurian to Lower Devonian period from around 420 to 380 million years ago. Geological structural features located in the vicinity of the proposal area include:

- The Jenolan Thrust Fault, located around 450 metres to the east of the main failure
- Two dyke intrusions located to the west of the proposal area with enclosing cleaved mudstone
- Faults/inferred faults at around 650 metres to 1 kilometre to the south of the failures.

Both failure sites are underlain by fill and colluvium and are interbedded of slightly metamorphosed siltstone/claystone and coarse ash tuff.

The fill stratum mainly comprises of the road base including asphalt and compacted soil of silty sandy gravel. Large rock fragments are also noted below the road base and appeared mixed with the colluvium which is probably in relation to the road formation when it was first constructed. The thickness of fill in the main failure is about 0.4 metres to 1.6 metres thick. At the second failure, two different layers of fill appear to have been placed on the road and it appears to be around two metres thick.

The colluvium stratum mainly comprises of silty sandy gravel and possibly cobbles and is about 0.2 metres to 1.6 metres thick at the main failure, and is about 1.5 metres to 2 metres thick at the second failure.

The bedrock for the two failures is expected to be similar. The main failure is underlain by interbedded slightly metamorphosed coarse ash tuff and claystone/siltstone, while the second failure was observed to be mainly metamorphosed claystone/siltstone from observation on site. However, metamorphosed tuff may still be encountered at lower depths.

Surface water

The proposal lies in the Mid Coxs River sub-catchment of the Sydney Drinking Water Catchment, which forms part of the Hawkesbury-Nepean River system. The proposal traverses several first order feeder streams of an unnamed tributary of Jenolan River.

Ancillary facilities A, B and C (refer to Figure 3-8) are all distant from waterways. However, ancillary facilities D and E are in close proximity to waterways, which flow through culverts underneath each ancillary facility. The existing culverts at these ancillary facilities are designed to capture run-off which flowed into nearby creeks and tributaries. However, the culvert at ancillary facility D is blocked and not functioning as designed.

On the inside of road bends against the hillside, existing roadside drainage through the proposal area includes informal table drains that flow over natural rock.

An EPL would not be required for this proposal, meaning the requirements for water quality and quantity in any discharges would default to typical Transport and Blue Book (Landcom, 2004) recommendations to comply with Section 120 of the POEO Act.

Water Quality Objectives for the Hawkesbury-Nepean River are determined by the nature of the local land use and the prevailing waterway conditions. All waterways near the proposal are within the Jenolan Karst

Conservation Reserve and are unaffected by urban development. Water quality objectives for the proposal would include, but not be limited to:

- A limit of 25 NTU is recommended for any active discharges, as that is the typical upper limit for aquatic ecosystem protection in upland rivers and streams
- pH 6.5 to 8
- No visible oils, greases or litter.

Sediment basins are unlikely to be feasible given the topography and space limitations of the proposal area. Dewatering might be required into nearby drainage lines if water accumulates in disturbed areas during construction.

Flooding

The proposal area is not prone to flooding due to the steep terrain. There are no major drainage lines which are likely to be flooded during extreme rainfall events located near the proposal.

Groundwater

Groundwater was not encountered up to a depth of 25.45 metres during site investigations. A perched groundwater table is expected on rock surface or clayey strata after prolonged heavy rains.

Soil

The proposal area and all ancillary facilities fall under the classification of the Kanangra Gorge Soil Landscape (eSpade, 2023). Table 6-8 contains a summary of key features of the Kanangra Gorge Soil Landscape.

Table 6-8 Kanangra Gorge Soil Landscape summary

Parameter	Kanangra Gorge Soil Landscape
Soil landscape description	Steep to very steep rugged hills on mixed metasedimentary geology. Slopes exceed 30 per cent. Soils are shallow, stony loams and lithosols on steep hillsides, with deeper, duplex soils in valleys due to the accumulation of colluvial materials.
Key landscape constraints	Key landscape constraints include: • Shallow, infertile soils • Steep slopes, mass movement (landslides) and rockfall hazard • Extreme erosion hazard • Foundation stability hazard • Highly acidic topsoils with aluminium toxicity potential.

The soil stratum is comprised of thin layers of fill and colluvium (less than two metres thick) at the main failure. The soil stratum is anticipated to be thicker at the second failure, however the founding materials for all stabilisation measures would be in rock.

Contamination

A search of the EPA contaminated sites land record and notifications on 24 March 2023 for the suburb of Jenolan indicated no contaminated land notifications have been received by the EPA within or near the proposal area, including at ancillary facilities.

6.3.3 Potential impacts

Construction

Table 6-9 summarises the potential surface water and groundwater impacts of the proposal during construction.

Table 6-9 Potential surface water and groundwater impacts during construction

Potential construction impact	Causes
Potential for soil or water contamination from leaks or spills and sediment-laden runoff	Soil and water contamination through spills or leaks and sediment-laden runoff has the potential to occur through the following construction activities: • Storage and use of potential contaminants or hazardous substances • Clearing and stripping of vegetation and topsoil • Upslope and downslope earthworks • Drainage works • Stockpiling of hazardous spoil and other materials at ancillary facilities • Potential cross-contamination of stockpiles • Use of plant and equipment • Use of portable toilets and temporary site facilities • Construction of stormwater systems • Concreting and asphalt activities. These activities have the potential to impact the drinking water catchment and the Jenolan Karst Conservation Reserve. The slope of the proposal area and its proximity to receiving waterways, including tributaries of the Jenolan River, mean that materials, sediment and chemicals used in the construction process pose a risk to the receiving environment through the above construction processes. The NorBE assessment carried out for the proposal identified that a neutral effect on water quality would occur during construction following implementation of the safeguards identified in Section 6.3.4 prior to and during construction. This would include development and implementation of a soil and water management plan (SWMP) which would include requirements for erosion and sediment controls to be implemented and maintained throughout the construction phase. Additionally, a more specific Erosion and Sedimentation Management Report (ESMR) and Erosion and Sedimentation Control Plans (ESCP) would be implemented during the construction phase to minimise these impacts. Erosion and sedimentation controls that may be implemented include: • Clean water diversions • Check dams along drainage lines • Temporary pipe diversions for disturbed drainage lines • Silt fences or coir logs.
Potential groundwater impacts from excavations	Groundwater impacts have the potential to result from excavations of the upslope and downslope areas. Excavation work required during the construction phase of the proposal (including the temporary access ramps) would be relatively shallow in depth and is not likely to intersect regional groundwater. As such, minimal impacts to groundwater quality or groundwater resources are anticipated as a result of the proposal.
Potential for polluted water to be accidentally discharged offsite or for inadequate treatment of water prior to being discharged	Discharges from the construction phase have the potential to cause turbidity and other impacts in the receiving waterways if polluted or sediment-laden water is discharged. Receiving waterways have been identified as drinking water catchments and sensitive receiving environments. Mitigation of these impacts would include measures such as minimising offsite discharges, testing water before discharging to ensure compliance with relevant criteria, and using multiple discharge points, rather than a single discharge point, to avoid concentrated erosion impacts.

	The requirements for water quality and quantity in any discharges would default to typical Transport and Blue Book (Landcom, 2004) recommendations. Discharge criteria would include: • A limit of 25 NTU is recommended for any active discharges, as that is the typical upper limit for aquatic ecosystem protection in upland rivers and streams. • pH 6.5 to 8 • No visible oils, greases or litter.
	The use of plant and equipment and the loading and transportation of construction materials has the potential to lead to road safety issues through the tracking of sediments onto public roads, including Jenolan Caves Road outside the proposal area. Dust may also be displaced from helicopter rotor downwash onto surrounding publicly accessible roads at ancillary facility B. Construction personnel would be trained in erosion and sediment control measures prior to construction commencing and measures to manage the tracking of materials would be included in the proposal CEMP.
	Impacts to waterways from waste could occur through littering by construction personnel, through waste material blowing, washing or falling offsite, through concreting activities, or through the use of portable toilets. The use of designated bins and the transportation of wastes by a contractor to a licensed facility for disposal would avoid these impacts.
	The loading and transportation of materials for the proposal's construction and excavation works on the upslope and downslope areas have the potential to lead to dust impacts, which could impact the receiving soil and water environments surrounding the proposal. Measures to minimise dust impacts, such as the covering of transport loads would be included in the proposal CEMP.
	Sediment basins are unlikely to be feasible given the topography and space limitations of the proposal area. Dewatering may be required into nearby drainage lines if water accumulates in disturbed areas during construction. Dewatering presents a risk of environmental harm if not carried out in a competent manner, so safeguards such as the diversion of clean water around disturbed areas would be implemented during construction to minimise the need for dewatering.

Construction of the proposal would require excavation and the removal of vegetation which has the potential to expose large areas of soil. Excavations would be required on the downslope of each failure where access ramps would need to be constructed for construction vehicle access to the base of each failure. This would require vegetation removal, which would be minimised as much as possible. Excavations would also be required on the upslope to accommodate the drainage design.

The largest construction impacts to soil would result from excavations which are required for the construction of access ramps to the base of the failures. Access constraints at the failures would require these ramps to be excavated, meaning the extent of disturbed soil would extend beyond the existing failures. If not adequately managed, disturbed soil from both the existing failures and subsequent excavations could have the following impacts:

- Dust generation during excavation
- Erosion of exposed soil and any stockpiled material
- An increase in sediment loads entering the stormwater system and/or local runoff, and therefore nearby receiving waterways including tributaries of Jenolan River.

Dust may also be generated from helicopter rotor downwash when operational and close to the ground. The helicopter would be used intermittently during construction and in accordance with the proposal's Helicopter Management Plan to minimise these impacts.

Soil contamination could occur as a result of any accidental spills or leaks of fuels, oils and other chemicals from equipment and vehicles throughout the construction phase, particularly during access ramp excavations. There is also the potential for unexpected finds of contaminated soils. These impacts are likely to be minor as exposure of soil would be temporary and in the short term.

The safeguards and management measures provided in section 6.3.4 would be implemented to manage the potential for erosion and sedimentation impacts and potential soils contamination during construction.

Operation

The operational phase of the proposal would not alter the potential pollutant profile from the conditions that existing prior to the landslides. Table 6-10 presents a summary of potential pollutant impacts during the operational phase of the proposal.

Table 6-10 Assessment of potential surface water and groundwater impacts during operation

Potential operational impact	Causes
Potential for soil or water contamination from leaks or spills and sediment-laden runoff	Potential pollutants from the operation of the proposal could include heavy metals, hydrocarbons, oils and grease, and other contaminants and gross pollutants. The proposal would return traffic and motor vehicle volume on the Jenolan Caves Road Five Mile to pre-failure conditions, which could increase the risk of motor vehicle accidents/collisions that may leak petrol into drainage lines and receiving waterways compared to the current scenario (where this section of road is closed). This could potentially lead to contamination of exposed soils or mobilisation of contaminated soils and liquids into local watercourses which could result in water quality impacts. Appropriate road signs and safety furniture would be included as part of the reinstatement of Jenolan Caves Road which would contribute to minimising the risk of vehicle accidents. By providing greater culvert capacity (through additional culverts and upgrading the existing northern culvert), the proposal would substantially reduce the volumes of sediment discharged into the drinking water catchment (subject to ongoing maintenance). As such, the NorBE assessment carried out for the proposal identified that a beneficial effect on water quality would occur during operation.
Potential for rubbish to be ejected from vehicles into the receiving environment	There is the potential for increased risk of rubbish entering waterways after being ejected from passing vehicles. Regular cleaning and maintenance of drainage infrastructure would minimise the chances of rubbish entering waterways via culverts.
Impacts to pavements due to large storm events and potential pollution to the receiving environment from poor maintenance practices	The operation and maintenance of road assets and pavements has the potential to impact the receiving water environment, particularly after large storm events, due to pollution from damaged road pavements, runoff from landscaping activities, and the use of patching equipment, chemicals and hydrocarbons during maintenance activities. The improved resilience of the road infrastructure as a result of the proposal would minimise operational and maintenance impacts to the receiving environment.
Operational drainage impacts	During operation of the proposal, there is potential for drainage infrastructure to become blocked with leaf litter, sediment and minor slips and for large storm events to damage road pavements and drains. The upgrade to the northern culvert at ancillary facility D would improve drainage compared to the existing scenario (as it is currently blocked) and minimise potential for future blockages by increasing its diameter. Regular maintenance of all drainage infrastructure and the road surface would minimise risks of further road failure and risks to water quality of nearby waterways.

The potential negative impacts of the operation of the proposal have not altered from pre-development conditions. However, the proposal includes slope stabilisation and improvements to drainage which would:

- Improve road resilience and reduce the risk of damage during extreme weather events
- Reduce the risk of potential pollution in the receiving environment from damage caused by extreme weather events
- Reduce the amount of erosion currently being experienced within the proposal area.

Operation of the proposal is not likely to result in any substantial impacts on soil, topography or geology. The risk of soil erosion in the proposal area during operation would be minimal as all areas impacted during construction would be either contained behind the new RSW or rehabilitated and revegetated to prevent soil erosion from occurring. This includes exposed soil within the proposal area as a result of the two failures and excavated areas resulting from the excavation of access ramps.

In addition, scour protection would be installed at the outlet of each culvert to prevent erosion and scour which can lead to instability and failure of the surrounding rock or soil structure. Due to the steep terrain of the downslope area, the culvert outlets have been designed in a way that spreads water flows as much as possible on the downslope prior to returning the flows to natural surface.

National park

The construction activities discussed in the previous sections have the potential to impact the Jenolan Karst Conservation Reserve, although the implementation of mitigation measures (refer to section 6.3.4) would minimise these impacts.

Excavations on the upslope and downslope pose a risk to the Jenolan Karst Conservation Reserve through potential increases in erosion and sediment-laden runoff which could impact waterways throughout the reserve. The implementation of mitigation measures, such as temporary ground covers, would minimise water quality risks due to exposed soils throughout the construction phase of the proposal.

The installation of drainage infrastructure would minimise risks of future road failures at the Five Mile. Additionally, erosion and scour protection installed at the culvert outlets on the downslope would reduce velocity of the runoff before it reaches natural ground surface. This would minimise water quality impacts to downstream waterways by reducing erosion and sediment movement.

Given the proposal would involve reinstating an existing road that runs through the Jenolan Karst Conservation Reserve, it is not anticipated to have a major adverse effect on the existing soil profile of the reserve. The construction of the proposal would involve excavations to install temporary access ramps on the downslope as well as excavations on the upslope, which would impact the soil landscape of the Jenolan Karst Conservation Reserve. The operation of the proposal would improve soil conditions and stability, including through the installation of soil nails and the RSW. This would improve soil conditions in the Jenolan Karst Conservation Reserve and would minimise future risks to soils during extreme weather events.

The proposal would also minimise erosion and scour of soil at culvert outlets, including at the northern culvert outside the road reserve, through installation of scour protection. This would reduce the potential for instability or future failures arising from erosion and scour at the outlets.

Spills and leaks from vehicles during the operation phase are not anticipated to be more frequent than pre-failure conditions. The operation of the proposal is anticipated to improve road resilience and reduce water pollution and erosion risks, which would reduce potential risks to the reserve. These benefits are anticipated to outweigh any potential impacts from damaged road infrastructure or maintenance activities. The reduction in water quality impacts as a result of the proposal would align with the management principles for karst conservation reserves outlined in section 30I(2) of the NPW Act, which includes the protection of natural water movement and processes within the karst environment.

The improved soil stability and reduced potential for erosion and scour as a result of the proposal aligns with the management principles for karst conservation reserves outlined in Section 30I(2) of the NPW Act, which include to protect the geological and geomorphological features of natural landscapes catchment values, such as hydrological processes and water quality. The reinstatement of soil conditions at the proposal site also aligns with the NPWS policy on landslides and rockfalls in that it would contribute to the NPWS duty of care to minimise the risk of landslides and rockfalls to people in parks.

6.3.4 Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing
Soil and water	A SWMP would be prepared and implemented as part of the CEMP. The SWMP would identify all reasonably foreseeable risks relating to soil erosion and water pollution and describe how these risks would be addressed during construction. The plan would address issues relating to (but not limited to): • Clearing and boundaries • Chemical and fuel storage and use • Spills and incident management • Waste management, including using designated bins and transporting waste to a licenced facility for disposal • Soil and water management • Erosion and sediment control through progressive ESCPs in line with the Blue Book (Landcom, 2004). The contractor should keep an up-to-date register of progressive ESCPs • Clean water diversion, including through temporary drainage, to minimise the amount of sediment-laden water discharged during construction • Stockpile site management (in line with Transport's Stockpile Management Procedures) • Contamination.	Contractor	Detailed design / pre-construction
	Environmental incidents where material harm to the environment is caused or threatened should be managed and reported in line with the CEMP.	Contractor	Construction
	A requirement for environmental management training of relevant construction personnel should be included in the Transport specifications for the proposal, and should be documented in the CEMP and SWMP.	Contractor	Pre-construction / construction
Erosion and sediment runoff	Sediment basins are not feasible due to topography, space and clearing constraints. As such, a high focus on erosion control (particularly the use of temporary ground covers when rain is imminent) would be adopted during construction to minimise the amount of sediment-laden water discharged from the proposal during construction. If mulch is required as part of erosion and sediment controls, it will occur in accordance with the Roads and Maritime *Management of Tannins from Vegetation Mulch Environmental Direction* (Roads and Maritime, 2012).	Contractor	Pre-construction / construction
Discharges	As much as possible, discharges to the receiving surface water environment from the proposal should be avoided. Instead, strategies to disperse or infiltrate water on surrounding land should be used as much as possible.	Contractor	Construction

Impact	Environmental safeguards	Responsibility	Timing
	Controlled discharges during construction are not to be concentrated at a single point to try to reduce the potential for downstream erosion.	Contractor	Pre-construction / construction
	If discharges are required to dewater parts of the proposal area during construction, water must first be treated to the following standards: • Turbidity: 25NTU (the upper limit for aquatic ecosystem protection in upland rivers and streams) • pH 6.5 to 8 • No visible oils, greases or litter. The requirements for water quantity and quality in any discharges would default to typical Transport and Blue Book (Landcom, 2004) recommendations to comply with Section 120 of the POEO Act.	Contractor	Pre-construction / construction
Leaf litter, sediments and minor slips during operation	Frequent inspection and cleaning (maintenance) of roadside drains and pipe inlets is recommended to reduce this risk.	Transport	Post-construction
Contaminated land	If contaminated areas are encountered during construction, appropriate control measures would be implemented to manage the immediate risks of contamination. All other works that may impact on the contaminated area would 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 Transport have been implemented.	Contractor	Construction
Accidental spill	A site-specific emergency spill plan would be developed and include spill management measures in line with Transport's *Code of Practice for Water Management* (RTA, 1999) and relevant EPA guidelines. The plan would 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 and EPA officers).	Contractor	Detailed design / Pre-construction
Excavated material/spoil	A contamination assessment and waste classification report would be required to assess the environmental and human health risks of excavated soil as well as potential for material reuse or disposal in line with the POEO Act.	Contractor	Construction
Heavy rainfall management	Weather conditions would be monitored daily and no works would be conducted if there is an imminent threat of a heavy rainfall event (>75% chance of more than 5 millimetres). In the event of a rainfall event, works would cease if there is a risk of sediment loss off site or ground disturbance due to waterlogged conditions. Plant and equipment would not be stored at the failure sites to avoid risks associated with adverse weather events.	Contractor	Construction

6.4 Biodiversity

The potential impacts on biodiversity during construction and operation of the proposal have been assessed as part of the *Biodiversity Assessment Report* (BAR) that has been prepared by EcoPlanning, provided in Appendix H.

6.4.1 Methodology

The methodology for the BAR included the following:

- Background research including desktop based searches of relevant databases to understand existing environment and obtains records of threatened species and ecological communities, important habitat for migratory species and areas of outstanding biodiversity value within and near to the proposal area.
- A field survey carried out on 14 November 2022 to identify and assess biodiversity values, including targeted surveys for *Eucalyptus macarthurii* (Paddys River Box) with suitable habitat identified next to ancillary facility A and B (PCT 963)
- An assessment of 'likelihood of occurrence' following the collation of database records and species and community profiles
- An assessment of the potential impacts to flora, fauna, migratory and fauna species including preparation of assessments of significance
- A waterway habitat assessment
- Recommendations for mitigation measures to minimise impacts
- An assessment of the need for biodiversity offsets.

Due to safety concerns about slope stability, field surveys were restricted to the road corridor near the Five Mile failures. As such, the sampling of vegetation integrity survey plots and targeted threatened species surveys within this area could not be carried out. Additionally, given no native vegetation would be impacted at ancillary facilities, these areas were only assessed for indirect impacts. All areas of vegetation within the proposal area that do not contain native vegetation have been mapped as 'exotic'.

During field surveys, any habitat features within the proposal area that could be viewed from the roadside were recorded. One species credit flora species and nine species credit fauna species (or dual credit species where breeding habitat is identified) was identified as having a moderate to high likelihood of occurring within the proposal area.

Due to the restricted access, targeted surveys for the nine species/dual credit fauna species with a moderate to high likelihood of occurrence have not been carried out within the proposal area. In accordance with Transport's guidelines, these species credit species have been assumed present as they have a moderate to high likelihood of occurrence but have not been adequately surveyed.

6.4.2 Existing environment

Landscape features

The landscape features of the proposal area are summarised in Table 6-11 and Figure 6-7.

