



NSW National Parks and Wildlife Service

Glow Worm Tunnel path and exit

Review of environmental factors



© 2023 State of NSW and Department of Planning and Environment

With the exception of photographs, the State of NSW and Department of Planning and Environment are pleased to allow this material to be reproduced in whole or in part for educational and non-commercial use, provided the meaning is unchanged and its source, publisher and authorship are acknowledged. Specific permission is required for the reproduction of photographs.

The Department of Planning and Environment (DPE) has compiled this report in good faith, exercising all due care and attention. No representation is made about the accuracy, completeness or suitability of the information in this publication for any particular purpose. DPE shall not be liable for any damage which may occur to any person or organisation taking action or not on the basis of this publication. Readers should seek appropriate advice when applying the information to their specific needs.

All content in this publication is owned by DPE and is protected by Crown Copyright, unless credited otherwise. It is licensed under the [Creative Commons Attribution 4.0 International \(CC BY 4.0\)](#), subject to the exemptions contained in the licence. The legal code for the licence is available at [Creative Commons](#).

DPE asserts the right to be attributed as author of the original material in the following manner: © State of New South Wales and Department of Planning and Environment 2023.

Cover photo: Glow Worm Tunnel, Newnes Plateau. Daniel Tran/DPE

Published by:

Environment and Heritage Group
Department of Planning and Environment
Locked Bag 5022, Parramatta NSW 2124
Phone: +61 2 9995 5000 (switchboard)
Phone: 1300 361 967 (Environment and heritage enquiries)
TTY users: phone 133 677, then ask for 1300 361 967
Speak and listen users: phone 1300 555 727, then ask for 1300 361 967
Email: info@environment.nsw.gov.au
Website: www.environment.nsw.gov.au

Report pollution and environmental incidents
Environment Line: 131 555 (NSW only) or info@environment.nsw.gov.au
See also www.environment.nsw.gov.au

ISBN 978-1-923132-04-7
EHG 2023/0319
September 2023



Find out more about your environment at:

www.environment.nsw.gov.au

Contents

1.	Brief description of the proposal	1
2.	Proponent's details	3
3.	Permissibility and assessment pathway	4
3.1	Permissibility under NSW legislation	4
3.2	Environmental Planning and Assessment Act 1979	6
3.3	Other relevant NSW legislation	7
3.4	Commonwealth legislation	7
3.5	Consistency with NPWS policy	8
3.6	Summary of licences and approvals	8
4.	Consultation – general	10
4.1	Statutory consultation	10
4.2	Targeted consultation	11
5.	Consultation – Aboriginal communities	12
5.1	Native title notification requirements	12
5.2	Parks under other joint management arrangements	12
5.3	Other parks	12
6.	Proposed activity (or activities)	13
6.1	Location of activity	13
6.2	Description of the proposed activity	13
7.	Reasons for the activity and consideration of alternatives	19
7.1	Objectives and reasons for the proposal	19
7.2	Consideration of alternatives	19
7.3	Justification for preferred option	20
8.	Description of the existing environment	21
8.1	Overview of the project area	21
8.2	Natural values	21
8.3	Cultural values	27
8.4	Social values	29
8.5	Matters of national environmental significance	29
9.	Impact assessment	31
9.1	Physical and chemical impacts during all stages of the activity	32
9.2	Biodiversity impacts during all stages of the activity	36
9.3	Community impacts during all stages of the activity	38
9.4	Natural resource impacts during all stages of the activity	41
9.5	Aboriginal cultural heritage impacts during all stages of the activity	42

9.6	Other cultural heritage impacts during all stages of the activity	45
9.7	Impacts on matters of national environmental significance during all stages	47
9.8	Cumulative impacts during all stages of the activity	48
10.	Proposals requiring additional information	50
11.	Summary of impacts and conclusions	50
12.	Supporting documentation	53
13.	Fees for external proponents	54
14.	Declarations	54
	References	55
	More information	55