Table 6-11 Proposal landscape features

Landscape feature	Proposal area
IBRA bioregions and subregions	The proposal area is located entirely within the Kanangra IBRA subregion (Version 7), which forms part of the South Eastern Highlands IBRA region (Version 7)
NSW Landscapes Region (Mitchell Landscapes)	Rockley Plains and Shooters Hill landscapes
Soils and geology	The proposal area occurs over the Kanangra Gorge and Gum valley soil landscapes

Landscape feature	Proposal area
Rivers and streams	The proposal area is in the vicinity of several unnamed first and second order streams. The proposal also intersects a third order stream (Surveyors Creek) within ancillary facility E.
Wetlands	No local or important wetlands are present within the proposal area.
Areas of geological significance and soil hazard features	No other landscape features including areas of geological significance (including karst, caves, crevices and cliffs) were observed within the proposal area, however these may be present as the area was not completely traversed. The proposal area and surrounds do not comprise any areas with an acid sulphate soil risk.
Key fish habitat	Key Fish Habitat is mapped along Surveyors Creek, which intersects the proposal at ancillary facility E. The section of the stream that intersects the proposal flows within a culvert underneath a carpark. Sections of the stream that have been concrete-lined or piped are not considered key fish habitat.

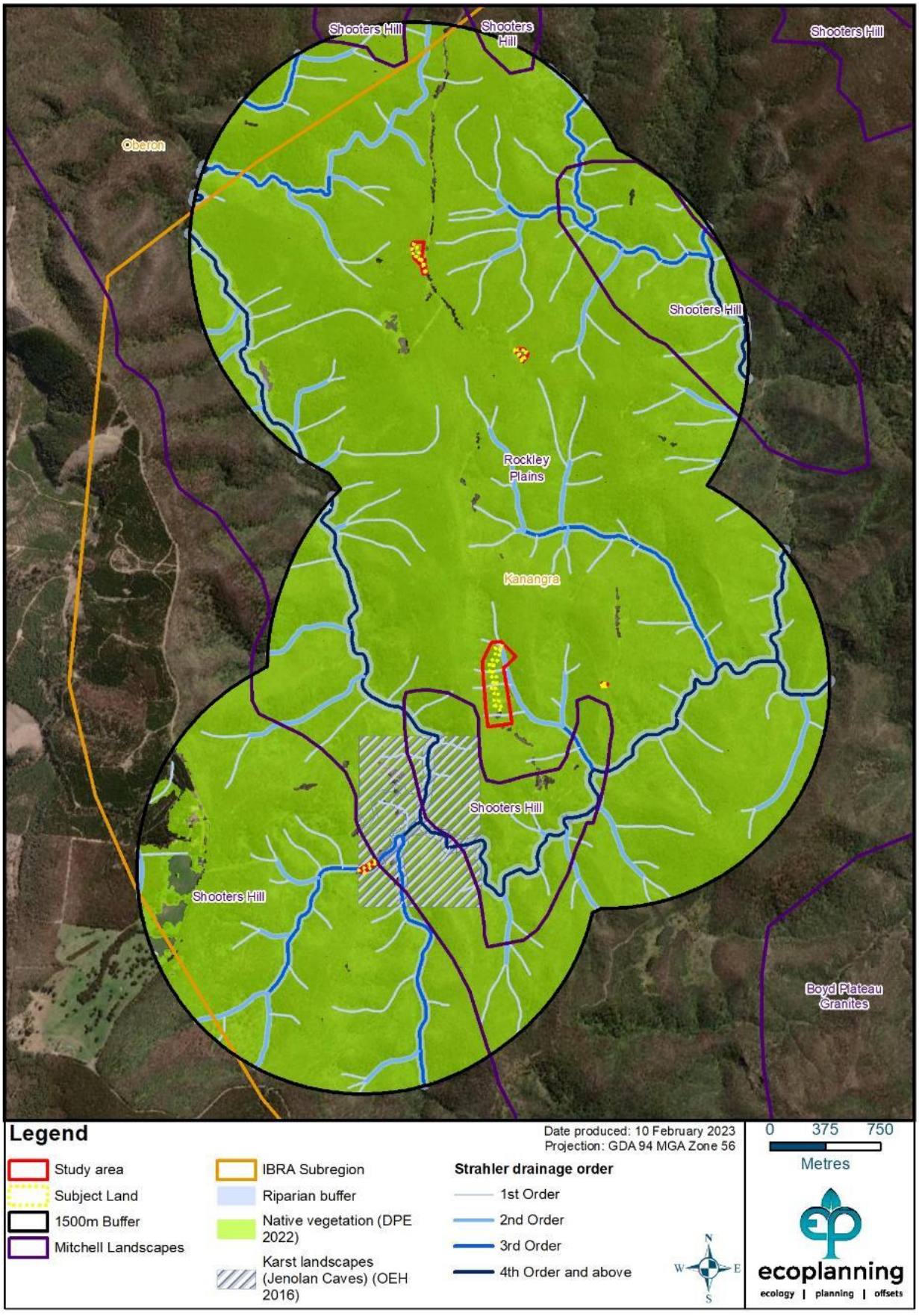


Figure 6-7 Key landscape features

Plant community types and vegetation zones

Two PCTs were identified and mapped within the proposal area:

- PCT 821 - Eurabbie - stringybark shrubby woodland on limestone in the Jenolan Caves area, Sydney Basin Bioregion
- PCT 963 - Narrow-leaved Peppermint - Mountain Gum - Brown Barrel moist open forest on high altitude ranges, northern South Eastern Highlands Bioregion.

In addition, one vegetation zone that did not conform to a locally occurring PCT was designated 'exotic' vegetation.

A summary of the PCTs within the study area for the biodiversity assessment (refer to Figure 6-7) is contained in Table 6-12.

Table 6-12 Plant community types

Plant community type (PCT)	Condition	Threatened ecological community (BC Act listed)	Area (ha) in biodiversity study area
PCT 821 - Eurabbie - stringybark shrubby woodland on limestone in the Jenolan Caves area, Sydney Basin Bioregion	Good	Not a TEC	8.340
	Low	Not a TEC	0.239
PCT 963 - Narrow-leaved Peppermint - Mountain Gum - Brown Barrel moist open forest on high altitude ranges, northern South Eastern Highlands Bioregion	Good	Not a TEC	0.664
	Low	Not a TEC	0.097
N/A	Exotic vegetation	N/A	0.504

Threatened ecological communities

No threatened ecological communities (TECs) under the BC Act or EPBC Act occur within the study area.

Groundwater dependent ecosystems

Groundwater dependent ecosystems (GDEs) are defined as 'ecosystems that need access to groundwater to meet all or some of their water requirements to maintain their communities of plants and animals, ecological processes and ecosystem services'. The Groundwater Dependent Ecosystem Atlas (GDE Atlas) (Commonwealth of Australia, 2022) was reviewed in January 2023 to determine any GDEs occurring within the proposal area and its immediate surrounds.

The proposal area contains high potential terrestrial GDEs next to ancillary facility B, although this is associated with PCT 1155 which does not occur within the proposal area. The remaining portion of the proposal area contains low potential and moderate potential for GDEs. In addition, the proposal area intersects an aquatic GDE, Surveyors Creek, at ancillary facility E.

Threatened species

As has been mentioned in section 6.4.1, the habitat suitability assessment revealed one species credit flora species with a moderate likelihood of occurring within the proposal area:

- *Eucalyptus macarthurii* (Paddys River Box)

Targeted surveys were carried for this species next to ancillary facilities A and B, as these areas contained suitable habitat for this species and were accessible. Paddys River Box was not found to occur in these areas and therefore is considered to have a low likelihood of occurring. Other species credit flora species were not

considered likely to occur within the proposal area due to unsuitable habitat, including no associated PCTs and/or an absence of habitat.

The habitat assessment mapped five hollow-bearing trees near the proposal area, six hollow-bearing trees near ancillary facility A and one hollow-bearing tree near ancillary facility E, ranging from 10 centimetres to more than 25 centimetres in diameter. Other fauna habitat features observed within the proposal area included woody debris, a small burrow, rocks and rubble (providing crevices for small mammals and reptiles), and freshwater habitat along several first and second order streams, as well as Surveyors Creek (a third order stream). Foraging habitat for mobile birds, bats and mammals was also present within areas of native vegetation. One threatened fauna species, *Petroica phoenicea* (Flame Robin), was recorded foraging around 145 metres from the proposal area.

The habitat suitability assessment revealed nine species credit fauna species (or dual credit fauna species with potential breeding habitat) with a moderate or high likelihood of occurring within the proposal area:

- *Callocephalon fimbriatum* (Gang-gang Cockatoo), Vulnerable BC Act, Endangered EPBC Act; BAM dual credit species
- *Chalinolobus dwyeri* (Large-eared Pied Bat), Vulnerable BC Act & EPBC Act; BAM species credit species
- *Hieraaetus morphnoides* (Little Eagle), Vulnerable BC Act; BAM dual credit species
- *Miniopterus orianae oceanensis* (Large Bent-winged Bat), Vulnerable BC Act; BAM dual credit species
- *Ninox strenua* (Powerful Owl), Vulnerable BC Act; BAM dual credit species
- *Petauroides volans* (Greater Glider), Endangered BC Act & EPBC Act; BAM species credit species
- *Petrogale penicillata* (Brush-tailed Rock-wallaby), Endangered BC Act, Vulnerable EPBC Act; BAM species credit species
- *Phascolarctos cinereus* (Koala), Endangered BC Act & EPBC Act; BAM species credit species
- *Tyto tenebricosa* (Sooty Owl), Vulnerable BC Act; BAM dual credit species.

No targeted surveys were conducted for these species within the proposal area due to restricted accessibility near the Five Mile failure. Based on the Transport guidelines, where a species credit species with a moderate to high likelihood of occurrence has not been adequately surveyed, then the species must be assumed present. Species polygons have been prepared for these species, which can be found in Section 3.5.3 of the BAR.

In addition, the habitat suitability assessment carried out for the proposal identified three ecosystem credit species as having a moderate-high likelihood of occurrence within the study area:

- *Dasyurus maculatus* (Spotted-tailed Quoll), Vulnerable BC Act, Endangered EPBC Act; BAM ecosystem species
- *Petroica boodang* (Scarlet Robin), Vulnerable BC Act; BAM ecosystem species
- *Petroica phoenicea* (Flame Robin), Vulnerable BC Act; BAM ecosystem species (observed in close proximity to the study area).

Assessment of significance for each threatened species under the BC Act can be found in Appendix H.

Aquatic results

Results from the aquatic habitat assessment are included in Table 6-13.

Table 6-13 Aquatic habitat assessment

Feature/criteria assessed	Results
Ecosystem type	First, second and third order streams
Dimensions and depth of waterway	Ephemeral first and second order streams (less than one metre wide and 10-15 centimetres deep) occur near the Five Mile failure. Surveyors Creek (about 2-3 metres wide by 20 centimetres deep) flows through a culvert underneath ancillary facility E.
Flow characteristics and hydrological features	Rapid water flow was recorded at the time of survey. Ephemeral creeks near the Five Mile failure are likely to dry during periods of low rainfall. These creeks flow across Jenolan Caves Road and continue downslope. Surveyors Creek is highly altered as it flows through several culverts and is likely to see consistent flows without periods of rainfall.
Bed substrate	All creeks have a rocky substrate. Where Surveyors Creek flows through the culvert underneath ancillary facility E, the substrate is concrete.
Habitat features	No pools or riffles were recorded. Rapid water flow was evident during site assessment.
Existing infrastructure and barriers to fish movement	The first and second order streams flow onto Jenolan Caves Road before continuing downslope. The culvert below ancillary facility E along Surveyors Creek may present a barrier during times of low flow.
Width and species composition of riparian vegetation including the type and condition of vegetation present	No visible snags, coarse weedy debris, macrophytes, seaweeds, seagrasses, mangroves or saltmarsh was recorded. In stream vegetation was mostly absent. The first and second order streams near the Five Mile failure are typically surrounded by native vegetation. The riparian zone of Surveyors Creek is typically dominated by exotic species.
Water quality	Clear

Areas of outstanding biodiversity value

No areas of outstanding biodiversity value (as defined in Section 3.1 of the Biodiversity Conservation Regulation 2017) are located within the proposal area.

Wildlife connectivity corridors

Extensive areas of habitat connectivity are present in the areas surrounding the proposal area. The proposal area is situated along a road corridor, however it is surrounded by large, vegetated areas that form part of the Jenolan Karst Conservation Reserve. This ultimately links with Kanangra-Boyd National Park and Blue Mountains National Park, as well as other largely vegetated areas that form part of the Great Dividing Range. The western extent of the locality is somewhat fragmented due to forestry and farming activities, however most of the locality is vegetated. Due to the small nature of the proposed works, it is not anticipated that the proposal would pose a barrier to the movement of wildlife, particularly threatened species across their range, considering the extensive areas of habitat surrounding the proposal area.

Matters of national environmental significance

The following MNES are relevant to the proposal:

- World Heritage Properties
- National Heritage Places
- Listed threatened species and communities
- Listed migratory species.

The proposal area is situated within both the road reserve and heritage curtilage of the Greater Blue Mountains Area, a declared world heritage property and listed national heritage place under the EPBC Act. The area provides significant representation of Australia's biodiversity, with ten per cent of the vascular flora as well as large numbers of rare or threatened species, including endemic and evolutionary relict species, such as the Wollemi pine, which have persisted in highly-restricted microsites. The non-Aboriginal heritage factors of the proposal are discussed further in Section 6.2.

The Protected Matters Search Tool (PMST) report indicated the following four EPBC listed TECs have the potential to occur within the proposal area:

- Natural Temperate Grassland of the South Eastern Highlands
- Temperate Highland Peat Swamps on Sandstone
- Upload Basalt Eucalypt Forests of the Sydney Basin Bioregion
- White Box-Yellow Box- Blakey's Red Gum Grassy Woodland and Derived Native Grassland.

The site assessment and subsequent analysis revealed that no TECs listed under the EPBC Act were present within the proposal area.

Database searches indicated that 54 EPBC listed threatened species and 12 listed migratory species have the potential to occur within the proposal area. A habitat assessment was subsequently carried out to assess the likelihood of each threatened and/or migratory species occurring in the proposal area. The assessment was based on the results of database searches within a 10-kilometre radius of the proposal area. Furthermore, the BioNet 'Threatened Species to Plant Community Types Association' data power query was used to assess the threatened species that are associated with the PCTs mapped within the proposal area for the relevant IBRA subregion. The site assessment revealed that six EPBC listed threatened species have a moderate to high potential of occurring within the proposal area. These included:

- *Callocephalon fimbriatum* (Gang-gang Cockatoo)
- *Chalinolobus dwyeri* (Large-eared Pied Bat)
- *Dasyurus maculatus* (Spotted-tailed Quoll)
- *Petauroides volans* (Greater Glider)
- *Petrogale penicillata* (Brush-tailed Rock-wallaby)
- *Phascolarctos cinereus* (Koala).

Assessment of significance for each of these species can be found in Appendix H.

6.4.3 Potential impacts

Construction

Removal of native vegetation

A summary of the direct impacts of Five Mile failure reinstatement on native vegetation in provided in Table 6-14. The amount of vegetation removal required to facilitate the proposal is 1.499 hectares, which is comprised of 0.995 hectares of native vegetation communities and 0.504 hectares of exotic vegetation. None of these PCTs have been identified as a TEC within the proposal area.

Table 6-14 Summary of direct impacts on native vegetation

Plat community type (PCT)	Broad condition class	Area to be impacted (ha)[1]
PCT 821 - Eurabbie - stringybark shrubby woodland on limestone in the Jenolan Caves area, Sydney Basin Bioregion	Good	0.933
PCT 821 - Eurabbie - stringybark shrubby woodland on limestone in the Jenolan Caves area, Sydney Basin Bioregion	Low	0.062
PCT 963 - Narrow-leaved Peppermint - Mountain Gum - Brown Barrel moist open forest on high altitude ranges, northern South Eastern Highlands Bioregion	Good	0
PCT 963 - Narrow-leaved Peppermint - Mountain Gum - Brown Barrel moist open forest on high altitude ranges, northern South Eastern Highlands Bioregion	Low	0
Total		0.995
Note 1: Area to be cleared based on ground-truthed vegetation mapping within the subject land.		

Removal of threatened fauna habitat

Relevant key threatening processes related to direct impacts on habitat features include:

- Clearing of native vegetation
- Loss of hollow-bearing trees
- Removal of dead wood and dead trees.

Direct impacts on threatened fauna species (comprising species credit fauna species and ecosystem credit species) and their habitat are summarised in Table 6-15. Primarily, the proposed impacts would result in the loss of potential foraging habitat for highly mobile threatened bats, birds and mammals. Key habitat features affected by the proposal would include the loss of two hollow-bearing trees with a diameter of around 10 centimetres that form potential breeding habitat for the Gang-gang Cockatoo and the Greater Glider. As impacts would be restricted to the existing road corridor and immediate surrounds, the removal of native vegetation is unlikely to affect the species listed below, particularly as they are highly mobile and extensive areas of habitat exist in the surrounding area.

Table 6-15 Summary of construction impacts on threatened fauna and habitat

Species name	BC Act	EPBC Act	Credit type[1]	Potential occurrence	Associated habitat in subject land	Impact (ha)
Callocephalon fimbriatum (Gang-gang Cockatoo)	V	E	Dual	High	PCT 821	0.995
Chalinolobus dwyeri (Large-eared Pied Bat)	V	V	Species	High	PCT 821	0.995

Species name	BC Act	EPBC Act	Credit type[1]	Potential occurrence	Associated habitat in subject land	Impact (ha)
Dasyurus maculatus (Spotted-tailed Quoll)	V	E	Ecosystem	High	PCT 821	0.995
Hieraaetus morphnoides (Little Eagle)	V	-	Dual	Moderate	PCT 821	0.995
Miniopterus orianae oceanensis (Large Bent-winged Bat)	V	-	Dual	High	PCT 821	0.995
Ninox strenua (Powerful Owl)	V	-	Dual	Moderate	PCT 821	0.995
Petauroides volans (Greater Glider)	-	E	Species	High	PCT 821	0.995
Petrogale penicillata (Brush-tailed Rock-wallaby)	E	V	Species	High	PCT 821	0.995
Petroica boodang (Scarlet Robin)	V	-	Ecosystem	Moderate	PCT 821	0.995
Petroica phoenicea (Flame Robin)	V	-	Ecosystem	Recorded	PCT 821	0.995
Phascolarctos cinereus (Koala)	E	E	Species	High	PCT 821	0.995
Tyto tenebricosa (Sooty Owl)	V	-	Dual	Moderate	PCT 821	0.995

Threatened fauna may also be impacted by noise and vibration during the installation of the rockfall barrier via helicopter. These impacts are anticipated to be minor, however, given helicopter noise would be temporary and localised at the failure sites.

Removal of threatened flora species

No threatened flora species are anticipated to be impacted by the proposal.

Paddys River Box was not found in the proposal area during field surveys. As there are no other known threatened flora species within the proposal area, impacts to threatened flora species are not anticipated.

Aquatic impacts

It is not anticipated that aquatic habitat would be impacted by the proposal. Significant erosion issues currently exist along Jenolan Caves Road at the Five Mile, which would have resulted in increased sedimentation of downstream waterways. The installation of structures to stabilise the road may prevent similar events occurring in the future and improve downstream water quality.

There would be no direct impacts to key fish habitat because of the proposal. Although key fish habitat is mapped along Surveyors Creek, which intersects the proposal at ancillary facility E, no impacts to the creek are anticipated as it flows within a culvert beneath the ancillary facility (a carpark). Indirect impacts may result via inappropriate stockpiling of soils and other materials within ancillary facility E, causing runoff into Surveyors Creek. A CEMP should address soil and water management of any stockpiles to ensure nearby key fish habitat is not affected.

There would be no direct or indirect impacts to threatened species, populations, ecological communities or their habitat listed under the FM Act. As such no assessment of significance in accordance with Division 12 of the FM Act is required.

Injury and mortality

The proposal would include repairs at the Five Mile main and second failures and temporary disturbance of ancillary facilities. Given the failure occurs along Jenolan Caves Road which has been long established, the risk

of injury and mortality during construction of the road is considered low. Injury threat along Jenolan Caves Road is already present and repairing the road would not increase this risk.

Ancillary facilities are located in predominately cleared areas, however historically piled materials (particularly in ancillary facility A) may provide habitat for fauna, including small mammals, reptiles and amphibians. There is a slight risk that utilising this facility by moving rubble/rubbish or further dumping may cause injury and/or mortality to fauna. This impact can be minimised through pre-clearance surveys and clearing supervision.

Noise, light, dust and vibration

A helicopter would be required to be used during construction for the installation of the rockfall barrier, which would result in an increase in noise within the proposal area. This is only expected to be used for short periods. An increase in noise may result in temporary displacement of fauna, however this is unlikely to have a long-term effect.

Groundwater dependent ecosystems

It is anticipated that impacts to GDEs would be negligible due to the minor extent of works that would largely be in keeping with the cut and fill of the existing road, despite including excavation and vegetation clearing. The proposal area intersects an aquatic GDE, Surveyors Creek, at ancillary facility E. Impacts to this creek is discussed in the previous sections.

Operation

Edge effects on native vegetation and habitat

The native vegetation within the proposal area is in relatively good condition, although some edge effects are already apparent along the road edge and boundaries with other cleared areas. Nonetheless, there is potential that additional clearing of native vegetation and soil disturbance may result in additional edge effects which may infiltrate nearby vegetation. This risk is expected to be relatively minor considering works would be situated along Jenolan Caves Road which is already exposed to edge effects and any areas of cleared vegetation due to excavations would be reinstated as part of the proposal. The risk of edge effects nonetheless can be successfully managed through the implementation of mitigation measures during construction and operation, including the implementation of a CEMP. It is unlikely that the proposal would increase edge effects on areas of habitat for native fauna, particularly as the area of clearing is relatively minor.

Wildlife connectivity and habitat fragmentation

Significant areas of habitat connectivity exist within and beyond the proposal area. The relatively minor nature of vegetation clearing as a result of the proposal is unlikely to result in habitat fragmentation. Works would be predominately restricted to the existing road corridor, with some minor vegetation removal required. Vegetation removal would be required for the excavation of access ramps to each failure, however this clearance is necessary for the road to be reinstated and would be minimised as much as possible. Ancillary facility areas are in historically cleared areas that have little biodiversity value, and as such, no removal of native vegetation is required. Overall, the works would not pose a barrier to the movement of wildlife considering the extensive areas of habitat surrounding the study area.

Injury and mortality

The proposal would pose a low risk to the injury and mortality of wildlife, especially given that Jenolan Caves Road has been long established and any vegetation removal is relatively minor. The re-opening of Jenolan Caves Road may pose an increased risk to wildlife as a result of vehicle strike, however, this would not be additional to the traffic volumes collision risk profile prior to the road closure.

Invasion and spread of weeds

Exotic species are already apparent along the roadside edges around the proposal along Jenolan Caves Road. In addition, areas of exotic vegetation were evident in historically cleared and disturbed areas. There is a moderate risk that the clearing of native vegetation and soil disturbance, as well as the use of areas of ancillary facilities, may lead to the invasion and spread of additional weed species into the area. However, the risk of invasion and spread of weeds can be successfully managed through the implementation of mitigation measures during construction and operation, including the implementation of a CEMP.

Invasion and spread of pests

Pest species were not recorded during field surveys. However, it is likely that common pest species including *Vulpes vulpes* (European Fox), *Rattus rattus* (Black Rat) and *Oryctolagus cuniculus* (Rabbit) occur within the proposal area. The proposed works are unlikely to introduce other pest fauna or increase the spread of pest species.

Invasion and spread of pathogens and disease

There was no evidence of diseases within the proposal area which have been recorded in the wider region (e.g. Die back, rust on Myrtaceae, dead frogs, bats or parrots). Of most risk to the proposal area is the introduction of infected soil containing Phytophythora, Myrtle Rust of Chytrid Fungus during the proposed works. 'Come clean – go clean' protocols for plant and equipment, use of clean fill and use of plant material including mulch from plants within the proposal area would reduce this risk.

Changes to hydrology

The existing hydrology near the proposal is already altered due to the presence of Jenolan Caves Road, where first and second order streams flow onto the road (and sometimes along the road) before continuing downslope. Seven culverts are to be installed and one culvert is to be upgraded as part of the proposal to assist with water management, as the flow of water along Jenolan Caves Road is likely leading to failure points. This is unlikely to significantly impact the hydrology of the area as flows would continue downslope, although it may slightly alter the existing drainage pathways.

Noise, light, dust and vibration

There may be temporary increases in dust, noise and vibration during operation, however this is unlikely to displace local fauna or have long term effects. There is the potential for noise and light increases once Jenolan Caves Road has reopened due to the presence of cars, however this would not be any more than what was experienced prior to the road closure.

National park

The construction and operation of the proposal is unlikely to result in significant impacts to threatened flora and fauna within the Jenolan Karst Conservation reserve. 0.995 hectares of native vegetation is proposed to be removed as part of the proposal, including through excavation works on the upslope and downslope areas. However, this is unlikely to impact species which use this vegetation as habitat given the vast areas of habitat in the wider reserve.

Construction activities such as the installation of the RSW and pavement works would be unlikely to impact the biodiversity of the reserve given these would occur in already disturbed areas. Additionally, aquatic habitats and wildlife connectivity are unlikely to be significantly impacted within the wider reserve, including by the rockfall barrier given its proximity to the road corridor. As such, the Jenolan Karst Conservation Reserve and its associated biodiversity is unlikely to be significantly impacted by the proposal.

The containment of the works within the road corridor and the placement of ancillary facilities in already disturbed areas is in line with many of the management principles for karst conservation reserves outlined in section 30I(2) of the NPW Act. This includes the conservation of the karst environment, including the protection of catchment values, such as hydrological processes and water quality, as well as the conservation of biodiversity and the maintenance of ecosystem function.

Conclusion on significance of impacts

The proposal is not likely to significantly impact threatened species, populations or ecological communities or their habitats, within the meaning of the *Biodiversity Conservation Act 2016* or *Fisheries Management Act 1994* and therefore a Species Impact Statement is not required.

The proposal is not likely to significantly impact threatened species, populations, ecological communities or migratory species, within the meaning of the *Environment Protection and Biodiversity Conservation Act 1999*.

6.4.4 Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing
Biodiversity	A site-specific CEMP would be developed prior to construction taking place and implemented over the life of the proposal. The CEMP would incorporate adaptive management principles and would outline management actions to avoid inadvertently causing additional impacts to those described in this section. Management actions would avoid and/or limit the potential for indirect offsite impacts and include an appropriate erosion and sedimentation control plan and weed control activities. Any management actions should follow best practice protocols such as Landcom (2004) or the RTA Biodiversity Guidelines (2011).	Transport	Detailed design / pre-construction
	A Flora and Fauna Management Plan would be prepared in line with Transport's Biodiversity Guidelines: Protecting and Managing Biodiversity on Projects (RMS, 2011) and implemented as part of the CEMP. It would include, but not be limited to: • Plans showing areas to be cleared and areas to be protected, including exclusion zones, protected habitat features and revegetation areas • Requirements set out in the Landscape Guideline (RMS, 2008) • Pre-clearing survey requirements • Procedures for unexpected threatened species finds and fauna handling • Protocols for machinery, vehicles, equipment and materials to manage weeds and pathogens.	Contractor	Detailed design / pre-construction
Removal of native vegetation	Native vegetation removal would be minimised through detailed design and construction.	Transport / Contractor	Detailed design / construction
	Ancillary facilities outside the proposal area (A, B, C and E) are to be located in cleared areas to avoid native vegetation removal and impacting threatened species which may occur in surrounding vegetation. Any stockpiling at existing ancillary facilities (i.e. ancillary facility A) is to remain within a fenced compound and not extend into areas of native vegetation. Fencing should be placed around ancillary facilities to delineate areas and prevent unintended impacts to native vegetation.	Contractor	Detailed design / pre-construction
	Pre-clearing surveys would be carried out in line with *Guide 1: Pre-clearing process* of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).	Contractor	Pre-construction
	Vegetation removal would be carried out in line with *Guide 4: Clearing of vegetation and removal of bushrock* of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011). Where possible, where fallen timber is to be relocated, it is to be relocated so outside the excavation and works area but is retained onsite.	Contractor	Construction

Impact	Environmental safeguards	Responsibility	Timing
	Native vegetation would be re-established in line with *Guide 3: Re-establishment of native vegetation* of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011). This would include collection and use of local seed stock from surrounding vegetation to maintain the local genetic diversity, where appropriate.	Contractor	Pre-construction / post-construction
	The unexpected species find procedure is to be followed under *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011) if threatened ecological communities, not assessed in the biodiversity assessment, are identified in the proposal site.	Contractor	Pre-construction / construction
	A Tree and Hollow Replacement Plan should be prepared for any residual biodiversity impact that does not require offsets in line with the No Net Loss Guidelines. Where suitable land is not available for replacement, payment would be made to the Transport Conservation Fund.	Transport / Contractor	Detailed design
	A tree count would be required within PCT 821 to determine tree replacement requirements in accordance with Transport's guidelines.	Transport / Contractor	Pre-construction / construction
Removal of threatened fauna habitat	Removal of significant threatened species habitat should be avoided where possible, including hollow-bearing trees and large, old trees.	Contractor	Detailed design / construction
	Fauna would be managed in line with *Guide 9: Fauna handling* of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).	Contractor	Pre-construction / construction
	Habitat would be replaced or re-instated in line with *Guide 5: Re-use of woody debris and bushrock* and *Guide 8: Nest boxes* of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).	Contractor	Construction
Aquatic impacts	Impacts to aquatic habitat will be minimised through detailed design and construction.	Contractor	Detailed design / construction
	Aquatic habitat would be protected in line with *Guide 10: Aquatic habitats and riparian zones* of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011) and Section 3.3.2 *Standard precautions and mitigation measures of the Policy and guidelines for fish habitat conservation and management Update 2013* (DPI (Fisheries NSW) 2013).	Contractor	Detailed design / construction
	Stockpiling should be restricted to designated ancillary facilities as outlined in this report. Several first/second order streams occur near the proposal area and if material is stockpiled in this vicinity, any significant rainfall event would wash material down slope.	Contractor	Pre-construction / construction
Groundwater dependent ecosystems	Interruptions to water flows associated with groundwater dependent ecosystems would be minimised through detailed design. No substantial	Contractor	Detailed design

Impact	Environmental safeguards	Responsibility	Timing
	impacts to groundwater flows are anticipated as a result of the proposal.		
Changes to hydrology	Changes to existing surface water flows would be minimised through detailed design. New drainage infrastructure (i.e. culverts) and water quality controls would be installed within the proposal area.	Contractor	Detailed design / construction
Edge effects on nearby native vegetation and habitat and invasion and spread of pathogens and disease	Exclusion zones would be set up at the limit of clearing in line *with Guide 2: Exclusion zones* of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).	Contractor	Pre-construction
Invasion and spread of weeds	Weed species would be managed in line *with Guide 6: Weed management* of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).	Contractor	Pre-construction / construction
Invasion and spread of pests	Pest species would be managed within the proposal site.	Contractor	Pre-construction / construction
Noise, light, dust and vibration	Shading and artificial light impacts would be minimised through detailed design. The use of the helicopter to install the rockfall barrier is to be minimised where possible to avoid displacement of local fauna from noise.	Contractor	Detailed design / construction

6.4.5 Biodiversity offsets

This section details the process of identifying the biodiversity impacts in the BAR that trigger thresholds set out by No Net Loss Guidelines (Transport, 2022d). Residual impacts that do not exceed offset thresholds must then consider the requirements of the Tree and Hollow Replacement Guidelines (Transport, 2022e).

The assessment of vegetation impacts against thresholds revealed that no vegetation zones within the proposal area trigger the offset thresholds, as they do not involve clearing of an endangered ecological community (EEC) or a critically endangered ecological community (CEEC). Vegetation zones that require clearing have been subsequently assessed against the requirements of the Tree and Hollow Replacement Guideline. The assessment of vegetation clearing impacts against the offset thresholds can be found in Table 6-16.

Table 6-16 Assessment of vegetation impacts against offset thresholds

Plant community type (PCT)	Condition	TEC	Impact area (ha)	Threshold triggered?
PCT 821 - Eurabbie - stringybark shrubby woodland on limestone in the Jenolan Caves area, Sydney Basin Bioregion	Good	Not a TEC	0.933	**No offset threshold triggered. Tree and hollow replacement required.**
PCT 821 - Eurabbie - stringybark shrubby woodland on limestone in the Jenolan Caves area, Sydney Basin Bioregion	Low	Not a TEC	0.062	**No offset threshold triggered.**

Plant community type (PCT)	Condition	TEC	Impact area (ha)	Threshold triggered?
PCT 963 - Narrow-leaved Peppermint - Mountain Gum - Brown Barrel moist open forest on high altitude ranges, northern South Eastern Highlands Bioregion	Good	Not a TEC	0	**No offset threshold triggered.**
PCT 963 - Narrow-leaved Peppermint - Mountain Gum - Brown Barrel moist open forest on high altitude ranges, northern South Eastern Highlands Bioregion	Low	Not a TEC	0	**No offset threshold triggered.**

No offsets have been triggered by the proposal. Calculation of tree and hollow replacement requirements requires counting trees and hollows within areas that do not require offsetting. A tree count would be required within PCT 821 to determine tree replacement requirements. Two hollow-bearing trees were present within the relevant areas, which would require replacement with six artificial hollows.

As tree and hollow replacement is required under the Tree and Hollow Replacement Guidelines, a Tree and Hollow Replacement Plan is to also be prepared prior to the commencement of works as an environmental safeguard. Alternatively, where suitable land is not available for replacement, payment would be made to the Transport Conservation Fund prior to the commencement of works.

6.5 Noise and vibration

The potential noise and vibration impacts during construction and operation of the proposal have been assessed as part of the REF and are included in this section.

6.5.1 Methodology

Noise calculations have been conducted in line with the Transport's Construction Noise and Vibration Guideline (Roads and Maritime Services, 2016) (CNVG) and the associated estimator tool. The assumptions for this assessment included:

- Defining the traffic volumes and land use on Jenolan Caves Road to identify the representative noise environment (R0) from the noise estimator tool was used with the Distance Based Assessment (Construction Scenario) worksheet
- Defining the assessment of noise from the proposal area as the 'bulk earthworks' scenario. This offered the most conservative estimation of construction noise and vibration. A conservative approach was deemed appropriate given works would involve both earthworks from access ramp excavations and noise from a helicopter (e.g. for the installation of the rockfall barrier)
- The 'line of sight' scenario was used for the assessment of noise from the proposal area as part of the conservative approach and to account for times where the helicopter may be visible to receivers
- Defining the assessment of the ancillary facilities as the Distance Based Assessment (Construction Scenario) worksheet. For ancillary facilities A, D and E, the assessment used the 'compound operation' scenario, which was more appropriate for ancillary facilities where no earthworks would be carried out. Ancillary facilities B and C would be used for helicopter operations at the beginning of construction, meaning the 'bulk earthworks' scenario was used for these facilities as this offered the most conservative noise scenario. The line-of-sight scenario was adjusted based on the location of the ancillary facilities relative to nearby receivers
- The estimator tool was used for both standard hours and out of hours assessments.

A desktop assessment of vibration impacts was carried out due to the distance between the proposal area and nearby receivers. Mitigation measures have been included to ensure that further slope failures and landslips do not occur as a result of the construction of the proposal.

As the reinstatement of the failures would result in the proposal area would being returned to pre-failure conditions and operational noise impacts are anticipated to be negligible, no operational noise assessment has been carried out.

6.5.2 Existing environment

Background noise near the proposal area is characteristic of a nature reserve area with low ambient noise levels dominated by natural sounds. Noise sources in the vicinity of the proposal area are largely associated with the use of the area for tourism. This includes traffic noise from visitors accessing the site and general noise generated by visitors within the Jenolan Caves precinct.

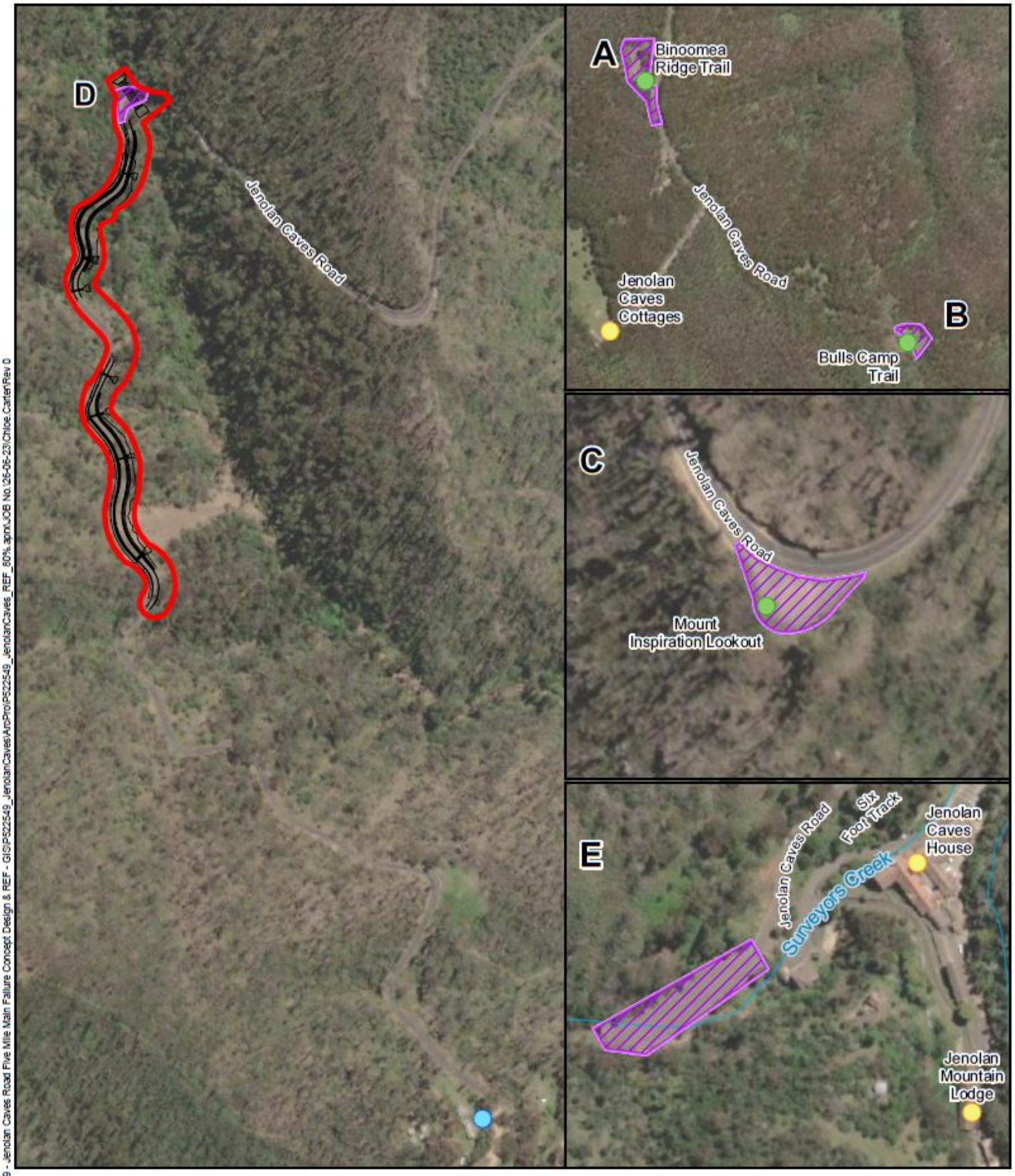
Sensitive receivers located near the proposal site include:

- Residential receiver, located around 500 metres south of the main failure
- Commercial receiver (Jenolan Caves Reserve Trust), located around 500 metres south of the main failure
- Jenolan Cave House Hotel, located around 1.25 kilometres southwest of the main failure
- Jenolan Mountain lodge, located around 1.4 kilometres southwest of the main failure
- Users of the Jenolan River walking track, located around 800 southeast of the main failure.

As is detailed in section 0, the proposal requires ancillary facilities to be established in the surrounding area for stockpiling materials and to allow construction vehicles to turn around. The location of these facilities is included in Figure 3-8. Receivers which are near these ancillary facilities may also be impacted by construction noise and vibration. Receivers close to ancillary facilities include:

- Jenolan Caves Cottages, located around 250 metres north of ancillary facility A and around 750 metres west of ancillary facility B
- Binoomea Ridge Trail, which begins at the site of ancillary facility A
- Bulls Camp Trail, which begins at the site of ancillary facility B
- Mount Inspiration Lookout, located at the same site as ancillary facility C
- Jenolan Caves House, located around 100 metres east of ancillary facility E.

The locations of various sensitive receivers are included in Figure 6-8.



REF proposal area

Proposed ancillary facility

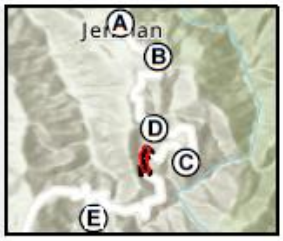
Design

Sensitive receivers

Commercial receivers

Passive recreation receivers

Residential receivers



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0 50 100m

Jenolan Caves Road Five Mile Failure **Review of Environmental Factors**

Projection: GDA2020 MGA Zone 56

Figure 6-8: Noise sensitive receiver locations

C:\Users\chloe.carter\Aurecon Group\522549 - Jenolan Caves Road Five Mile Main Failure Concept Design & REF - GIS\P522549_JenolanCaves\ArcPro\P522549_JenolanCaves_REF_80%.aprx\JOB No.\26-06-23\Chloe.Carter\Rev 0

In line with section 3.3.3, work is expected to occur during daytime work hours, with a proposed extension to the standard working hours. Night works would be avoided where possible, however out of hours noise criteria have still been used. Noise criteria for the proposal are summarised in Table 6-17.

Table 6-17 Proposal noise criteria

Noise criteria	Representative noise environment – R0	
	Rated background level (RBL) (dBA)	Noise management level (NML) (dBA)
Standard daytime work hours	30	40
Out of hours work hours	30	35

6.5.3 Potential impacts

Construction

During construction, the proposal has the potential to generate noise and vibration from a variety of sources, including:

- Site establishment and earthworks
- The use of equipment and machinery
- Loading and dumping materials and waste
- The movement of heavy vehicles to and from the site
- Construction traffic on local roads
- General noise from people onsite
- Installation of the rockfall barrier on the upper slope via helicopter.