List of tables

Table 1	Consistency with NPWS policies and procedures	8
Table 2	Triggers for publication of the review of environmental factors	9
Table 3	Consultation triggers under the <i>Transport and Infrastructure SEPP</i>	10
Table 4	Threatened flora species targeted in the broader precinct assessment	25
Table 5	Threatened fauna species considered during assessment	26
Table 6	Summary of heritage elements identified within, and in close proximity to, the Glow Worm Tunnel (Tunnel #2)	28
Table 7	Impact assessment: physical and chemical impacts	32
Table 8	Impact assessment: biodiversity impacts	36
Table 9	Impact assessment: community impacts	38
Table 10	Impact assessment: natural resources	41
Table 11	Impact assessment: Aboriginal cultural heritage	42
Table 12	Impact assessment: other cultural heritage	45
Table 13	Impact assessment: matters of national environmental significance (MNES)	47
Table 14	Impact assessment: cumulative impacts	48
Table 15	Summary of impacts and conclusions	50
Table 16	Supporting documentation	53

List of figures

Figure 1	Location of the activity	2
Figure 2	Geology of the project area, extracted from NSW Seamless Geology mapping	22
Figure 3	Localised hydrology around the eastern entrance to the Glow Worm Tunnel at Newnes	23

1. Brief description of the proposal

The proposal

Proposal name: Glow Worm Tunnel path and exit

Brief description:

- The National Parks and Wildlife Service (NPWS) proposes to construct a new pedestrian path through the Glow Worm Tunnel in Wollemi National Park and upgrade the tunnel exit area, including retaining the collapsed tunnel exit area.
- The path design has been developed with extensive consideration to the management and protection of the natural (glow-worms) and cultural (historic heritage) values of the tunnel. The path design is edged with a row of double-bricks. The brick-edged pathway was chosen as the most sympathetic design. Various aspects of the pathway design enhance the heritage significance of the tunnel and its elements and minimise impacts on its glow-worm population.

Location of activity: Glow Worm Tunnel. See Figure 1.

Name of NPWS park or reserve: Wollemi National Park

NPWS Area: Kanangra

Council: Lithgow Local Government Area (LGA)