Construction noise and vibration impacts would not permanently affect the community or surrounding environment. Noise and vibration impacts would be limited to the construction period and would occur over short durations when construction equipment is operational. Helicopter operations would impact the nearby residential receiver and commercial receivers through increased noise, however this would only be for short periods. The helicopter would only be used during daylight hours and is expected to be required only for a few shifts (subject to confirmation during detailed design). Aircraft noise is typically assessed at airports where flights occur on a daily basis and affect the acoustic amenity at nearby residences. Given there would only be intermittent aircraft noise during construction, it is not considered necessary to conduct a full assessment of noise from the helicopter as part of the proposal.

Noise impacts from the proposal area

The assessment using the estimator tool identified an affected distance for residential receivers of 1010 metres during standard hours and an affected distance of 1430 metres during out of hours periods for the 'bulk earthworks' scenario. The noise levels above background levels associated with each level of noise intrusion and the related affected distances for residential receivers are outlined in Table 6-18.

Table 6-18 Noise intrusion distances for residential receivers during standard and out of hours work

Noise level above background	Standard hours	OOHW
Noticeable (5 to 10 dBA)	N/A	N/A
Clearly audible (10 to 20 dBA)	N/A	1010 metres
Moderately intrusive (20 to 30 dBA)	485 metres	485 metres
Highly intrusive (>30dBA)	230 metres	230 metres

As detailed in Section 6.5.2, there is only one residential receiver near the proposal area, which is around 500 metres away from construction noise. As such, it is anticipated that this residential receiver would be affected by construction noise during standard hours, but not to a moderately or highly intrusive extent. During out of hours periods, the residential receiver would experience clearly audible noise. Mitigation measures have been included in section 6.5.4 to minimise these noise impacts to this receiver.

There is one commercial receiver (Jenolan Caves Reserve Trust) which is also around 500 metres away from construction noise. The estimator tool identifies an affected distance of 60 metres for offices and retail outlets during standard hours and out of hours work with no line of sight (behind solid barrier), meaning this receiver would not be affected by construction noise as a result of the proposal during either time period. Other commercial receivers, such as Jenolan Caves House, would also be unaffected by construction noise from the proposal area due to their distance from the works during both periods.

Noise impacts from ancillary facilities

For each ancillary facility, noise impacts would differ due to varying distances to nearby receivers. Noise impacts from each of the ancillary facilities are detailed in Table 6-19.

Table 6-19 Noise impacts from ancillary facilities

Ancillary facility	Noise impacts
A	This ancillary facility would be located at the beginning of the Binoomea Ridge Trail (a passive recreation receiver), meaning line of sight to the facility would be possible from the beginning of the trail. Using the 'compound operation' scenario, the estimator tool lists passive recreation receivers within 20 metres of an ancillary facility as being highly affected by noise during standard hours, meaning notification (via signage on the trail) would be required for users of this trail. The estimator tool also lists passive recreation receivers within 6 metres of compound operations as being highly affected by noise during out of hours periods, however given patronage of the walking trail is likely to be at its lowest during out of hours periods, notification (via signage on the trail) has been deemed a sufficient mitigation measure. It should be noted that noise impacts to this receiver in both standard hours and out of hours periods would be minimal as noise from the ancillary facility would only impact the beginning of the trail. Line of sight to the facility is not possible from the Jenolan Caves Cottages ('behind substantial solid barrier' scenario used in the noise tool). The Jenolan Caves Cottages were defined as a commercial receiver (offices, retail outlets) for this assessment. The estimator tool therefore identified an affected distance of 10 metres during standard hours and out of hours periods, meaning the Jenolan Caves Cottages would not be affected by noise from the ancillary facility, which is around 250 metres away.
B	This ancillary facility would be located at the beginning of the Bulls Camp Trail (a passive recreation receiver), meaning line of sight to the facility is possible from the beginning of the trail. As is detailed in section 0, the facility would be used as a helicopter base, meaning helicopter noise has been factored into this noise assessment. Using the 'bulk earthworks' scenario (most conservative estimate of helicopter noise), the estimator tool lists passive recreation receivers within 60 metres of the ancillary facility as being highly affected by noise during standard hours, meaning notification (via signage on the trail) would be required for users of this trail. The estimator tool also lists passive recreation receivers within 19 metres as being highly affected by noise during out of hours periods. Further mitigation measures would be required during out of hours work, however it is anticipated that the helicopter would only be used during standard hours. Additionally, the helicopter would only be used for short periods, meaning the 'compound operation' scenario, as used for ancillary facility A, would be a more appropriate assessment scenario following the use of the helicopter at this facility. This scenario lists passive recreation receivers within 20 metres of the ancillary facility as being highly affected by noise, meaning notification (via signage on nearby trails) would still apply as mitigation measures following the use of the helicopter. The estimator tool lists passive recreation receivers within 6 metres of compound operations as being highly affected by noise during out of hours periods, however given the walking trail is unlikely to be used in out of hours periods, notification (via signage on the trail) has been deemed a sufficient mitigation measure. It should be noted that noise impacts at this receiver would be minimal as noise from the ancillary facility would only impact the beginning of the trail.

Ancillary facility	Noise impacts
	Line of sight to the ancillary facility is not possible from the Jenolan Caves Cottages ('behind substantial solid barrier' scenario used in tool). The Jenolan Caves Cottages were defined as a commercial receiver (offices, retail outlets) for this assessment. Using the 'bulk earthworks' scenario to estimate noise from the helicopter, an affected distance of 10 metres was identified by the estimator tool during both standard hours and out of hours periods. As such, it is not anticipated that the Jenolan Caves Cottages, which are around 750 metres away, would be significantly affected by noise from the helicopter. Using the 'compound operation' scenario to estimate noise impacts after the use of the helicopter, the assessment using the estimator tool identified an affected distance of 35 metres for both standard hours and out of hours periods, meaning the Jenolan Caves Cottages would not be affected by noise from the ancillary facility.
C	This ancillary facility would be located at the Mount Inspiration Lookout site (a passive recreation receiver), meaning line of site to the facility is possible from the lookout. Using the 'bulk earthworks' scenario (most conservative estimate of helicopter noise), the estimator tool lists passive recreation receivers within 60 metres of the ancillary facility as being highly affected by noise during standard hours, and within 19 metres as being highly affected by noise during out of hours periods. However, the lookout would not be accessible to the public given Jenolan Caves Road would be closed between the Jenolan Caves Road / Bulls Camp Trail intersection and Jenolan Caves. As such, noise impacts would not be experienced by the public during construction at this location.
D	This ancillary facility is located within the proposal area, around 200 metres north of the second failure. As such, noise impacts would be consistent with that of the proposal area, as detailed above.
E	This ancillary facility is located in the car park of Jenolan Caves House, meaning line of sight to the facility is possible from this commercial receiver. Plant and heavy vehicles would not use this ancillary facility due to access limitations through the Grand Arch to the failures, which would minimise noise impacts at this facility. Additionally, the assessment using the estimator tool identified an affected distance of 35 metres during both standard hours and out of hours periods, meaning this receiver would not be affected by noise from the ancillary facility, which is around 100 metres away.

Vibration impacts

Vibration impacts would not impact any nearby receivers due to the distance between the proposal site and the receivers. Operation of plant and equipment would comply with the recommended minimum working distances for vibration intensive plant specified in Section 7.1 of the CNVG. Vibration, however, has the potential to cause further land slips in nearby areas. Such impacts are considered to be minimal, with much of the surrounding area currently considered stable due to existing vegetation. Mitigation measures would be implemented to ensure that vibration from soil nail installation does not result in further slope failures. This would include vibration monitoring to identify potential damage to heritage items identified near the proposal.

Operation

Outside of noise from vehicles travelling on Jenolan Caves Road, the proposal would not have any noise and vibration impacts following the completion of the proposal. Road conditions would return to pre-failure conditions, meaning traffic access into the Jenolan Caves precinct via the Five Mile section would be reinstated. It is not anticipated that the operation of the proposal would result in greater road traffic noise than prior to the closure of Jenolan Caves Road, meaning operational noise and vibration impacts would be negligible.

National park

The proposal would not cause major adverse noise and vibration impacts to the Jenolan Karst Conservation Reserve. As detailed above, noise impacts from the proposal area throughout the construction phase would not be felt by receivers to a moderately or highly intrusive extent. As such, noise impacts to the Jenolan Karst Conservation Reserve from the proposal area are anticipated to be minimal.

Noise from ancillary facilities would impact users of the reserve throughout construction, particularly at ancillary facilities A and B which are located at the beginning of walking trails. Additionally, the use of the helicopter (e.g., for the installation of the rockfall barrier at the beginning of construction) would result in noise impacts for a short period of time. These impacts would be concentrated at ancillary facilities B and C which would be used as helicopter landing and winch sites, and noise from the helicopter would be felt throughout the wider reserve but to a lesser extent. Noise impacts from the helicopter are not anticipated to have major adverse noise impacts on wildlife within the reserve (refer to Section 0 for more details).

Although minor noise impacts are anticipated as a result of construction, the benefits to the Jenolan Karst Conservation Reserve that would result from the reinstatement of Jenolan Caves Road at the Five Mile would outweigh any noise and vibration impacts to the reserve. The operation of the proposal is not anticipated to increase traffic noise levels any more than the pre-landslide noise environment, which aligns with the management principles for karst conservation reserves as part of section 30I(2) of the NPW Act, which includes the provision for visitor or tourist use and enjoyment that is compatible with the karst conservation reserve's natural values.

6.5.4 Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing
Noise and vibration	A Noise and Vibration Management Plan (NVMP) would be prepared and implemented as part of the CEMP. The NVMP would generally follow the approach in the *Interim Construction Noise Guideline* (ICNG) (DECC, 2009) and identify: • All potential significant noise and vibration generating activities associated with the proposal • Feasible and reasonable mitigation measures to be implemented • A vibration monitoring program to assess performance against relevant vibration criteria • A vibration minimisation procedure to mitigate the risk of activities with intensive vibration (such as drilling of soil nails) resulting in further slope failures • Arrangements for consultation with affected neighbours and sensitive receivers, including notification and complaint handling procedures • Contingency measures to be implemented in the event of non-compliance with noise and vibration criteria.	Contractor	Detailed design / pre-construction
Noise and vibration	All receivers likely to be affected by the proposal would be notified at least 5 working days prior to commencement of any works associated with the proposal that may have an adverse noise or vibration impact. The notification would provide details of: • The proposal • Construction period and construction hours • Contact information for management staff • Complaint and incident reporting • How to obtain further information. For passive receivers near ancillary facilities A and B, notification would be provided via signage on publicly accessible trails (including the Binoomea Ridge Trail and the Bulls Camp Trail) for the duration of construction. At a minimum, signage would be established at the highly affected noise distance from these ancillary facilities.	Contractor	Detailed design / pre-construction / construction
Construction noise	Noise impacts would be minimised in accordance with Practice Note 7 in Roads and Maritime Services'	Contractor	Construction

Impact	Environmental safeguards	Responsibility	Timing
	Environmental Noise Management Manual and Environmental fact sheet No. 2- Noise management and Night Works.		
	Where feasible and reasonable, construction should be carried out during the standard daytime working hours. Work generating high noise and/or vibration levels should be scheduled during less sensitive time periods.	Contractor	Construction
Construction noise from machinery and equipment	All plant and equipment would be appropriately maintained to ensure optimum running conditions, with periodic monitoring.	Contractor	Construction
	Noise-emitting plant would be directed away from sensitive receivers, where possible.	Contractor	Construction
	Traffic flow, parking and loading and unloading areas would be planned to minimise reversing movements within the proposal site.	Contractor	Construction
	Reversing alarms that have a tonal noise character are to be avoided during out of hours activities. Quacker style or 'smart' reversing alarms are to be used during night-time activities (pending safety approvals).	Contractor	Construction
Construction noise from inappropriate practices	Site inductions would be provided to train staff on ways to minimise construction noise impacts on-site. Responsible work practices include: • Avoiding shouting and slamming doors • Where practical, operating machinery at low speed or power and switch off when not in use rather than left idling for prolonged periods • Minimising reversing • Avoiding dropping materials from height and avoiding metal to metal contact on material.	Contractor	Construction

6.6 Aboriginal cultural heritage

The potential impacts on Aboriginal heritage during construction and operation of the proposal have been assessed as part of the Stage 1 Procedure for Aboriginal Cultural Heritage Consultation and Investigation (PACHCI), provided in Appendix I.

6.6.1 Methodology

The assessment of Aboriginal cultural heritage impacts of the proposal was prepared in line with Stage 1 of the Transport Procedure for Aboriginal Cultural Heritage Consultation and Investigation (PACHCI) (RMS, 2011b). Previous ground truthing survey evaluations and reports were reviewed and searches of the Aboriginal Heritage Information Management System (AHIMS) for the coordinates of the proposal area and all ancillary facilities were carried out on 22 June 2023.

6.6.2 Existing environment

The proposal is located within the Jenolan Karst Conservation Reserve, which features many areas of Aboriginal cultural significance. According to the Jenolan Caves Reserve Trust, for thousands of years, Aboriginal people from many Nations came to the Jenolan Caves. Passageways from the Grand Arch roadway once led to the lowest levels of the cave system, enabling Aboriginal people to enter the mountain and access the underground water. One of these passageways in the Grand Arch (now blocked) is believed to have once led to the Pool of Cerberus. At the junction of 'lake walk' and 'Devil's Coach House Cave', there are two saucer shaped depressions in the rock. These are the two chambers of the pool, with the top-most being for resting and the lower for bathing. The water contains dissolved minerals that were thought to have healing properties. Aboriginal people drank the healing waters for stomach ailments.

The proposal is located on Jenolan Caves Road, which, despite running through the Jenolan Karst Conservation Reserve, is a heavily disturbed environment, including from the road corridor and the recent landslides.

The proposal is also within the Gundungurra Area Agreement (NI2014/001) Indigenous Land Use Agreement. Members of the Aboriginal community continue to experience connection with the proposal area through cultural and family associations.

6.6.3 Potential impacts

Construction

The proposal was assessed as being unlikely to have an impact on Aboriginal cultural heritage based on the information provided in the Stage 1 PACHCI.

The assessment is based on the following due diligence considerations:

- The proposal is unlikely to harm known Aboriginal objects or places
- The AHIMS search did not indicate moderate to high concentrations of Aboriginal objects and places inside the proposal area or near ancillary facilities
- The proposal area did contain landscape features that indicated the presence of Aboriginal objects, based on DPE's *Due diligence Code of Practice for the Protection of Aboriginal objects in NSW* and the RMS procedure
- The cultural heritage potential of the proposal area appears to be heavily reduced due to current road alignment and past disturbance (previous construction activities).

Operation

The operation of the proposal would return Jenolan Caves Road to pre-landslide conditions. As such, no harm would be caused to Aboriginal cultural heritage during operation.

National park

The proposal is not anticipated to have an impact on the Aboriginal cultural heritage of the Jenolan Karst Conservation Reserve. Construction and operation of the proposal would be within the existing road corridor, meaning any sites or items of Aboriginal cultural significance would not be impacted. Ancillary facilities located throughout the Jenolan Karst Conservation Reserve would be established in already disturbed areas, meaning impacts to Aboriginal cultural heritage in the reserve as a result of the ancillary facilities would also be unlikely. This would align with the management principles for karst conservation reserves outlined in section 30I(2) of the NPW Act, which includes the sustainable use of modified natural areas having regard to the conservation of the karst conservation reserve's natural or cultural values.

6.6.4 Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing
Aboriginal heritage	• The *EMF-HE-PR-0076 Unexpected Heritage Items Procedure* (Transport, 2022c) would be followed in the event that an unknown or potential Aboriginal object/s, including skeletal remains, is found during construction. This applies where Transport 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 would only re-commence once the requirements of that Procedure have been satisfied.	Contractor	Detailed design / pre-construction
Aboriginal heritage	If there are any changes to construction or maintenance methodology, the Aboriginal Cultural Heritage Advisor – Western Region should be contacted.	Contractor	Detailed design / pre-construction / construction

6.7 Traffic and transport

The potential impacts on traffic and transport during construction and operation of the proposal have been assessed as part of the REF and are included in this section.

6.7.1 Methodology

A desktop review of existing traffic conditions, including existing road closures and access conditions associated with the Five Mile failures, was carried out to determine the construction and operational traffic and transport impacts of the proposal and, where necessary, any mitigation measures.

The Transport project information website for the Jenolan Caves Road program of works was used to understand the most up to date traffic conditions within and near the proposal area, including access to the Jenolan Caves precinct and surrounding reserve. The website included traffic alerts and notifications and community updates. No traffic modelling was carried out as part of this assessment as Jenolan Caves Road is currently closed to public traffic. Therefore, no existing traffic counts were available and as the proposal would reinstate access to pre-failure traffic conditions, it was determined future traffic would mimic previous circumstances.

6.7.2 Existing environment

The proposal is located on the Five Mile stretch of Jenolan Caves Road located northeast of the Jenolan Caves precinct. Jenolan Caves Road is both a service road and an emergency access road. It serves as the only vehicular access road to the Jenolan Caves and offers access to the Jenolan Karst Conservation Reserve. Jenolan Caves Road consists of a single travel lane in each direction with a posted speed limit of 50 kilometres per hour. The road is steep and narrow with posted speed limits of 25 kilometres per hour in winding sections of the road.

Jenolan Caves Road is currently closed between the Jenolan Caves Road / Bulls Camp Trail intersection and Jenolan Caves due to the failures. An emergency ROL is currently in place for traffic control along Jenolan Caves Road. A ROL would also be required once works commence as part of the proposal. The proposal area and the section of Five Mile to the north (Jenolan Caves Road from Hampton), which connects the proposal area with ancillary facilities A, B, C and D, would occur in an area currently inaccessible to public traffic movements.

The key road features surrounding the proposal area are listed below:

- Edith Road is a local road that consists of a single travel lane in each direction with no kerbs and an unmarked intersection between Jenolan Caves Road and Kanangra Walls Road. The posted speed limit is 60 kilometres per hour with additional signage identifying winter road closures due to snow and ice.
- Kanangra Walls Road is an unsealed narrow dirt road allowing traffic in both directions. The ‘no through road’ transects high country grazing land and pine plantations and terminates at a carpark providing access to Kanangra Boyd Lookout.

Access to the proposal site would occur from the north. Works on the second failure restoration would need to occur first for the main failure to be accessed.

6.7.3 Potential impacts

Construction

The proposal would result in the generation of construction vehicles, including workers and heavy vehicles, accessing the proposal area and nearby ancillary facilities. Heavy vehicle traffic would be generated mainly by the following activities:

- Delivery and removal of construction equipment and machinery to the proposal site and stockpiles at ancillary facilities (detailed in section 0)
- Spoil removal from stockpile locations to licensed spoil disposal facilities or reuse locations
- Movement of construction personnel, including contractors, site labour force and specialist supervisory personnel.

As per the existing scenario, the road would remain closed to public traffic between the Jenolan Caves Road / Bulls Camp Trail intersection and Jenolan Caves until completion of construction. All plant and equipment and most light vehicles would access the proposal area from the north via Five Mile as there is limited clearance through the Grand Arch at Jenolan Caves to access the proposal area from the south.

A helicopter would be used for short periods (e.g., at the start of construction to install the upslope rockfall barrier above each failure). The helicopter would travel to site by air. Ancillary facility B has been identified as a potential helicopter base and ancillary facility C has been identified as a potential loading site for winching materials. When the helicopter is operational at ancillary facility B, rotor downwash may displace dust and pose a safety risk to motorists and pedestrians in adjacent publicly accessible areas and to construction workers and items within the ancillary facility. This may cause disruption to public pedestrian or vehicle movements near the ancillary facility. These risks would be minimised in accordance with the proposal's Helicopter Management Plan, which would include provision for establishing and enforcing exclusion zones near helicopter operations.

Heavy vehicle traffic during construction would not significantly impact the traffic and transport environment of the proposal area as this additional construction traffic would be limited. The Five Mile section of Jenolan Caves Road would not be in use by the public when the works are occurring. Additionally, given the constraints of Jenolan Caves Road, only vehicles with the capacity to turn 180 degrees would be used in and around the proposal area, as is detailed in section 3.3.7. This would further minimise disruptions from heavy vehicle traffic and its related noise.

Some light vehicles may access the proposal area from the south (for example, from ancillary facility E at Jenolan Caves) via Two Mile. However, these vehicles would not require traffic control along the current publicly accessible section of Jenolan Caves Road. As such, there would be minimal additional traffic disruptions, with no additional road closures, detours, altered traffic arrangements and delays to traffic anticipated during construction compared to the current scenario.

Some disruption may be experienced north of the proposal area and south of the Jenolan Caves Road / Duckmaloi Road intersection by forestry trucks and light vehicles accessing the Jenolan State Forest, however these impacts are anticipated to be minor.

There are no public walking trails within the proposal area. However, there are walking trails near ancillary facilities A, B and E, and to the west of the proposal area. The Six Foot Track is also about 200 metres west of the proposal area. Access to these trails would be maintained during construction, with detours or alternate access routes provided if required. Signage would also be installed to notify community members using these trails of nearby construction work, where required.

Emergency access to the Jenolan Caves precinct is currently via Two Mile as vehicles cannot pass through Five Mile due to the two failures. The proposal would not change these existing emergency access arrangements during construction.

Operation

Operation of the proposal would have a positive impact by providing a long-term solution to the ongoing access issues and safety risks associated with slope failures on Jenolan Caves Road.

National park

The proposal would allow access to be restored to the Jenolan Karst Conservation Reserve via the Jenolan Caves Road Five Mile. It is anticipated that this would not drastically increase the number of vehicles accessing the reserve each day, meaning the reserve would not be adversely affected by traffic and transport as a result of the proposal. The reinstatement of traffic access via the Five Mile would align with the management principles set out in Section 30I(2) of the NPW Act, which include the promotion of public appreciation and understanding of the reserve's values and the provision of sustainable visitor and tourist use of the reserve. The proposal would also align well with the NPWS vehicle access policy, which aims to supply opportunities for visitors to understand, enjoy and appreciate parks, and take maximum advantage of interpretive opportunities and scenic values within parks.

6.7.4 Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing
Traffic and transport	A Traffic Management Plan (TMP) would be prepared and implemented as part of the CEMP. The TMP would be prepared in line with the Traffic Control at Work Sites Manual (Transport, 2022f) and QA Specification G10 Control of Traffic (Transport, 2008). The TMP would include: • Confirmation of haulage routes • Measures to maintain access to local roads and properties • Site-specific traffic control measures (including signage) to manage and regulate traffic movement • Measures to maintain pedestrian and cyclist access • Requirements and methods to consult and inform the local community of impacts on the local road network • Access to construction sites including entry and exit locations and measures to prevent construction vehicles queuing on public roads • A response plan for any construction traffic incident • 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 • Monitoring, review and amendment mechanisms • Procedures for notification and approval of proposed detours (including pedestrian detours), alternate access routes and signage by NPWS (if they occur on NPWS estate).	Contractor	Detailed design / Pre-construction
Use of a helicopter	A Helicopter Management Plan (HMP) would be prepared and implemented as part of the CEMP. The HMP would be prepared in accordance with Civil Aviation Safety Authority guidelines and developed in consultation with NPWS and Jenolan Caves Reserve Trust. The HMP would include: • Procedures for mobilisation, operation and demobilisation of the helicopter, including refuelling and maintenance of the helicopter • Requirements to establish exclusion zones near helicopter operations • Requirements for vehicular and pedestrian traffic management where helicopter operations would occur near publicly accessible areas.	Contractor	Detailed design / Pre-construction
Vehicle movement	Vehicle movements (in particular, heavy vehicles) to the proposal would avoid peak periods, where possible.	Contractor	Construction
Property access impacts	Access to properties along Jenolan Caves Road would be available throughout construction. Where impacts are anticipated, consultation would be carried out with the affected property owner to confirm any access arrangements.	Contractor	Construction

6.8 Socio-economic

The potential socio-economic impacts during construction and operation of the proposal have been assessed as part of the REF and are included in this section.

6.8.1 Methodology

This socio-economic impact assessment has been prepared in line with the *Roads and Maritime Environmental Impact Assessment Practice Note on Socio-economic assessment* (EIA-05) as well as in line with the NPWS Guidelines for preparing a Review of Environmental Factors: How to assess the environmental impacts of activities within NSW national parks (NPWS, 2021).

The socio-economic assessment included:

- Review of statutory planning and legislative requirements, including a review of existing State and local government strategies relevant to the social and economic environment of the study area
- Description of the existing socio-economic environment of the study area to establish the baseline
- Identification and assessment of the potential socio-economic impacts of the proposal's construction and operation on business operations within the Jenolan Caves precinct and surrounds
- Measures to manage or mitigate potential impacts on the socio-economic environment and maximise potential benefits of the proposal.

Information used to inform the socio-economic assessment has been obtained from the following sources:

- Australian Bureau of Statistics (ABS) 2021 Census of Population and Housing
- NSW Government strategic planning reports and plans.

6.8.2 Existing environment

According to 2021 census data, the Oberon LGA has a population of 5,580 people. The current largest employment sectors are wooden structural fitting and component manufacturing with 6.3 per cent of the population, beef and sheep farming at 6.2 per cent, and log sawmilling at 3.8 per cent.

The tourism sector is anticipated to grow, given the natural attraction of the LGA including the Jenolan Karst Conservation Reserve. The Jenolan Caves are considered a major tourist attraction with an estimate of 230,000 visitors annually (Jenolan Caves Reserve Trust, 2012). The Jenolan Caves precinct, located south of the proposal area, contains the Jenolan Caves House and the Jenolan Mountain Lodge. The area contains several attractions such as the Orient Cave, Blue Lake and Carlotta Arch, with a number of walking trails also located in the vegetated areas surrounding the proposal area. Tourism within the precinct has decreased due to the closure of the Five Mile section of road and the Two Mile section of road being closed intermittently.

There are no public walking trails within the proposal area. However, there are walking trails near ancillary facilities A, B and E, and to the west of the proposal area. The Six Foot Track is also about 200 metres west of the proposal area.

6.8.3 Potential impacts

Construction

During construction, access to the Jenolan Caves precinct would be limited given Jenolan Caves Road would only be open via the Two Mile access. The Five Mile access would remain closed given vehicular access would still not be possible. These access conditions already exist for the precinct, meaning businesses within the Jenolan Caves precinct and tourists wanting to access the precinct would not be any more affected by construction than in the existing scenario. Impacts to businesses within the precinct would be felt if closure of the Two Mile stretch were to occur due to future unfavourable weather conditions. The potentially reduced access to the precinct during construction would be offset by the benefits the proposal would provide in the form of improved future access and increased road user safety.

There is potential for some impacts to access for businesses within the precinct throughout construction due to the movement of construction vehicles and the positioning of construction equipment at ancillary facilities,

such as at the Jenolan Caves House carpark. However, these disruptions are expected to be minor as there are other carparks at the Jenolan Caves precinct. There is potential for increased business throughout the Jenolan Caves precinct with the presence of construction personnel, including at the Caves Café

Walking tracks, including the Binoomea Ridge Trail and Bulls Camp Trail, may also have access affected by ancillary facilities located at their entrances. While there would be signage installed to warn pedestrians of construction work and local track diversions around the ancillary facilities, access to the trails would be maintained during construction. Such impacts are manageable as the number of vehicle movements required is expected to be minimal and access would be maintained where possible. Consultation would also be carried out with affected businesses to determine any property access requirements to make sure suitable access can be provided when required.

There would be a reduction in amenity and community values at ancillary facilities and within the proposal area. The greatest temporary amenity impacts to the community would occur near ancillary facilities A, B and E and include:

- During construction activities that use noise or vibration intensive equipment (including a helicopter) for receivers near ancillary facilities A and B
- Visual impacts of construction plant and machinery at ancillary facilities A, B and E
- Air quality impacts, including an increase in dust levels from helicopter rotor downwash near ancillary facility B.

As work near walking tracks would be contained to these ancillary facilities, these impacts would be limited to users of walking tracks immediately adjacent to the ancillary facilities for the duration of construction only. As most construction work would occur in areas not accessible to the public, amenity impacts are expected to be minor and temporary. The noise and vibration impacts and air quality impacts of the proposal would be minimised through implementation of the Safeguards outlined in Sections 6.5.4 and 6.9.2 respectively. In addition, a Communications Plan would be developed to inform the community of activities which may result in amenity impacts.

The proposal would not require property acquisition, with ancillary facilities leased for the duration of construction (refer to Section 3.6). There would be temporary changes in land use at the ancillary facilities and within the proposal area during construction. As the road is currently closed and ancillary facilities are existing hardstand areas, these changes are expected to have a minor social impact.

Operation

During operation, the proposal is considered to provide a community benefit as it would re-open Five Mile access into the Jenolan Caves precinct for the public. This improved access would minimise risks should future weather events restrict Two Mile access. The improved access would also benefit businesses within the Jenolan Caves Precinct as improved access would potentially increase patronage to include those who may not visit currently due to the access arrangements currently in place.

There would be no acquisition or leases during operation. Permanent changes in land use, with ancillary facilities returned to their prior use and the road reinstated and re-opened to traffic upon completion of construction.

National park

The Jenolan Karst Conservation Reserve and the Jenolan Caves precinct are major tourist attractions for the region. The proposal would reinstate Jenolan Caves Road at the Five Mile, which would allow for improved tourist and business access to the Jenolan Caves precinct and the surrounding reserve. This would improve the resilience of the road to future extreme weather events and, as such, the overall reliability of access to the Jenolan Caves precinct compared to pre-failure conditions. Improvements in socio-economic outcomes would contribute to the management principles outlined in Section 30I(2) of the NPW Act through the promotion of public appreciation and understanding of the reserve's natural and cultural values and the provision for sustainable visitor or tourist use of the reserve. This would be achieved through the increased access and tourism. Additionally, improvements in access and tourism would contribute to the NPWS vehicle access policy.

6.8.4 Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing
Socio-economic	A Communication Plan (CP) would 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): • Mechanisms to provide details and timing of proposed activities to affected residents and passive receivers, including changed traffic and access conditions • Contact name and number for complaints.	Contractor	Pre-construction
Business impacts	Where access to the Jenolan Caves precinct is impacted, consultation would be carried out with the Jenolan Caves Reserve Trust and all businesses operating within the precinct to confirm access requirements including timing and the nature of access required. Where access to the precinct is impacted, 48 hours' notice is required to be given to both the Jenolan Caves Reserve Trust and National Parks and Wildlife Service.	Contractor	Construction
	Should closures of the precinct occur, these would be managed in consultation with all relevant stakeholders and would avoid any busy periods such as school holidays and public holidays.	Contractor / Transport	Construction

6.9 Other impacts

Other potential impacts during construction and operation of the proposal have been assessed as part of the REF and are included in this section.

6.9.1 Existing environment and potential impacts

The existing environment and the associated impacts resulting from the proposal for other environmental factors are provided in Table 6-20.

Table 6-20 Existing environment and potential impacts for other environmental factors

Environmental factor	Existing environment	Potential impacts
Air quality	Air quality in the vicinity of the proposal is typical of a predominantly vegetated area with limited access and facilities. Local air emissions are dominated by motor vehicles using Jenolan Caves Road to access the Jenolan Caves precinct.	Potential impacts to air quality from disturbed topsoil, removal of vegetation and construction of the proposal would be minor. While dirt may also be disturbed from helicopter rotor downwash, these impacts would be temporary as they would only occur when a helicopter is operational nearby. Potential dust and emissions from trucks and plant machinery are considered likely during construction, although the impacts would be minor and short-term. Mitigation measures outlined in section 6.9.2 would minimise these risks.
Bushfire	The proposal site and surrounding area is mapped as High Bushfire Prone land in the Oberon LEP.	The nature of the proposal means that the use of equipment or activities which could potentially cause a bushfire would not be required. Any potential impacts would be managed through the implementation of standard control measures, particularly prohibiting any hot works during high fire danger periods. During periods of higher bushfire risk at the proposal site, regular weather checks would occur. Work would not proceed during times where there are bushfires within the vicinity.
Hazard and risk management	The proposal area features two slope failures which present a hazard to construction personnel and vehicles. The risk to tourists and community members is currently low as Jenolan Caves Road currently closed to the public. However, there would be a high risk if any members of the public continued past the fencing and closed road signage. Additionally, the steepness and instability of the existing slopes presents a risk of falling objects onto the road surface.	The proposal area features hazards and risks that would need to be addressed or minimised. These include: • The existing failures and unstable ground • Risks of falling objects from upslope of the failures • Working at height (on the edge of failures) • Working in or around aircraft (i.e., a helicopter). Additionally, hazards and risks that would arise throughout the construction phase would include: • Risks from excavation work • Fuel and chemical leakage from vehicles

Environmental factor	Existing environment	Potential impacts
		• Hazards associated with plant and equipment use • Hazards associated with proposal area access along narrow, winding roads. The potential hazards and risks are expected to substantially improve during operation, as the proposal would provide safe access to the Jenolan Caves precinct.
Property and land use	The proposal area is located along Jenolan Caves Road and is zoned SP3 - Tourist. No property or land use changes are required within the proposal area as the proposal would reinstate the road to its former use. Ancillary facility locations are included in section 0. Temporary property leases would be required during construction (as detailed in section 3.6).	Some impacts would result outside of the road reserve near the large culvert at the north of the proposal area. Works would extend into land reserved under the NPW Act, meaning authorisation by NPWS would be required. These works would not change the existing land use given there is an existing culvert and hardstand area. Ancillary facilities would be temporary and would be leased, not acquired and would therefore not impact land use in the long-term. Impacts would be felt by users of the Binoomea Ridge Trail and the Bulls Camp Trail, whose access may be impacted by the establishment of ancillary facilities at the two entrances to the trails. The trails would remain open throughout construction, meaning it is anticipated that access impacts would be minimal. Impacts may also be felt by visitors to the Jenolan Caves House, where the ancillary facility would reduce parking access.
Waste	Transport is committed to ensuring the responsible management of unavoidable waste and promotes the reuse of such waste in line with the resource management hierarchy principles outlined in the *Waste Avoidance and Resource Recovery Act 2001*. These resource management hierarchy principles, in order of priority, are: • Avoidance of unnecessary resource consumption • Resource recovery (including reuse, reprocessing, recycling and energy recovery) • Disposal. By adopting the above principles, Transport aims to efficiently reduce resource use, reduce costs, and reduce environmental harm in line with the principles of ecologically sustainable development, as outlined in section 8.3 of this REF.	Potential impacts from waste relate to contamination of the surrounding environment (such as pollution of waterways, attracting pest fauna) through improper waste handling, storage and transport practices. The significance of these impacts is predicted to be low, as proposed safeguards and management measures would manage potential impact pathways into the surrounding environment. Waste produced during construction would be managed in line with the waste management hierarchy principles of the *Waste Avoidance and Resource Recovery Act 2001*.

6.9.2 Safeguards and management measures

Table 6-21 Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing
Air quality	Air quality impacts would be integrated into the CEMP. Air quality provisions would include: • Identification of potential sources of air pollution • Air quality management objectives consistent with any relevant published EPA and/or EES guidelines • Mitigation and suppression measures to be implemented • Methods to manage work during strong winds or other adverse weather conditions • A progressive rehabilitation strategy for exposed surfaces.	Contractor	Detailed design / pre-construction
Bushfire	A Bushfire Management Plan (BMP) would be prepared and implemented as part of the CEMP. The BMP would include, but not be limited to: • Processes to mitigate bushfire risk • Requirements to stop work that could result in ignition of a fire, including: – When there are bushfires within the vicinity of the proposal – During a Park Fire Ban for Jenolan Karst Conservation Reserve – During a declared Total Fire Ban for the zone which includes Jenolan Karst Conservation Reserve • Procedures to follow during periods of high bushfire risk in the proposal area or at the ancillary facilities, including regular weather checks • Response procedures in the event of a bushfire.	Contractor	Construction
	Consultation with the NPWS, Rural Fire Service and other emergency services would be carried out throughout construction to advise of any access changes. Where possible, access through the proposal site is to be maintained at all times.	Contractor	Construction
Hazard and risk management	A Hazard and Risk Management Plan (HRMP) would be prepared and implemented as part of the CEMP. The HRMP would include, but not be limited to: • Details of hazards and risks associated with the activity • Measures to be implemented during construction to minimise these risks • 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 • A monitoring program to assess performance in managing the identified risks • Contingency measures to be implemented in the event of unexpected hazards or risks arising, including emergency situations.	Contractor	Detailed design / pre-construction

Impact	Environmental safeguards	Responsibility	Timing
	The HRMP would be prepared in line with relevant guidelines and standards, including relevant Safe Work Australia *Codes of Practice*, and EPA or DPE publications.		
Property and land use	Site specific management plans would be developed in consultation with National Parks and Wildlife Service and Jenolan Caves Reserve Trust for the use of identified ancillary facility locations. These plans would include details of how these areas are to be used and requirements to maintain access to publicly accessible trails near ancillary facilities. For ancillary facility A, this would include requirements for NPWS access to Binoomea Ridge Trail to be maintained at all times.	Contractor	Pre-construction / Construction
	Areas to be used within existing car parks are to be minimised with alternative locations to be used based on where the demand for parking is at the time.	Contractor	Construction
Waste	A Waste Management Plan (WMP) would be prepared and implemented as part of the CEMP. The WMP would include but not be limited to: • Measures to avoid and minimise waste associated with the proposal • Classification of wastes and management options (re-use, recycle, stockpile, disposal) • Statutory approvals required for managing both on and off-site waste, or application of any relevant resource recovery exemptions • Procedures for storage, transport and disposal • Monitoring, record keeping and reporting. The WMP would be prepared taking into account the *Environmental Procedure - Management of Wastes on Transport for NSW Land* (Transport, 2014) and relevant Transport Waste fact sheets.	Contactor	Detailed design / pre-construction

6.10 Cumulative impacts

6.10.1 Broader program of work

Rainfall in March 2021, which resulted in the slope failures discussed in this report, caused similar slope failures along Jenolan Caves Road and in the surrounding area. Transport, NPWS and the Jenolan Caves Reserve Trust are carrying out several works in the area to stabilise areas impacted by the heavy rainfall. These works are at varying phases of the design process.

Other works part of the broader program of work include:

- Two Mile slope remediation (operational)
- Hampton slope remediation (under investigation).

The broader program of work is outlined in Figure 6-9.

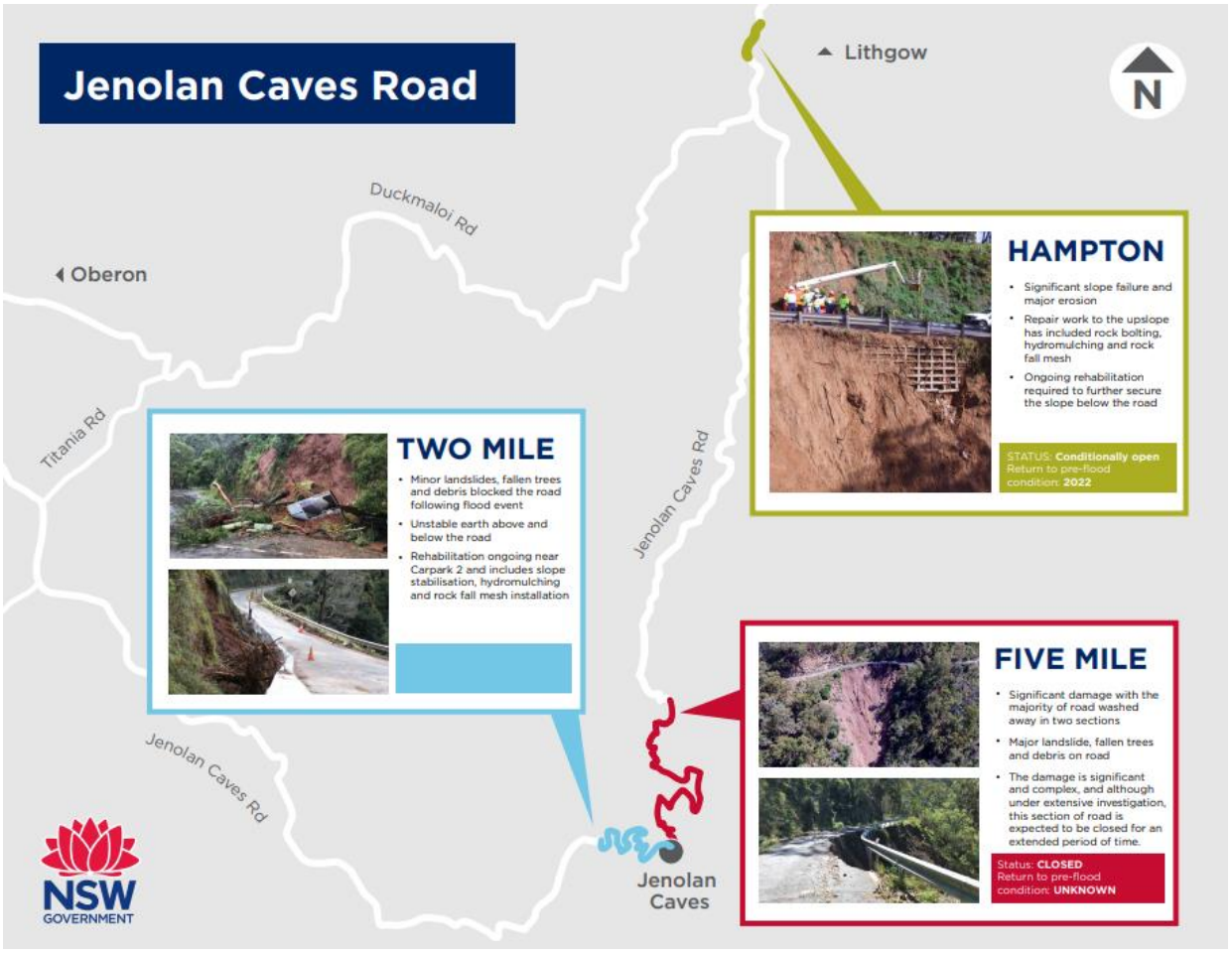

Figure 6-9 Broader program of work

6.10.2 Other projects and development

A search of the NSW Major Projects website and of Oberon Council's current works was carried out to identify other projects outside of the broader program of work which may have cumulative impacts when considered alongside the proposal. One other project was identified near the proposal. This project is expected to be complete in mid 2023, therefore would not impact the proposal. As assessment has been completed to understand the potential construction impacts (if the project is delayed and coincides with the proposal) and operational impacts, with the findings outlined in Table 6-22.