NSW State electorate: Bathurst

Estimate capital cost of project: \$800,000

Estimated duration of project: 5 months

Proposed commencement date: August 2023

Proposed completion date: December 2023

Glow Worm Tunnel path and exit: review of environmental factors

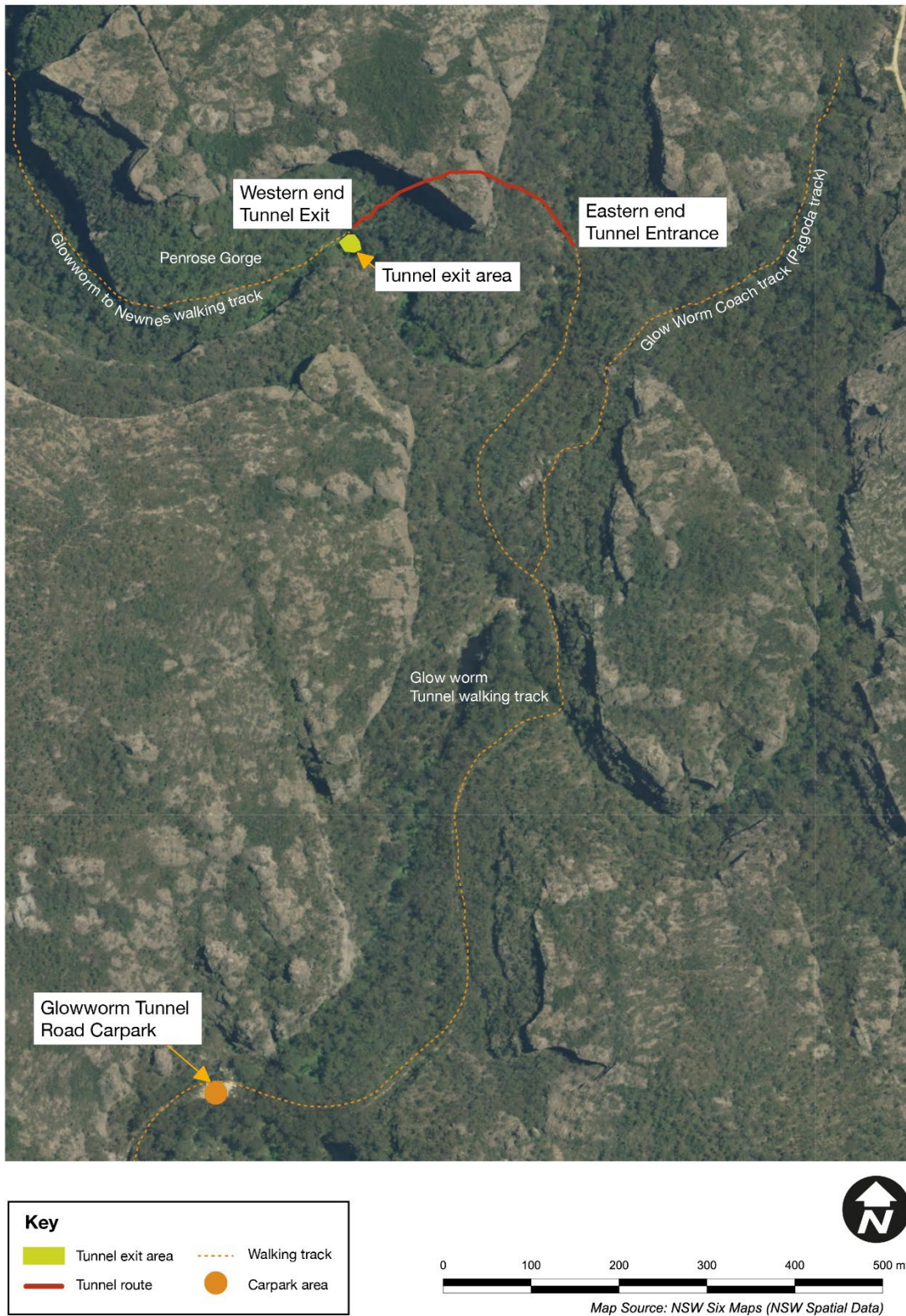


Figure 1 Location of the activity

2. Proponent's details

Contact name: Angela Lonergan

Position: Area Manager, Kanangra; Blue Mountains Branch; NSW National Parks and Wildlife Service

Street address: 38 Ross Street, Oberon NSW 2787

Postal address: As above

Contact numbers: 02 6336 6200

Email: angela.lonergan@environment.nsw.gov.au

3. Permissibility and assessment pathway

3.1 Permissibility under NSW legislation

The following sections outline how the activity is permissible under applicable NSW legislation.

3.1.1 National Parks and Wildlife Act 1974

On land reserved and acquired under the NPW Act

The proposal seeks to foster public appreciation, understanding and enjoyment of nature and cultural heritage and their conservation, consistent with object 1(c) of the *National Parks and Wildlife Act 1974* (NPW Act) by providing facilities that allow suitable public interaction with and enjoyment of the natural and cultural environment of Wollemi National Park.

Key management principles of national parks include the sustainable visitor use and promotion of public appreciation and understanding of the park's natural and cultural values. Specific principles applicable to the development under section (s) 30E of the NPW Act include:

- the conservation of biodiversity, the maintenance of ecosystem function, the protection of geological and geomorphological features and natural phenomena and the maintenance of natural landscapes
- the conservation of places, objects, features and landscapes of cultural value
- the promotion of public appreciation and understanding of the national park's natural and cultural values
- provision for sustainable visitor or tourist use and enjoyment that is compatible with the conservation of the national park's natural and cultural values.

The proposal seeks to uphold these principles through the repair and upgrade of existing facilities to enhance the landscape values and allow for sustainable public recreation and education in a natural environment.

The *Wollemi National Park plan of management* (PoM) was adopted in April 2001 (NPWS 2001). The proposal seeks to mitigate the impacts associated with the existing facility in accordance with the requirements of section 3 of the PoM 'Objectives of management', in particular, the protection and preservation of the scenic and natural features; and the conservation of native plants and animals and provision of appropriate recreational opportunities.

The PoM references the Glow Worm precinct, specifically:

- Section 4.2.2 'Historic Heritage' states:
Future works at Newnes will be guided by the recommendations contained within the archaeological report for the site... together with a conservation plan for the Newnes / Glow Worm historic precinct and a master plan covering recreational use and conservation works for the area as a whole management unit.