Table 6-22 Other projects and development

Project	Construction impacts	Operational impacts
Duckmaloi Road Works Oberon Council will be carrying out works along a 5-kilometre section of Duckmaloi Road, including • Widening shoulders • Vegetation clearing • Installing safety barriers, linemarking • Installation of vehicle activated signs, curve alignment markers and audio Tactile Line Marking (rumble strips). This work is expected to take 12 weeks to complete from 20 March 2023. Therefore, should be complete before the proposal construction commences.	Minor traffic delays would be experienced during the 12-week period. The work will generate noise from construction machinery. Lane closures, intermittent stopping and a reduced speed limit of 40 kilometres per hour will be in place during work hours. Traffic control and reduced speed limits of 60 kilometres per hour and 80 kilometres per hour will be in place outside of work hours, until the work is complete.	It is anticipated that the operation of this project would result in road safety improvements to Duckmaloi Road and the surrounding road network.

Other projects and development would also include minor and routine works around the Jenolan Caves precinct, which would have minor impacts on access to and enjoyment of the precinct alongside the proposal. The potential for future failures and repairs at the Jenolan Caves Road Five Mile should also be noted given the potential for these to cause more long-term access impacts to the precinct alongside the current failures.

6.10.3 Potential impacts

The proposed reinstatement of Jenolan Caves Road and road works in surrounding areas are likely to result in altered access conditions throughout the area. The failed sections of road along Jenolan Caves Road at the Five Mile mean that access to the Jenolan Caves precinct is only possible via the Two Mile section of road, which remains open subject to weather conditions. Roadworks on Duckmaloi Road would mean that access to the Jenolan Caves precinct would be subject to detours and to altered road conditions including reduced speeds. However, these cumulative impacts are anticipated to be reduced once construction of the proposal begins, given it is likely that the Duckmaloi Road works would likely have been completed.

The program of works along Jenolan Caves Road, while potentially resulting in some cumulative impacts, is considered to have an overall cumulative benefit as, once complete, the stabilisation works would reinstate road access to the Jenolan Caves precinct to pre-landslide conditions. The program of works would also ensure that the pristine natural environment, which is a major selling point for the area, is not further impacted because of further slope failures and impacts such as the sedimentation of waterways.

The Duckmaloi Road works, when considered alongside the Jenolan Caves Road program of works, would also have an overall cumulative benefit given the improvements in accessibility and road safety across the wider road network that would result. Any traffic delays from the Duckmaloi Road works would likely not occur at the same time as delays from the proposal, meaning cumulative traffic or noise impacts would not eventuate.

6.10.4 Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing
Cumulative impacts	The Consultation Plan would include consultation with Transport, NPWS and the Jenolan Caves Reserve Trust to determine the timing of all works proposed and details of how to manage any impacts.	Contractor	Construction

7. Environmental management

This chapter describes how the proposal would be managed to reduce potential environmental impacts throughout detailed design, construction and operation. A framework for managing the potential impacts is provided. A summary of site-specific environmental safeguards is provided and the licence and/or approval requirements needed prior to construction are also listed.

7.1 Environmental management plans (or system)

A number of safeguards and management measures have been identified in the REF in order to minimise adverse environmental impacts, including social impacts, which could potentially arise as a result of the proposal. Should the proposal proceed, these safeguards and management measures would be incorporated into the detailed design and applied during the construction and operation of the proposal.

A Construction Environmental Management Plan (CEMP) would be prepared to describe the safeguards and management measures identified. 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 proposal and must be reviewed and certified by the Transport for NSW Environment Officer, Western 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 line with the specifications set out in the QA Specification *G36 – Environmental Protection (Management System)*, QA Specification *G38 – Soil and Water Management (Soil and Water Plan)*, QA Specification *G40 – Clearing and Grubbing* and QA Specification *G10 – Traffic Management*.

7.2 Summary of environmental safeguards and management measures

Environmental safeguards and management measures outlined in this REF would be incorporated into the detailed design phase of the proposal and into the construction of the proposal, should it proceed. These safeguards and management measures would minimise any potential adverse impacts arising from the proposed works on the surrounding environment. The safeguards and management measures are summarised in Table 7-1.

Table 7-1 Summary of safeguards and management measures

No.	Impact	Environmental safeguards and management measures	Responsibility	Timing
GEN1	General - minimise environmental impacts during construction	A CEMP would be prepared and submitted for review by and endorsement of the Transport Senior Environment & Sustainability Officer prior to commencement of the activity. As a minimum, the CEMP would address the following: • Any requirements associated with statutory approvals • Details of how the project will implement the identified safeguards outlined in the REF • Procedures to minimise potential impacts of construction on adjacent land including NPWS land • Issue-specific environmental management plans, including consideration of: – Soil and water management – Erosion and sediment control including necessary erosion, sediment and water quality controls – Traffic management – Communications and stakeholder management – Construction noise and vibration management – Flora and fauna protection and management – Weed management • Roles and responsibilities • Communication requirements • Induction and training requirements • Procedures for monitoring and evaluating environmental performance, and for corrective action • Reporting requirements and record-keeping	Contractor / Transport	Pre-construction / detailed design

No.	Impact	Environmental safeguards and management measures	Responsibility	Timing
		• Procedures for emergency and incident management, including emergency reporting requirements to NPWS via the NPWS Environment Line on 131 555 and in writing to the Manager, NPWS Kanangra Area • Procedures for audit and review. The endorsed CEMP would be implemented during the carrying out of the activity.		
GEN2	General - notification	All businesses, residential properties and other key stakeholders (e.g., local councils, Jenolan Caves Reserve Trust, local organisations) affected by the activity would be notified at least five days prior to commencement of the activity. NPWS would be notified at least four weeks before commencement of the activity. The notification to NPWS is to include relevant contact details of the: • Transport communications team and direct website links to the project page • Transport project coordinator as the primary contact for NPWS during project delivery • Onsite primary contractor delivering the project works adjacent to the park.	Contractor / Transport	Pre-construction
GEN3	General – environmental awareness	All personnel working on site would receive training to ensure awareness of environment protection requirements to be implemented during the project. This would include up-front site induction and regular toolbox-style briefings.	Contractor / Transport	Detailed design / pre-construction
GEN4	General – Jenolan Karst Conservation Reserve	A Jenolan Karst Conservation Reserve Management Framework will be prepared to collate and manage potential impacts to the reserve. As a minimum the strategy will: • Ensure that works within the Jenolan Karst Conservation Reserve are not to commence until authorisation has been received from the National Parks and Wildlife Service • Ensure demarcation of the proposal area and ancillary facility boundaries at the start of construction (including signage where appropriate) • Ensure that the site and ancillary facility boundaries are secured to prevent unauthorised access • Outline site induction requirements specific to the reserve, including: – That all areas of NPWS estate outside the proposal area and ancillary facility boundaries are restricted areas – NPWS estate boundary management protocols and procedures	Contractor	Pre-construction / construction

No.	Impact	Environmental safeguards and management measures	Responsibility	Timing
		– Restrictions applying to the protection of the NPWS estate • Outline water quality controls to be implemented during construction (refer to the Erosion and Sedimentation Control Plans (ESCP) prepared for the proposal) • Apply tree protection protocols on the reserve interface in accordance with Australian Standard *4970-2009 Protection of Trees on Development Sites* • Establish hygiene protocols for machinery, vehicles, equipment and materials to avoid introduction of any pests or diseases • Require access to be maintained to the adjoining reserve entry roads and management trails • Inform communication between Transport and the NSW NPWS • Identify additional risks to the reserve and opportunities to maintain the conservation values of the reserve during construction and operation of the proposal.		
GEN5	Ancillary facilities	The use of ancillary facilities on NPWS estate is subject to completion of a condition report and repair of any resulting damage. The condition report for ancillary facilities is to be submitted to NPWS and agreement on reinstatement requirements for each site agreed with NPWS prior to work commencing. At a minimum, the repair of damage during use of the ancillary facilities would include: • Remediation of ancillary facilities A, B, C, and E to their existing condition (as captured in the condition report) • Remediation of ancillary facility D through removal of all construction equipment and materials and ensuring that the ground surface is intact in accordance with the proposal design.	Contractor	Pre-construction / construction
V1	Landscape character and visual impact	An Urban Design Plan would continue to be developed throughout detailed design. Urban design would be integrated into proposal development processes to make sure the proposal aligns with the urban design objectives. The following policy/guidelines would guide future design development of the proposal: • Transport Urban Design Policy (Beyond the Pavement) • Transport Urban Design Guidelines	Contractor	Detailed design

No.	Impact	Environmental safeguards and management measures	Responsibility	Timing
		• The urban design objectives, principles and concept design strategy presented in the urban design report for the proposal (refer to Appendix D).		
V2	Revegetation	Revegetation would be carried out in line with the landscaping principles, urban design concept outlined in the LCVIA and Transport's Biodiversity Guidelines. Revegetation strategies would include (but not be limited to): • Selecting plant species such as shrub species and native grasses that, once established, would help to reduce the visual bulk of the proposal • Tubestock planting works in soft soil pockets above the upslope modifications and rockfall barrier where vegetation has been removed • Tubestock planting works to the downslope in soft soil pockets and over-seeding prior to the construction of the RSW where existing vegetation has been removed • Making sure that any new planting adheres to proposed species lists compiled in the urban design strategy with reference to existing species on site • Selecting plant species in consultation with the Jenolan Caves Trust • Carrying out seed collection where possible to provide reproduction of existing endemic species for over-seeding or tubestock propagation • Revegetation should take place throughout the construction phase when access allows.	Contractor	Construction
V3	Design elements	• Material selection should include the colour and texture selections for the RSW. Darker colours would be more recessive to the bushland setting.	Contractor	Detailed design / construction
V4	Design elements	Where isolated pockets of shotcrete are required to stabilise soft rock areas, this should be sensitively coloured and textured to replicate natural rock outcrops.	Contractor	Detailed design / construction
V5	Design elements	Safety barriers would be selected to minimise visual impacts and maintain views through the barrier.	Contractor	Detailed design
V6	Drainage infrastructure	Use local materials and resources where possible.	Contractor	Construction
V7	Drainage infrastructure	Stormwater discharge design would continue to be developed throughout detailed design to integrate the proposal with natural systems and reduce erosion.	Contractor	Detailed design / construction
NA1	Non-Aboriginal heritage	A Non-Aboriginal Heritage Management Plan (NAHMP) would be prepared and implemented as part of the CEMP. It would provide specific guidance on	Contractor	Detailed design / pre-construction

No.	Impact	Environmental safeguards and management measures	Responsibility	Timing
		measures and controls to be implemented to avoid and mitigate impacts to non-Aboriginal heritage. The NAHMP would be prepared in consultation with DPE.		
NA2	Non-Aboriginal heritage	The *EMF-HE-PR-0076 Unexpected Heritage Items Procedure* (Transport, 2022c) would be followed in the event that any unexpected heritage items, archaeological remains or potential relics of non-Aboriginal origin are encountered. Work would only re-commence once the requirements of that procedure have been satisfied.	Contractor	Detailed design / pre-construction
NA3	Non-Aboriginal heritage	All contractors involved in the proposal, including design professionals, helicopter operators and tradespeople, should receive a site-specific heritage induction prior to the commencement of works outlining the significance of the area, the locations of any heritage items, and the unexpected finds procedure.	Contractor	Pre-construction
NA4	Non-Aboriginal heritage	A Photographic Archival Record (PAR) of the Jenolan Caves Road failures and the stone embankment wall would be carried out prior to works commencing. This recording must be in line with the NSW Heritage Division publication *Photographic Recording of Heritage Items using Film or Digital Capture* (2006). A digital copy of the archival record should be provided to Heritage NSW.	Contractor	Pre-construction
NA5	Heritage impacts at ancillary facilities	The establishment of ancillary facilities, particularly at ancillary facility E, has the potential to result in incidental contractor damage to heritage fabric. Mitigation measures for the protection of heritage items, including Jenolan Caves House and the wider reserve, will be covered in the heritage induction.	Contractor	Pre-construction / construction
NA6	Heritage impacts to the surrounding environment	To reduce construction impacts to other areas of Jenolan Caves Road, other embankments and other areas of the Jenolan Karst Conservation Reserve, regular monitoring of vibration levels during construction for the existing roadway, rock cutting and stone embankment wall should be implemented.	Contractor	Pre-construction / construction
SW1	Soil and water	A SWMP would be prepared and implemented as part of the CEMP. The SWMP would identify all reasonably foreseeable risks relating to soil erosion and water pollution and describe how these risks would be addressed during construction. The plan would address issues relating to (but not limited to): • Clearing and boundaries • Chemical and fuel storage and use • Spills and incident management • Waste management, including using designated bins and transporting waste to a licensed facility for disposal • Soil and water management	Contractor	Detailed design / pre-construction

No.	Impact	Environmental safeguards and management measures	Responsibility	Timing
		• Erosion and sediment control through progressive ESCPs in line with the Blue Book (Landcom, 2004). The contractor should keep an up-to-date register of progressive ESCPs • Clean water diversion, including through temporary drainage, to minimise the amount of sediment-laden water discharged during construction • Stockpile site management (in line with Transport's Stockpile Management Procedures) • Contamination.		
SW2	Soil and water	Environmental incidents where material harm to the environment is caused or threatened should be managed and reported in line with the CEMP.	Contractor	Construction
SW3	Soil and water	A requirement for environmental management training of relevant construction personnel should be included in the Transport specifications for the proposal and should be documented in the CEMP and SWMP.	Contractor	Pre-construction / construction
SW4	Erosion and sediment runoff	Sediment basins are not feasible due to topography, space and clearing constraints. As such, a high focus on erosion control (particularly the use of temporary ground covers when rain is imminent) would be adopted during construction to minimise the amount of sediment-laden water discharged from the proposal during construction. If mulch is required as part of erosion and sediment controls, it will occur in accordance with the Roads and Maritime *Management of Tannins from Vegetation Mulch Environmental Direction* (Roads and Maritime, 2012).	Contractor	Pre-construction / construction
SW5	Discharges	As much as possible, discharges to the receiving surface water environment from the proposal should be avoided. Instead, strategies to disperse or infiltrate water on surrounding land should be used as much as possible.	Contractor	Construction
SW6	Discharges	Controlled discharges during construction are not to be concentrated at a single point to try to reduce the potential for downstream erosion.	Contractor	Pre-construction / construction
SW7	Discharges	If discharges are required to dewater parts of the proposal area during construction, water must first be treated to the following standards: • Turbidity: 25NTU (the upper limit for aquatic ecosystem protection in upland rivers and streams) • pH 6.5 to 8 • No visible oils, greases or litter.	Contractor	Pre-construction / construction

No.	Impact	Environmental safeguards and management measures	Responsibility	Timing
		The requirements for water quantity and quality in any discharges would default to typical Transport and Blue Book (Landcom, 2004) recommendations to comply with section 120 of the POEO Act.		
SW8	Leaf litter, sediments and minor slips during operation	Frequent inspection and cleaning (maintenance) of roadside drains and pipe inlets is recommended to reduce this risk.	Transport	Post-construction
SW9	Contaminated land	If contaminated areas are encountered during construction, appropriate control measures would be implemented to manage the immediate risks of contamination. All other works that may impact on the contaminated area would 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 Transport have been implemented.	Contractor	Construction
SW10	Accidental spill	A site-specific emergency spill plan would be developed and would include spill management measures in line with Transport's *Code of Practice for Water Management* (RTA, 1999) and relevant EPA guidelines. The plan would 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 and EPA officers).	Contractor	Detailed design / Pre-construction
SW11	Excavated material/spoil	A contamination assessment and waste classification report would be required to assess the environmental and human health risks of excavated soil as well as potential for material reuse or disposal in line with the POEO Act.	Contractor	Construction
SW12	Heavy rainfall management	Weather conditions would be monitored daily and no works would be conducted if there is an imminent threat of a heavy rainfall event (>75% chance of more than 5 millimetres). In the event of a rainfall event, works would cease if there is a risk of sediment loss off site or ground disturbance due to waterlogged conditions. Plant and equipment would not be stored at the failure sites to avoid risks associated with adverse weather events.	Contractor	Construction
B1	Biodiversity	A site-specific CEMP would be developed prior to construction taking place and implemented over the life of the proposal. The CEMP would incorporate adaptive management principles and would outline management actions to avoid inadvertently causing additional impacts to those described in this section. Management actions would avoid and/or limit the potential for indirect offsite impacts and include an appropriate erosion and sedimentation control plan and weed control activities. Any management actions should follow best practice protocols such as Landcom (2004) or the RTA Biodiversity Guidelines (2011).	Transport / contractor	Detailed design / pre-construction
B2	Biodiversity	A Flora and Fauna Management Plan would be prepared in line with Transport's Biodiversity Guidelines: Protecting and Managing Biodiversity on Projects (RMS,	Contractor	Detailed design / pre-construction

No.	Impact	Environmental safeguards and management measures	Responsibility	Timing
		2011) and implemented as part of the CEMP. It would include, but not be limited to: • Plans showing areas to be cleared and areas to be protected, including exclusion zones, protected habitat features and revegetation areas • Requirements set out in the Landscape Guideline (RMS, 2008) • Pre-clearing survey requirements • Procedures for unexpected threatened species finds and fauna handling • Protocols to manage weeds and pathogens.		
B3	Removal of native vegetation	Native vegetation removal would be minimised through detailed design and construction.	Transport / contractor	Detailed design / construction
B4	Removal of native vegetation	Ancillary facilities outside the proposal area (A, B, C and E) are to be located in cleared areas to avoid native vegetation removal and impacting threatened species which may occur in surrounding vegetation. Any stockpiling at existing ancillary facilities (i.e. ancillary facility A) is to remain within a fenced compound and not extend into areas of native vegetation. Fencing should be placed around ancillary facilities to delineate areas and prevent unintended impacts to native vegetation.	Contractor	Detailed design / pre-construction
B5	Removal of native vegetation	Pre-clearing surveys would be carried out in line with *Guide 1: Pre-clearing process* of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).	Contractor	Pre-construction
B6	Removal of native vegetation	Vegetation removal would be carried out in line with *Guide 4: Clearing of vegetation and removal of bushrock* of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).	Contractor	Construction
B7	Removal of native vegetation	Native vegetation would be re-established in line with *Guide 3: Re-establishment of native vegetation* of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011). This would include collection and use of local seed stock from surrounding vegetation to maintain the local genetic diversity, where appropriate.	Contractor	Pre-construction / post-construction
B8	Removal of native vegetation	The unexpected species find procedure is to be followed under *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011) if threatened ecological communities, not assessed in the biodiversity assessment, are identified in the proposal site.	Contractor	Pre-construction / construction
B9	Removal of native vegetation	A Tree and Hollow Replacement Plan should be prepared for any residual biodiversity impact that does not require offsets in line with the No Net Loss Guidelines. Where suitable land is not available for replacement, payment would be made to the Transport Conservation Fund.	Transport	Detailed design

No.	Impact	Environmental safeguards and management measures	Responsibility	Timing
B10	Removal of threatened fauna habitat	Removal of significant threatened species habitat should be avoided where possible, including hollow-bearing trees and large, old trees.	Transport / contractor	Detailed design / construction
B11	Removal of threatened fauna habitat	Fauna would be managed in line with *Guide 9: Fauna handling* of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).	Contractor	Pre-construction / construction
B12	Removal of threatened fauna habitat	Habitat would be replaced or re-instated in line with *Guide 5: Re-use of woody debris and bushrock* and *Guide 8: Nest boxes* of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).	Contractor	Construction
B13	Aquatic impacts	Impacts to aquatic habitat will be minimised through detailed design and construction.	Transport / contractor	Detailed design / construction
B14	Aquatic impacts	Aquatic habitat would be protected in line with *Guide 10: Aquatic habitats and riparian zones* of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011) and Section 3.3.2 *Standard precautions and mitigation measures of the Policy and guidelines for fish habitat conservation and management Update 2013* (DPI (Fisheries NSW) 2013).	Transport / contractor	Detailed design / construction
B15	Aquatic impacts	Stockpiling should be restricted to designated ancillary facilities as outlined in this report. Several first/second order streams occur near the proposal area and if material is stockpiled in this vicinity, any significant rainfall event would wash material down slope.	Contractor	Pre-construction / construction
B16	Groundwater dependent ecosystems	Interruptions to water flows associated with groundwater dependent ecosystems would be minimised through detailed design. No substantial impacts to groundwater flows are anticipated as a result of the proposal.	Transport	Detailed design
B17	Changes to hydrology	Changes to existing surface water flows would be minimised through detailed design. New drainage infrastructure (i.e. culverts) and water quality controls would be installed within the proposal area.	Transport / contractor	Detailed design / construction
B18	Edge effects on nearby native vegetation and habitat and invasion and spread of pathogens and disease	Exclusion zones would be set up at the limit of clearing in line *with Guide 2: Exclusion zones* of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).	Contractor	Pre-construction
B19	Invasion and spread of weeds	Weed species would be managed in line *with Guide 6: Weed management* of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).	Contractor	Pre-construction / construction
B20	Invasion and spread of pests	Pest species would be managed within the proposal site.	Contractor	Pre-construction / construction