The activity is proposed as stage 2 of the precinct plan for the Glow Worm Tunnel recreational complex. A separate precinct plan will be developed for the Newnes Shale Oil complex. Together these plans form the master plan covering recreational use and conservation works for the area as a 'whole management unit' in accordance with section 4.2.2 of the PoM.

- section 4.3.1 'Recreation Management and Tourism' states:
Dunns Swamp and the Newnes / Glow Worm Tunnel precinct on the western side of the park are also popular locations for picnicking and car-based camping.

The activity ensures continued sustainable access for recreation and tourism.

- section 4.3.4 'Picnicking, Camping and Boating' states:
Picnicking sites are provided at Honeysuckle Creek Rest Area on the Bylong-Sandy Hollow Road, picnic sites along the Glow Worm Tunnel Road and at Wheeney Creek Picnic Area where barbeques, tables and toilets are provided for public use.

The activity provides for the upgrade of the existing walking tracks and will provide opportunities for picnicking in the area.

- section 4.3.8 'Promotion of the Park: Actions' states:
Park interpretive/information displays will be located in ... [the] Glow Worm Tunnel precinct...

The activity provides for new interpretive signs and experiences.

Assets of intergenerational significance

The activity is not on land identified as an asset of intergenerational significance or in close proximity to such an asset.

Leasing, licensing and easement provisions

Not applicable.

For internal NPWS projects only

This proposal falls within the powers and responsibilities of NPWS (the Service) defined in the NPW Act, specifically:

- s 8 (3) The Secretary shall in the case of every national park, historic site, state conservation area, regional park, nature reserve, karst conservation reserve and Aboriginal area:
 - (b) arrange for the carrying out of such works as the Secretary considers necessary for or in connection with the management and maintenance thereof....
- s 12 The Service is to carry out such works and activities as the Minister may direct, either generally or in a particular case, in relation to the following:
 - (f) the provision of facilities and opportunities for sustainable visitor or tourist use and enjoyment on land reserved under this Act.

3.1.2 Wilderness Act 1987 (for activities in wilderness areas)

Not applicable as the location of the activity is outside the boundary of the Wollemi Wilderness.

3.1.3 Biodiversity Conservation Act 2016

The activity seeks, in general, to improve biodiversity outcomes by proposing actions to reverse existing impacts to the tunnel's ecological communities from watercourse trampling and minimising human interactions with wildlife, ensuring longer-term sustainable use of the site.

The activity is consistent with the purposes of the *Biodiversity Conservation Act 2016* (BC Act) and specifically consistent with:

- conserving biodiversity at bioregional and state scales
- maintaining the diversity and quality of ecosystems and enhancing their capacity to adapt to change and provide for the needs of future generations
- regulating human interactions with wildlife by applying a risk-based approach.

In summary, the proposed activity is not likely to have an adverse effect on habitat or species that could be important for maintaining life cycles of locally recorded species if present.

3.1.4 NSW Reconstruction Authority Act 2022

Not applicable.

3.1.5 Rural Fires Act 1997

The proposed activity does not adversely affect the ability of NPWS to undertake responsibilities as outlined in the Rural Fires Act or the park's fire management strategy, nor does it increase the likelihood of fire risks. No modifications or additional impacts will result. It is therefore considered not inconsistent with the Rural Fires Act.

3.2 Environmental Planning and Assessment Act 1979

3.2.1 Assessment pathway

It is confirmed that a review of environmental factors (REF) is the applicable assessment pathway because each of the following apply:

- The activity is not declared to be state significant infrastructure under s 2.13 of the *Planning Systems State Environmental Planning Policy (SEPP)*.
- The activity may be undertaken without development consent under the provisions of s 2.73(1)(a) of the *Transport and Infrastructure SEPP* as it is:
 - on land reserved under the NPW Act or acquired under Part 11 of the NPW Act, **and** is for a purpose authorised under the NPW Act.
- The activity is not identified as not permissible without development consent under another environmental planning instrument that prevails over the *Transport and Infrastructure SEPP*. In particular:
 - The activity is not in a coastal wetland or littoral rainforest, or does not otherwise meet the criteria for development requiring consent outlined in s 2.7(2) of the *Resilience and Hazards SEPP*.
 - The activity is not coastal protection works or, if coastal protection works, the activity is one of the types of coastal protection works that may be carried out by or on behalf of a public authority without development consent.
- The activity is not a type of development requiring development consent under s 2.9 of the *Resources and Energy SEPP*.

The activity is not declared to be exempt development under an environmental planning instrument or fails to fully meet the requirements for exempt development as it will have more than a minor impact on a heritage item listed as state significant requiring a s 60

Heritage Act 1997 approval (*Transport and Infrastructure SEPP*) so it remains an activity for the purposes of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

3.2.2 Strategic plans

Not applicable.

3.3 Other relevant NSW legislation

3.3.1 Coal Mine Subsidence Compensation Act 2017

The activity is not within a mine subsidence district.

3.3.2 Fisheries Management Act 1994

The activity does not require notification or approval under the Fisheries Management Act.

3.3.3 Heritage Act 1977

The activity is on land that contains an item listed on the State Heritage Register. The Wolgan Railway Complex, including the Glow Worm Tunnel, is listed as part of the 'Blue Mountains Walking Tracks' listing (Listing No: 00980). As such it is protected and managed in accordance with the provisions of Part 4 Division 2 of the Heritage Act.

The preparation and submission, to Heritage NSW, of a statement of heritage impact was required (Mountains Heritage 2023, at Appendix G) and supported an application under s 60 of the Heritage Act. Approval was granted by Heritage NSW in July 2023 (Appendix H).

3.3.4 Marine Estate Management Act 2014

The activity is not within nor is likely to affect a marine park or aquatic reserve.

3.4 Commonwealth legislation

3.4.1 Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) applies as the activity is on land that contains the following, or the activity may affect:

- World Heritage or National Heritage values of a place on the World Heritage List or National Heritage List
- the ecology of a Ramsar wetland
- nationally listed threatened species and ecological communities or listed migratory species.

A matters of national environmental significance assessment was completed (see Appendix G sections 6.4, 6.5 and 7) in accordance with the *Significant impact guidelines 1.1: matters of national environmental significance* (DEWHA 2013). The assessment concludes the introduction of a new pathway through the Glow Worm Tunnel is not likely to have a significant impact on World Heritage values. One or more of the World Heritage values will not be lost, degraded or damaged or altered, modified, obscured or diminished. No habitats

would be affected by the proposed works and, as a result, no flora and fauna species would be affected. Given that the action is not likely to have a significant impact on the World Heritage values of the Greater Blue Mountains Area World Heritage property, approval from the Commonwealth Minister for Department of Climate Change, Energy, the Environment and Water is not required.

3.4.2 Native Title Act 1993

The activity is a not a future act for the purposes of the Native Title Act.

3.5 Consistency with NPWS policy

Table 1 lists the NPWS policies, procedures and operational manuals relevant to this REF and outlines how the proposal is consistent with these documents.

Table 1 Consistency with NPWS policies and procedures

Policies and procedures	How proposal is consistent
Construction assessment procedures (OEH 2011)	The proposed activity is designed and constructed in accordance with the recommendations of the <i>Parks facilities manual</i> (NPWS 2016a) as required where certification is not undertaken
Parks facilities manual (NPWS 2016a)	The proposed activity is designed and constructed in accordance with the recommendations of the manual
Walking tracks policy (see link in 'More information' section)	The proposed activity is designed and constructed in accordance with the policy
Guidelines for preparing a review of environmental factors (DPE 2022)	The proposal considers the objectives and requirements of the guidelines
Due diligence code of practice for the protection of Aboriginal objects in New South Wales (DECCW 2010)	This assessment is developed in accordance with the code of practice
Parks signage manual (NPWS 2016b) and Signage policy and procedures	All signage to comply with policy and specifications of the <i>Parks signage manual</i> (NPWS 2016b)
Landslides and rockfalls procedures (DPIE 2020)	The proposed activity considers the objectives of the policy and requirements within the procedures
Interpretation policy	The proposal considers the objectives and requirements of this policy

3.6 Summary of licences and approvals

3.6.1 Approval under the National Parks and Wildlife Act

The activity is an internal proposal of the NPWS, developed in consultation with the relevant internal parties and to be authorised by the Director, Blue Mountains Branch.