No.	Impact	Environmental safeguards and management measures	Responsibility	Timing
B21	Noise, light, dust and vibration	Shading and artificial light impacts would be minimised through detailed design. The use of the helicopter is to be minimised where possible to avoid displacement of local fauna from noise.	Transport / contractor	Detailed design / construction
NV1	Noise and vibration	A Noise and Vibration Management Plan (NVMP) would be prepared and implemented as part of the CEMP. The NVMP would generally follow the approach in the *Interim Construction Noise Guideline* (ICNG) (DECC, 2009) and would identify: • All potential significant noise and vibration generating activities associated with the proposal • Feasible and reasonable mitigation measures to be implemented • A vibration monitoring program to assess performance against relevant vibration criteria • A vibration minimisation procedure to mitigate the risk of activities with intensive vibration (such as drilling of soil nails) resulting in further slope failures • Arrangements for consultation with affected neighbours and sensitive receivers, including notification and complaint handling procedures • Contingency measures to be implemented in the event of non-compliance with noise and vibration criteria.	Contractor	Detailed design / pre-construction
NV2	Noise and vibration	All receivers likely to be affected by the proposal would be notified at least 5 working days prior to commencement of any works associated with the proposal that may have an adverse noise or vibration impact. The notification would provide details of: • The proposal • Construction period and construction hours • Contact information for management staff • Complaint and incident reporting • How to obtain further information. For passive receivers near ancillary facilities A and B, notification would be provided via signage on publicly accessible trails (including the Binoomea Ridge Trail and the Bulls Camp Trail) for the duration of construction. At a minimum, signage would be established at the highly affected noise distance from these ancillary facilities.	Contractor	Detailed design / pre-construction / construction
NV3	Construction noise	Noise impacts would be minimised in accordance with Practice Note 7 in Roads and Maritime Services' Environmental Noise Management Manual and Environmental fact sheet No. 2- Noise management and Night Works.	Contractor	Construction

No.	Impact	Environmental safeguards and management measures	Responsibility	Timing
NV4	Construction noise	Where feasible and reasonable, construction should be carried out during the standard daytime working hours. Work generating high noise and/or vibration levels should be scheduled during less sensitive time periods.	Contractor	Construction
NV5	Construction noise from machinery and equipment	All plant and equipment would be appropriately maintained to ensure optimum running conditions, with periodic monitoring.	Contractor	Construction
NV6	Construction noise from machinery and equipment	Noise-emitting plant would be directed away from sensitive receivers, where possible.	Contractor	Construction
NV7	Construction noise from machinery and equipment	Traffic flow, parking and loading and unloading areas would be planned to minimise reversing movements within the proposal site.	Contractor	Construction
NV8	Construction noise from machinery and equipment	Reversing alarms that have a tonal noise character are to be avoided during out of hours activities. Quacker style or 'smart' reversing alarms are to be used during night-time activities (pending safety approvals).	Contractor	Construction
NV9	Construction noise from inappropriate practices	Site inductions would be provided to train staff on ways to minimise construction noise impacts on-site. Responsible work practices include: • Avoiding shouting and slamming doors • Where practical, operating machinery at low speed or power and switch off when not in use rather than left idling for prolonged periods • Minimising reversing • Avoiding dropping materials from height and avoiding metal to metal contact on material.	Contractor	Construction
AH1	Aboriginal heritage	• The *EMF-HE-PR-0076 Unexpected Heritage Items Procedure* (Transport, 2022c) would be followed in the event that an unknown or potential Aboriginal object/s, including skeletal remains, is found during construction. This applies where Transport 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 would only re-commence once the requirements of that Procedure have been satisfied.	Contractor	Detailed design / pre-construction
AH2	Aboriginal heritage	If there are any changes to construction or maintenance methodology, the Aboriginal Cultural Heritage Advisor – Western Region should be contacted.	Contractor	Detailed design / pre-construction / construction
TT1	Traffic and transport	A Traffic Management Plan (TMP) would be prepared and implemented as part of the CEMP. The TMP would be prepared in line with the Traffic Control at Work	Contractor	Detailed design / Pre-construction

No.	Impact	Environmental safeguards and management measures	Responsibility	Timing
		Sites Manual (Transport, 2022f) and QA Specification G10 Control of Traffic (Transport, 2008). The TMP would include: • Confirmation of haulage routes • Measures to maintain access to local roads and properties • Site-specific traffic control measures (including signage) to manage and regulate traffic movement • Measures to maintain pedestrian and cyclist access • Requirements and methods to consult and inform the local community of impacts on the local road network • Access to construction sites including entry and exit locations and measures to prevent construction vehicles queuing on public roads • A response plan for any construction traffic incident • 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 • Monitoring, review and amendment mechanisms • Procedures for notification and approval of proposed detours (including pedestrian detours), alternate access routes and signage by NPWS (if they occur on NPWS estate).		
TT2	Use of a helicopter	A Helicopter Management Plan (HMP) would be prepared and implemented as part of the CEMP. The HMP would be prepared in accordance with Civil Aviation Safety Authority guidelines and developed in consultation with NPWS and Jenolan Caves Reserve Trust. The HMP would include: • Procedures for mobilisation, operation and demobilisation of the helicopter, including refuelling and maintenance of the helicopter • Requirements to establish exclusion zones near helicopter operations • Requirements for vehicular and pedestrian traffic management where helicopter operations would occur near publicly accessible areas.	Contractor	Detailed design / Pre-construction
TT3	Vehicle movement	Vehicle movements (in particularly heavy vehicles) to the proposal would avoid peak periods, where possible.	Contractor	Construction
TT4	Property access impacts	Access to properties along Jenolan Caves Road would be available throughout construction. Where impacts are anticipated, consultation would be carried out with the affected property owner to confirm any access arrangements.	Contractor	Construction
SE1	Socio-economic	A Communication Plan (CP) would 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):	Contractor	Pre-construction

No.	Impact	Environmental safeguards and management measures	Responsibility	Timing
		• Mechanisms to provide details and timing of proposed activities to affected residents and passive receivers, including changed traffic and access conditions • Contact name and number for complaints.		
SE2	Business impacts	Where access to the Jenolan Caves precinct is impacted, consultation would be carried out with the Jenolan Caves Reserve Trust and all businesses operating within the precinct to confirm access requirements including timing and the nature of access required. Where access to the precinct is impacted, 48 hours' notice is required to be given to both the Jenolan Caves Reserve Trust and National Parks and Wildlife Service.	Contractor	Construction
SE3	Business impacts	Should closures of the precinct occur, these would be managed in consultation with all relevant stakeholders and would avoid any busy periods such as school holidays and public holidays.	Contractor / Transport	Construction
O1	Air quality	Air quality impacts would be integrated into the CEMP. Air quality provisions would include: • Identification of potential sources of air pollution • Air quality management objectives consistent with any relevant published EPA and/or EES guidelines • Mitigation and suppression measures to be implemented • Methods to manage work during strong winds or other adverse weather conditions • A progressive rehabilitation strategy for exposed surfaces.	Contractor	Detailed design / pre-construction
O2	Bushfire	A Bushfire Management Plan (BMP) would be prepared and implemented as part of the CEMP. The BMP would include, but not be limited to: • Processes to mitigate bushfire risk • Requirements to stop work that could result in ignition of a fire, including – When there are bushfires within the vicinity of the proposal – During a Park Fire Ban for Jenolan Karst Conservation Reserve – During a declared Total Fire Ban for the zone which includes Jenolan Karst Conservation Reserve • Procedures to follow during periods of high bushfire risk in the proposal area or at the ancillary facilities, including regular weather checks • Response procedures in the event of a bushfire.	Contractor	Construction

No.	Impact	Environmental safeguards and management measures	Responsibility	Timing
O3	Bushfire	Consultation with the NPWS, Rural Fire Service and other emergency services would be carried out throughout construction to advise of any access changes. Where possible, access through the proposal site is to be maintained at all times.	Contractor	Construction
O4	Hazard and risk management	A Hazard and Risk Management Plan (HRMP) would be prepared and implemented as part of the CEMP. The HRMP would include, but not be limited to: • Details of hazards and risks associated with the activity • Measures to be implemented during construction to minimise these risks • 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 • A monitoring program to assess performance in managing the identified risks • Contingency measures to be implemented in the event of unexpected hazards or risks arising, including emergency situations. The HRMP would be prepared in line with relevant guidelines and standards, including relevant Safe Work Australia *Codes of Practice*, and EPA or DPE publications.	Contractor	Detailed design / pre-construction
O5	Property and land use	Site specific management plans would be developed in consultation with National Parks and Wildlife Service and Jenolan Caves Reserve Trust for the use of identified ancillary facility locations. These plans would include details of how these areas are to be used and requirements to maintain access to publicly accessible trails near ancillary facilities. For ancillary facility A, this would include requirements for NPWS access to Binooma Ridge Trail to be maintained at all times.	Contractor	Pre-construction / Construction
O6	Property and land use	Areas to be used within existing car parks are to be minimised with alternative locations to be used based on where the demand for parking is at the time.	Contractor	Construction
O7	Waste	A Waste Management Plan (WMP) would be prepared and implemented as part of the CEMP. The WMP would include but not be limited to: • Measures to avoid and minimise waste associated with the proposal • Classification of wastes and management options (re-use, recycle, stockpile, disposal) • Statutory approvals required for managing both on and off-site waste, or application of any relevant resource recovery exemptions • Procedures for storage, transport and disposal • Monitoring, record keeping and reporting.	Contactor	Detailed design / pre-construction

No.	Impact	Environmental safeguards and management measures	Responsibility	Timing
		The WMP would be prepared taking into account the *Environmental Procedure - Management of Wastes on Transport for NSW Land* (Transport, 2014) and relevant Transport Waste fact sheets.		
C1	Cumulative impacts	The Consultation Plan would include consultation with Transport, NPWS and the Jenolan Caves Reserve Trust to determine the timing of all works proposed and details of how to manage any impacts.	Contractor	Construction

7.3 Licensing and approvals

Table 7-2 Summary of licensing and approval required

Instrument	Requirement	Timing
Roads Act 1993	Road occupancy licence	Prior to the start of the activity.
Heritage Act 1977 (s60)	Permit to carry out activities to an item listed on the State Heritage Register or to which an interim heritage order applies from the Heritage Council of NSW.	Prior to start of the activity.
National Parks and Wildlife Act 1974	Authorisation to carry out work within the Jenolan Karst Conservation Reserve. Refer to Section 4.2.2 for further details.	Prior to start of the activity.

8. Conclusion

This chapter provides the justification for the proposal taking into account its biophysical, social and economic impacts, the suitability of the site and whether or not the proposal is in the public interest. The proposal is also considered in the context of the objectives of the EP&A Act, including the principles of ecologically sustainable development as defined in Section 193 of the Environmental Planning and Assessment Regulation 2021.

8.1 Justification

The proposal is consistent with a number of State and local strategies and plans, as outlined in section 2.1.

While there would be minor non-Aboriginal heritage, soil, noise and vibration, traffic and transport, water and biodiversity impacts as a result of the proposal, these have been minimised or mitigated wherever possible.

8.1.1 Social factors

During operation, the proposal would result in positive long-term social impacts through:

- The re-opening of access to the Jenolan Caves precinct via the Five Mile stretch of road
- Improved safety conditions along Jenolan Caves Road.

Although minor, the proposal may result in some adverse impacts to the local community associated with:

- Increases in noise and vibration impacts throughout the construction phase
- Moderate-high visual impacts associated with reinstatement of the access ramps and failures as two RSWs.

Although construction vehicles and ancillary facilities would be used throughout the construction phase, these are not anticipated to alter access to the Jenolan Caves precinct or the Jenolan Karst Conservation Reserve any further than current conditions given Jenolan Caves Road is closed through the proposal area.

The listed adverse social impacts are all minor and are largely temporary in nature. Overall, the benefits of reinstating Jenolan Caves Road at the Five Mile are anticipated to outweigh the potential adverse social impacts identified.

8.1.2 Biophysical factors

Works for the proposal would be conducted in an already disturbed environment, meaning threatened species, ecological communities and migratory species, within the definitions of the BC Act, are unlikely to be impacted. The proposal would result in the removal of 0.995 hectares of native vegetation, however this is anticipated to have minimal impacts on threatened fauna given the already disturbed nature of the proposal area and the substantial amount of threatened fauna habitat in the surrounding reserve. No offsets would be required as a result of the proposal.

8.1.3 Economic factors

Access to the Jenolan Caves precinct via the Five Mile is currently not possible. Jenolan Caves Road has been closed to the public at the Five Mile as a result of the slope failures making it not possible to travel along the road, meaning access to the precinct is only possible via the Two Mile. As such, journey times for tourists and workers would not be adversely affected any further as a result of the construction of the proposal through the presence of construction vehicles and lane closures.

The operation of the proposal is anticipated to improve economic conditions in the Jenolan Caves precinct through improved access and safety conditions.

8.1.4 Public interest

As has been discussed, the proposal would improve access to the Jenolan Caves precinct and the Jenolan Karst Conservation Reserve. The precinct is noted as a major tourist attraction in NSW, with over 230,000 visitors annually. The Jenolan Caves House and the wider reserve also have heritage value, as is discussed in section 6.2. As such, the reinstatement of Jenolan Caves Road at the Five Mile through the proposal would be in the public interest given this would result in improved access to tourist and heritage sites.

The proposal is considered to be in the public interest as the reinstatement of Jenolan Caves Road would fulfil the needs of the majority. The proposal represents a cost-efficient investment in public infrastructure to maximise long-term social and economic benefits, while minimising long-term impacts to businesses and tourism. During the construction phase, the proposal would result in some short-term impacts on visual amenity and the local noise environment.

Compared with other alternatives considered, as well as with a 'do nothing' scenario, the adverse impacts of the proposal would be outweighed by its long-term benefits. The overall result would be improved access and safety conditions once the proposal is operational.

8.1.5 National Park factors

The proposal is located within the Jenolan Karst Conservation Reserve, which is designated as National Park. A summary of impacts relevant to the proposal on National Park land is provided in Table 8-1.

Table 8-1 Summary of National Park impacts

Category of impact	Significance of impacts		
	Extent of impact	Nature of impact	Environmentally sensitive features
Physical and chemical	Short-term – low adverse	• Potential erosion and sedimentation of surrounding vegetation and watercourses • Contamination of soil or water due to spills and leaks • Generation of dust and noise	• Steep slope • Watercourses • Native vegetation • Sydney Drinking Water Catchment • Jenolan Caves precinct including accommodation
	Long-term – positive	• Stabilisation of existing slope subject to past failures	
Biological	Short-term – low adverse	• Clearance of native vegetation (not threatened), however area to be impacted is largely cleared due to the slope failure and the emergency stabilisation works • Vegetation clearance would be required for the excavation of access ramps to the base of each failure, however these are necessary for the road to be reinstated and would be minimised as much as possible • No vegetation clearance would be required for ancillary facilities outside the proposal area (ancillary facilities A, B, C and E) • Impacts on habitat for threatened species (minimal given substantial habitat in surrounding reserve).	• Potential habitat for threatened species

Category of impact	Significance of impacts		
	Extent of impact	Nature of impact	Environmentally sensitive features
Natural resources	Long-term – positive	• Stabilisation of slope would prevent any future failures, thus minimising impacts on other surrounding vegetation and vegetation down slope.	
	Short-term – low adverse	• Impacts on access to Jenolan Karst Conservation Reserve due to road closures.	• Watercourses • Native vegetation • Sydney Drinking Water Catchment • Jenolan Karst Conservation Reserve
	Long-term – positive	• Improved access into the Jenolan Karst Conservation Reserve.	
Community	Short-term – low adverse	• Road closures.	• Jenolan Caves precinct including accommodation
	Long-term – low adverse	• Introduction of new built structure into the natural visual environment, although design reduces the dominance of this structure.	
	Long-term – positive	• Stabilisation would allow the existing road to open to the public, improving access to the Jenolan Caves precinct • Improvement to public safety through stabilisation of the slope.	
Cultural heritage	Nil (Aboriginal heritage)	Nil	Nil
	Long-term – low adverse (non-Aboriginal heritage)	• Introduction of new structure into the natural environment which forms part of various heritage listings • Introduction of a modern structure into the heritage precinct	• State Heritage Listed Jenolan Caves Reserve • World Heritage Listed Greater Blue Mountains Area

8.2 Objects of the EP&A Act

Table 8-2 Proposal alignment with the objects of the EP&A Act

Object	Comment
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.	Subject to future weather conditions, the proposal, along with the broader program of work, would allow the reopening of full public vehicular access into the Jenolan Caves Precinct which is currently limited in a way that may result in lower visitation into the precinct, therefore, impacting on the businesses operating in this location. The proposal would also seek to stabilise the slope to ensure that the risk of further failures is reduced.

Object	Comment
1.3(b) To facilitate ecologically sustainable development by integrating relevant economic, environmental and social considerations in decision-making about environmental planning and assessment.	Details of how the proposal meets the principles of ecologically sustainable development are outlined in section 8.3.
1.3(c) To promote the orderly and economic use and development of land.	The proposal seeks to restore the existing use of land downslope of the failures for the purpose of a road which would, in turn, improve access to the existing businesses located within the Jenolan Caves precinct.
1.3(d) To promote the delivery and maintenance of affordable housing.	Not relevant to the proposal.
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.	Although the proposal would result in the clearance of native vegetation which acts as habitat for threatened fauna, the cleared vegetation would be in an already disturbed environment due to the slope failures and the existing road corridor. Some vegetation clearance would be required for excavation of the access ramps to the base of each failure, however this is necessary for the road to be reinstated and would be minimised as much as possible. Additionally, there is substantial habitat for threatened fauna in the surrounding reserve, meaning impacts to fauna would be minimal. The proposal would not cause adverse impacts to key fish habitat or groundwater dependent ecosystems. The operation of the proposal would not increase the risk of injury or mortality to wildlife on pre-failure conditions and no offsets would be required as a result of the proposal. As such, the protection of the environment and the conservation of threatened species and ecosystems would not be threatened by the construction or operation of the proposal.
1.3(f) To promote the sustainable management of built and cultural heritage (including Aboriginal cultural heritage).	The proposal would have a minor adverse impact on non-Aboriginal heritage and would have a minor visual impact on items of non-Aboriginal heritage significance. Refer to section 6.2. The proposal would have a negligible impact to Aboriginal cultural heritage values, as per section 6.6.
1.3(g) To promote good design and amenity of the built environment.	The proposal would incorporate design features, including a shotcrete finish, to reduce the visual impact of the proposal on the surrounding natural and built environment.
1.3(h) To promote the proper construction and maintenance of buildings, including the protection of the health and safety of their occupants.	Not relevant to the proposal.
1.3(i) To promote the sharing of the responsibility for environmental planning and assessment between the different levels of government in the State.	Not relevant to the proposal.
1.3(j) To provide increased opportunity for community participation in environmental planning and assessment.	Due to the small-scale nature of the proposal and that it can be viewed as a maintenance activity to make sure of ongoing use of the existing access road to the Jenolan Caves Precinct, opportunities for community participation are limited. Consultation has been carried out to date in the form of updates via Transport's 'Current Projects' webpage, and the community would continue to be well informed about the proposal throughout construction to make sure impacts to the community are minimised, where possible.

8.3 Ecologically sustainable development

ESD is development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends. The principles of ESD have been an integral consideration throughout the development of the proposal.

ESD requires the effective integration of economic and environmental considerations in decision-making processes. The four main principles supporting the achievement of ESD are discussed below.

8.3.1 The precautionary principle

The precautionary principle deals with reconciling scientific uncertainty about environmental impacts with certainty in decision-making. It provides that where there is a threat of serious or irreversible environmental damage, the absence of full scientific certainty should not be used as a reason to postpone measures to prevent environmental degradation.

This principle was considered during options development (refer to section 2.4). The precautionary principle has guided the assessment of environmental impacts for this REF and the development of mitigation measures.

The preferred option was selected as it can provide long term safety for road users and improve access to the Jenolan Caves precinct, including public vehicular access into the precinct. The proposal does not pose a risk of serious or irreversible environmental damage. Adverse impacts associated with the proposal would be short term and minor. Measures to reduce adverse impacts as far as practicable have also been identified within this REF.

Best available technical information, environmental standards and measures have been used to minimise environmental risks. These include several safeguards that have been proposed to minimise potential impacts. These safeguards would be implemented during construction and operation of the proposal. No safeguards have been postponed because of lack of scientific certainty.

A CEMP would be prepared before construction starts. This requirement would make sure the proposal achieves a high-level of environmental performance. No mitigation measures or management mechanisms would be postponed because of a lack of information.

8.3.2 Intergenerational equity

Social equity is concerned with the distribution of economic, social and environmental costs and benefits. Inter-generational equity introduces a temporal element with a focus on minimising the distribution of costs to future generations.

The proposal would not result in any impacts that are likely to adversely impact on the health, diversity or productivity of the environment for future generations. The proposal would assist in meeting road safety objectives outlined in several NSW Government strategic plans and would improve access to the Jenolan Caves Precinct which is an important tourism asset identified in the Central West and Orana Regional Plan.

8.3.3 Conservation of biological diversity and ecological integrity

The environment in which the proposal would be carried out is a roadside hillslope which has been subject to slope failure. A thorough assessment of the existing local environment was carried out to identify and manage any potential impacts of the proposal on local biodiversity.

The proposal would not have a significant impact on biological diversity and ecological integrity. An assessment of the biodiversity impacts and appropriate site-specific safeguards are provided in section 6.4.4. An assessment of section 171 of the EP&A Regulation factors that broadly consider biological diversity and ecological integrity of the proposal area has been included in Appendix A.

8.3.4 Improved valuation, pricing and incentive mechanisms

The principle of internalising environmental costs into decision making requires consideration of all environmental resources which may be affected by the carrying out of a project, including air, water, land and living things.

The REF has examined the environmental consequences of the proposal and identified mitigation measures to manage the potential for adverse impacts. The requirement to implement these mitigation measures would result in an economic cost to Transport. The implementation of mitigation measures would increase both the capital and operating maintenance costs of the proposal. This signifies those environmental resources have been given appropriate valuation.

The detailed design would be developed with an objective of minimising potential impacts on the surrounding environment. This indicates that the proposal is being developed with an environmental objective in mind.

8.4 Conclusion

The proposed restoration and reinstatement at the Five Mile section of Jenolan Caves Road is subject to assessment under Division 5.1 of the EP&A Act. The 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 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 EPBC Act.

A number of potential environmental impacts from the proposal have been avoided or reduced during the concept design development and options assessment. The proposal as described in the REF best meets the proposal objectives but would still result in some minor impacts on biodiversity, landscape character and visual characteristics, non-Aboriginal heritage, water, soils and the surrounding noise environment. Safeguards and management measures as detailed in this REF would mitigate or minimise these expected impacts. The proposal would also improve safety for road users along the section of Jenolan Caves Road and reinstate road access for the public into the Jenolan Caves precinct, alongside the remainder of the program of works. On balance the proposal is considered justified and the following conclusions are made.

8.4.1 Significance of impact under NSW legislation

The proposal would be unlikely to cause a significant impact on the environment. Therefore, it is not necessary 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. A Biodiversity Development Assessment Report or Species Impact Statement is not required. The proposal is subject to assessment under Division 5.1 of the EP&A Act. Consent from Council is not required.

8.4.2 Significance of impact under Australian legislation

The proposal is not likely to have a significant impact on matters of national environmental significance or the environment of Commonwealth land within the meaning of the Environment Protection and Biodiversity Conservation Act 1999. A referral to the Australian Department of Climate Change, Energy, the Environment and Water is not required.

9. Certification

This review of environmental factors provides a true and fair review of the proposal 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 proposal.

Lachlan Mitchell

Consultant, Environment & Planning

Aurecon

25/08/2023

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

Pete Styles

Senior Project Development Manager

Transport for NSW

29/08/2023

10. EP&A Regulation publication requirement

Table 10-1 EP&A Regulation publication requirement

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

11. Terms and acronyms used in this REF

Term /acronym	Description
AEP	Annual exceedance probability
AHIMS	Aboriginal Heritage Information Management System
AHMP	Aboriginal Heritage Management Plan
AQMP	Air Quality Management Plan
BAM	Biodiversity assessment methodology
BAR	Biodiversity assessment report
BC Act	*Biodiversity Conservation Act 2016 (NSW).*
CEEC	Critically endangered ecological community
CEMP	Construction / Contractor's environmental management plan
CMP	Conservation Management Plan
CNVG	Construction noise and vibration guideline
CP	Communication Plan
DCP	Development Control Plan
DPE	NSW Department of Planning and Environment
EEC	Endangered ecological community
EIA	Environmental impact assessment
EP&A Act	*Environmental Planning and Assessment Act 1979* (NSW). Provides the legislative framework for land use planning and development assessment in NSW
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth). Provides for the protection of the environment, especially matters of national environmental significance, and provides a national assessment and approvals process.
EPA	NSW Environment Protection Authority
EPL	Environment protection licence
ESCP	Erosion and sediment control plans
ESD	Ecologically sustainable development
ESMR	Erosion and Sedimentation Management Report
FM Act	*Fisheries Management Act 1994* (NSW)
GDE	Groundwater dependent ecosystem
Heritage Act	*Heritage Act 1977* (NSW)
HRMP	Hazard and Risk Management Plan
IBRA	Interim Biogeographic Regionalisation for Australia
ICNG	Interim Construction Noise Guideline
LCVIA	Landscape character and visual impact assessment

Term /acronym	Description
LCZ	Landscape character zone
LEP	Local Environmental Plan. A type of planning instrument made under Part 3 of the EP&A Act.
LGA	Local government area
MCA	Multi criteria analysis
MNES	Matters of national environmental significance under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.
NAHMP	Non-Aboriginal Heritage Management Plan
NHL	National heritage list
NML	Noise management level
NPWS	National Park and Wildlife Service
NPW Act	*National Parks and Wildlife Act 1974* (NSW)
NT	National Trust of Australia
NVMP	Noise and vibration management plan
PACHCI	Procedure for Aboriginal Cultural Heritage Consultation and Investigation
PAR	Photographic archival record
PCT	Plant community type
PESA	Preliminary Erosion and Sedimentation Assessment
PMST	Protected matters search tool
POEO Act	*Protection of the Environment Operations Act 1997* (NSW)
RBL	Rated background level
REF	Review of Environmental Factors
RNE	Register of the National Estate
RSW	Reinforced soil wall
Roads and Maritime	NSW Roads and Maritime- dissolved by the Transport Administration Amendment Bill in August 2019. Al functions 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 (Transport and Infrastructure)	State Environmental Planning Policy (Transport and Infrastructure) 2021
SHR	State heritage register
SIS	State Infrastructure Strategy
SOHI	Statement of Heritage Impact
SWMP	Soil and Water Management Plan
TEC	Threatened ecological community
Transport	Transport for NSW
TMP	Traffic Management Plan

Term /acronym	Description
VIS	Vegetation Information Sydney
VM	Value management
WHL	World heritage list
WMP	Waste Management Plan

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Appendix A

Consideration of section 171(2) factors and matters of national environmental significance and Commonwealth land

Consideration of Section 171 factors

In addition to the requirements of the Guideline for Division 5.1 assessments (DPE 2022a) and the *Roads and Related Facilities EIS Guideline* (DUAP 1996) as detailed in the 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 proposal on the natural and built environment.

Factor	Description of impact	Duration and extent
(a) Any environmental impact on the community?	Construction of the proposal would result in short-term minor noise impacts and minor traffic impacts to the local community for the duration of construction. Access to the Jenolan Caves precinct via the Five Mile is currently blocked as a result of the slope failures, meaning traffic and access disruptions are not anticipated to exceed those that already exist. Native vegetation would be cleared as part of the proposal, however the impacts that this would have on threatened species is anticipated to be minor. Impacts would be minimised by the implementation of safeguards and management measures included in section 7.2. The proposal would have a positive long-term effect on the community by improving access to the Jenolan Caves precinct and improving the safety for users of Jenolan Caves Road.	Short-term: minor adverse Long-term: benefit
(b) Any transformation of the locality?	Construction of the proposal would not result in any short-term transformation of the locality given the road is currently closed and unsafe for vehicles to travel on. After the construction of the proposal, the locality would continue to be dominated by the existing environment including the Jenolan Karst Conservation Reserve and the Jenolan Caves precinct. The RSW installed as part of the proposal would transform the immediate locality and would have minor visual impacts in the long-term.	Short-term: nil Long-term: Minor adverse
(c) Any environmental impact on the ecosystems of the locality?	0.995 hectares of native vegetation would be cleared as part of the proposal. This vegetation is considered to hold potential habitat for some threatened fauna species, however given the proposal is located in an already disturbed environment (due to slope failures and the existing road corridor) and there is substantial threatened fauna habitat in the surrounding Jenolan Karst Conservation Reserve, these impacts are anticipated to be minimal. Some vegetation clearance would be required for the excavation of access ramps to the base of each failure, however this would be necessary for the road to be reinstated and would be minimised as much as possible. No vegetation clearance would be required for ancillary facilities outside of the proposal area (ancillary facilities A, B, C and E).	Short-term: minor adverse Long-term: minor adverse
(d) Any reduction of the aesthetic, recreational, scientific or other environmental quality or value of a locality?	During construction, the proposal would impact the aesthetic values of the wider locality through dust generation, noise, traffic and transport and visual impacts. Mitigation measures for these impacts are outlined in section 7.2. At operation, the RSW installed as part of the proposal would alter the visual environment of the proposal area, however this would only impact aesthetic values to a minor extent.	Short-term: minor adverse Long-term: minor adverse
(e) Any effect on any locality, place or building having aesthetic, anthropological, archaeological, architectural, cultural, historical, scientific or social significance or other special value for	The proposal is located within the road reserve and heritage curtilage (at ancillary facilities) of the State heritage listed Jenolan Caves Reserve and therefore has the potential to impact the significance of the item. The option chosen for the road reinstatement has been determined to not have a major impact on the heritage significance of the item. Similarly, the proposal is anticipated to impact Aboriginal cultural heritage to a negligible extent given the already disturbed site as a result of previous road construction activities and the recent slope failures.	Short-term: minor adverse Long-term: neutral

Factor	Description of impact	Duration and extent
present or future generations?		
(f) Any impact on the habitat of protected fauna (within the meaning of the *Biodiversity and Conservation Act 2016*)?	0.995 hectares of PCT 821 would be cleared as part of the proposal. PCT 821 acts as habitat for 12 species of threatened fauna in the locality under the BC Act. However, given the proposal is located in an already disturbed environment and there is substantial habitat for threatened fauna in the surrounding reserve, impacts to the habitat of protected fauna are anticipated to be minor. Some vegetation clearance would be required for the excavation of access ramps to the base of each failure, however this would be necessary for the road to be reinstated and would be minimised as much as possible. No vegetation clearance would be required for ancillary facilities outside of the proposal area (ancillary facilities A, B, C and E).	Short-term: minor adverse Long-term: minor adverse
(g) Any endangering of a species of animal, plant or other form of life, whether living on land, in water or in the air?	The proposal is not anticipated to impact threatened fauna to a major extent. Some threatened fauna habitat would be removed as part of the proposal's construction, however given the large extent of potential habitat within the wider Jenolan Karst Conservation Reserve, these impacts would be minor. Additionally, impacts to key fish habitat are expected to be minor given these mapped areas only intersect the proposal at an ancillary facility and in an already disturbed environment. No threatened flora species would be impacted by the proposal. Wildlife connectivity would not be impacted by the operation of the proposal and the injury or mortality of fauna in the proposal area would not increase on pre-failure conditions as a result of the proposal's operation.	Short-term: minor adverse Long-term: nil
(h) Any long-term effects on the environment?	The road reinstatement would prevent further creep and erosion and would improve drainage around the proposal area. The operation of the proposal would not increase the risk of injury or mortality to threatened fauna any further than pre-failure conditions.	Long-term: benefit
(i) Any degradation of the quality of the environment?	Construction activities have the potential to impact water quality through increased sediment, waste and fuel runoff. Additionally, excavation works would be required to construct access ramps to the base of each failure, which would impact soils within the proposal area during the construction phase. These potential impacts would be managed in line with the mitigation measures outlined in section 7.2. Long-term degradation of the nearby environment is not anticipated as a result of the proposal.	Short-term: minor adverse Long-term: nil
(j) Any risk to the safety of the environment?	The reinstatement of Jenolan Caves Road is anticipated to improve safety conditions for users of the road and for the surrounding environment.	Long-term: major benefit
(k) Any reduction in the range of beneficial uses of the environment?	Access to the Jenolan Karst Conservation Reserve and the Jenolan Caves precinct is already restricted via the Five Mile, meaning the construction of the proposal would not limit the range of beneficial uses of the surrounding environment any further than existing conditions. Once operational, the proposal would increase access to the reserve and precinct.	Short-term: nil Long-term: benefit
(l) Any pollution of the environment?	The proposal could potentially result in water pollution from sediments, waste and fuels. Management of water quality impacts would be carried out in line with the safeguards outlined in section 7.2. The proposal would also result in minor air emissions from plant and equipment and the generation of dust during construction. Safeguards for these impacts are also outlined in section 7.2.	Short-term: minor adverse Long-term: nil

Factor	Description of impact	Duration and extent
(m) Any environmental problems associated with the disposal of waste?	Any waste generated throughout the construction phase would be treated and disposed of appropriately. The proposal is not anticipated to result in an increase in waste throughout its operation.	Short-term: minor adverse Long-term: nil
(n) Any increased demands on resources (natural or otherwise) that are, or are likely to become, in short supply?	All resources required for the proposal are available and not in short supply.	Nil
(o) Any cumulative environmental effect with other existing or likely future activities?	The cumulative benefit of the Jenolan Caves Road program of works outweighs the cumulative impacts. The increased access and safety conditions along the entire road would benefit road users and businesses within the Jenolan Caves precinct.	Long-term: benefit
(p) Any impact on coastal processes and coastal hazards, including those under projected climate change conditions?	There are no anticipated impacts to coastal processes or coastal hazards.	Nil
(q) Any applicable local strategic planning statements, regional strategic plans or district strategic plans made under the Act, Division 3.1?	Strategic plans relevant to the proposal which have been considered in this REF (refer to Section 2.1.1 and 2.1.2) include: • Central West and Orana Regional Plan 2041 • Oberon Council Community Strategic Plan 2019-2040 • Oberon Council Local Strategic Planning Statement 2040.	Nil
(r) Any other relevant environmental factors?	All relevant environmental factors to the proposal have been considered in this REF (refer to Chapter 6).	Nil

Matters of National Environmental Significance and Commonwealth land

Under the environmental assessment provisions of the EPBC Act 1999, the following matters of national environmental significance and impacts on Commonwealth land are required to be considered to assist in determining whether the proposal should be referred to the Australian Government Department of Climate Change, Energy, the Environment and Water.

A referral is not required for proposed actions that may affect nationally listed threatened species, endangered ecological communities and migratory species. Impacts on these matters are still assessed as part of the REF in accordance with Australian Government significant impact criteria and taking into account relevant guidelines and policies.

Factor	Impact
(a) Any impact on a World Heritage property? The proposal area is located within the road reserve and heritage curtilage (at ancillary facilities) of the World Heritage listed Greater Blue Mountains Area. Impacts to this listing are expected to be minimal given works would mostly occur within the existing road corridor. Works for the large culvert at the northern end of the proposal area would extend into the heritage listed area, however given this would only reinstate and slightly increase the size of an existing culvert, impacts to the Greater Blue Mountains Area are anticipated to be minor.	Minor
(b) Any impact on a National Heritage place? The proposal area is located within the road reserve and heritage curtilage (at ancillary facilities) of the Nationally Heritage listed Greater Blue Mountains Area. Impacts to this listing are expected to be minimal given works would mostly occur within the existing road corridor. Works for the large culvert at the northern end of the proposal area would extend into the heritage curtilage of the listed area, however given this would only reinstate and slightly increase the size of an existing culvert, impacts to the Greater Blue Mountains Area are anticipated to be minor.	Minor
(c) Any impact on a wetland of international importance?	Nil
(d) Any impact on a listed threatened species or communities? Threatened fauna habitat would be cleared as part of the proposal, however the extent of clearing would be minor. Additionally, substantial threatened fauna habitat exists in the wider Jenolan Karst Conservation Reserve, meaning overall impacts to habitat would be minimal. No impacts to threatened flora species are anticipated.	Minor
(e) Any impacts on listed migratory species?	Nil
(f) Any impact on a Commonwealth marine area? The proposal is not located within a Commonwealth marine area.	Nil
(g) Does the proposed modification involve a nuclear action (including uranium mining)? The proposal would not involve nuclear action.	Nil
(h) Additionally, any impact (direct or indirect) on Commonwealth land? The proposal would not impact any Commonwealth land.	Nil

Appendix B

Statutory consultation checklists

SEPP (Transport and Infrastructure)

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	Oberon Council and the occupiers of adjoining land	Section 2.110
Bus depots	Does the project propose a bus depot?	No	Oberon 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	Oberon 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?	No	Oberon Council	Section 2.14

Note: See interactive map Coastal management - (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	Oberon Council	Section 2.10
Traffic	Are the works likely to generate traffic to an extent that will strain the capacity of the existing road system in a local government area?	No	Oberon Council	Section 2.10
Sewerage system	Will the works involve connection to a council-owned sewerage system? If so, will this connection have a *substantial* impact on the capacity of any part of the system?	No	Oberon Council	Section 2.10
Water usage	Will the works involve connection to a council-owned water supply system? If so, will this require the use of a *substantial* volume of water?	No	Oberon Council	Section 2.10
Temporary structures	Will 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, will this cause more than a *minor* or *inconsequential* disruption to pedestrian or vehicular flow?	No	Oberon Council	Section 2.10
Road and footpath excavation	Will 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	Oberon Council	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	Oberon Council	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, will the works change flood patterns to more than a *minor* extent?	No	Oberon 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?	No	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	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 *National Parks and Wildlife Act 1974*, or on land acquired under that Act?	Yes	Environment, Energy and Science, DPE	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?	No	Environment, Energy and Science, DPE	Section 2.15
Aquatic reserves and marine parks	Are the works adjacent to an aquatic reserve or a marine park declared under the *Marine Estate Management Act 2014*?	No	Department of Planning and Environment	Section 2.15
Sydney Harbour foreshore	Are the works in the Sydney Harbour Foreshore Area as defined by the *Sydney Harbour Foreshore Authority Act 1998*?	No	Property NSW	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?	No	Rural Fire Service	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)	No	Director of the Siding Spring Observatory	Section 2.15
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).	No	Secretary of the Commonwealth Department of Defence	Section 2.15

Development type	Potential impact	Yes / No	If 'yes' consult with	SEPP (Transport and Infrastructure) section
Mine subsidence land	Are the works on land in a mine subsidence district within the meaning of the *Mine Subsidence Compensation Act 1961*?	No	Mine Subsidence Board	Section 2.15

Appendix C

Neutral or beneficial effect on water quality assessment

Neutral or beneficial effect assessment

Chapter 6 (Water Catchment) of SEPP (Biodiversity and Conservation) relates to the use of land within the Sydney drinking water catchment. In accordance with Part 6.5 of SEPP (Biodiversity and Conservation), Transport is required to consider whether or not an activity to which Division 5.1 of the EP&A Act applies will have a neutral or beneficial effect on water quality before carrying out the activity.

Factor		Impact
1	Are there any identifiable potential impacts on water quality? What pollutants are likely? During construction and/or post construction?	The primary potential impacts to water quality would be during construction activities and if not mitigated could result in: • Increased sediment loads from exposed soil during rainfall events causing high sediment loads to be washed or deposited into nearby waterways • Increased sedimentation of downstream waterways, impacting on water quality and ecosystem health • Increased levels of nutrients, metals and other pollutants, transported via sediment to downstream waterways, impacting on water quality and ecosystem health • Chemical, heavy metal, oil and grease, and petroleum hydrocarbon spills from construction machinery directly polluting downstream waterways • Increased levels of litter from construction activities polluting downstream watercourses. Potential construction pollutants include: • Sediments (fine and coarse) and suspended solids • Increased levels of nutrients transported with sediments • Chemicals, heavy metals, oils and greases, and petroleum hydrocarbons • Increased levels of litter. The operational phase of the proposal would provide a significant upgrade to drainage and land stability compared to current conditions. The potential water quality impacts from the operation of the upgraded road asset are more than offset by the large improvements to site stability, asset resilience in significant weather events, and the reduction in sediment-laden waters flowing into the drinking water catchment. Leaf litter, sediment and minor slips can block drains and culvert inlets. These could impede flows in an extreme weather event, causing water to flow over the road surface and down the batters instead. Major erosion or slope instability could occur as a result. Regular maintenance activities would be carried out to minimise impacts from blocked drainage infrastructure.
2	For each pollutant, list the safeguards needed to prevent or mitigate potential impacts on water quality (these may be WaterNSW endorsed current recommended practices and/or equally effective other practices)	Construction would be carried out in line with a CEMP, which would include a SWMP as a sub-plan. The SWMP would include an ESCP. The guidelines and principles outlined in the NSW Blue Book (Landcom, 2004 and DECC, 2008), which are recognised as current recommended practices by Water NSW, would also be implemented.

Factor		Impact
		Relevant safeguards to prevent each pollutant entering nearby waterways have been provided in section 6.3.4 and section 7.2.
3	Will the safeguards be adequate for the time required? How will they need to be maintained?	The safeguards provided are adequate for the time required and identify specific mitigation to be implemented during rainfall events which may increase the potential for pollutants to enter nearby waterways.
4	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? Or will impacts on water quality be transferred outside the site for treatment? How? Why?	The implementation of safeguards and mitigation measures identified in section 6.3.4 and section 7.2 is anticipated to effectively contain water quality impacts resulting from the proposal. In the road's current condition, a downpour of rainfall has a high potential to lead to increased sedimentation in nearby water courses due to the instability of the slopes. Once the proposal's construction begins, there is the potential for polluted water to be accidentally discharged offsite following rainfall and for potential impacts on the drinking water catchment and surrounding reserve, however these impacts are anticipated to be minimal given clean water diversion and erosion control measures would be adopted during construction to minimise the amount of polluted or sediment-laden water being discharged. Additionally, controlled discharges during construction would not be concentrated at a single point, which would reduce the potential for downstream erosion. During the operational phase, the proposal would greatly reduce the volumes of sediment discharged into the drinking water catchment (subject to anticipated ongoing maintenance).
5	Is it likely that a neutral or beneficial effect on water quality will occur? Why?	Implementation of the guidelines and principles within the Blue Book is classified as a neutral effect on water quality – i.e. a deemed-to-comply solution to demonstrate NorBE. The Blue Book has been used as a defining standard for erosion and sediment control for this proposal. For the construction phase, providing the recommendations and safeguards in section 6.3.4 and section 7.2 of this report are adopted prior to and during construction, the proposal demonstrates a neutral effect on water quality during the construction phase. For the operational phase, given that the proposal would significantly reduce the volumes of sediment discharged into the drinking water catchment (subject to ongoing maintenance), a beneficial effect on water quality is anticipated.

Appendix D

Landscape character and visual impact assessment

Appendix E

Statement of Heritage Impact

Appendix F

Jenolan Caves Road: Five Mile Failure Preliminary Erosion and Sedimentation Assessment

Appendix G

Jenolan Caves Road: Five Mile Failure Water Quality Assessment

Appendix H

Biodiversity Assessment Report

Appendix I

Stage 1 Procedure for Aboriginal Cultural Heritage Consultation and Investigation

NSW GOVERNMENT