3.6.2 Other approvals

Pursuant to s 63 of the Heritage Act, approval is granted with conditions as detailed in Appendix H *Section 60 and s 65: delegated approval letter* (Heritage NSW 2023).

3.6.3 Publication triggers

Triggers for the publication of an REF are listed in Table 2. Following determination, the REF must be published due to the Heritage Act approval.

Table 2 Triggers for publication of the review of environmental factors

Permit or approval	Applicable?
Fisheries Management Act, ss 144, 200, 205 or 219	No
Heritage Act, s 57 (commonly known as a s 60)	Yes
National Parks and Wildlife Act, s 90 (Aboriginal heritage impact permit)	No
Protection of the Environment Operations Act 1997, ss 47–49 or 122	No

4. Consultation – general

4.1 Statutory consultation

The *Transport and Infrastructure SEPP* requires consultation with relevant authorities as identified in Table 3.

Table 3 Consultation triggers under the *Transport and Infrastructure SEPP*

Authority (SEPP section)	Trigger	Applicable to proposal?
Consultation with local council (s 2.10)	Development with impacts on council infrastructure or services (such as stormwater, sewer, water, roads and footpaths)	No
Consultation with local council (s 2.11)	Development with impacts on heritage items listed under the local environmental plan (LEP)	No
Consultation with local council (s 2.12)	Development that will change flood patterns on flood-labile land	No
Consultation with State Emergency Service (s 2.13)	Development on flood-labile land	No
Consultation with local council (s 2.14)	Development that is inconsistent with a certified coastal management program affecting land within the mapped coastal vulnerability area	No
Consultation with NPWS (s 2.15(2)(a))	Development adjacent to land reserved or acquired under the NPW Act	No
Consultation with NPWS (s 2.15(2)(b))	Development on land in Zone C1 that is yet to be reserved under the NPW Act	No
Consultation with Transport for NSW (s 2.15(2)(l))	Development comprising a fixed or floating structure in or over navigable waters	No
Consultation with the Director of the Siding Spring Observatory (s 2.15(2)(d))	Development that may increase the amount of artificial light in the night sky and that is on land within the mapped dark sky region	No
Consultation with the Cth Department of Defence (s 2.15(2)(e))	Development located within the buffer around the defence communications facility near Morundah as mapped under the Lockhart, Narrandera or Urana LEPs	No
Consultation with the Subsidence Advisory NSW (s 2.15(2)(f))	Development on land in a mine subsidence district	No
Consultation with the Willandra Lakes Region World Heritage Advisory Committee and Heritage NSW (s 2.15(2)(g))	Development on, or reasonably likely to have an impact on, a part of the Willandra Lakes Region World Heritage Property	No

Authority (SEPP section)	Trigger	Applicable to proposal?
Consultation with the Western Parkland City Authority (s 2.15(2)(h))	Development within a Western City operational area (<i>Western Parkland City Authority Act 2018</i> , Schedule 2) with a capital investment value of \$30 million or more	No
Consultation with Transport for NSW (s 2.221)	Traffic-generating development listed in Schedule 3	No

4.2 Targeted consultation

4.2.1 Adjacent landowners

Landowners of Wolgan Valley and the local community were invited to a community information session in the Wolgan Valley in June 2022. Feedback was positive with no major issues raised.

A number of local businesses provided letters of support for the Glow Worm Tunnel visitor precinct upgrade project when NPWS applied for the project's funding through the Bushfire Local Economic Recovery Fund managed by the Department of Regional NSW. The 'Glow Worm Tunnel visitor precinct' includes walking track and car park upgrades as well as the proposed activities outline in this REF.

4.2.2 Wider community consultation and/or notification of works

The wider community was invited to a community information session in the Wolgan Valley in June 2022. Feedback was positive with no major issues raised.

Project progress updates are included in the NPWS Gardens of Stone newsletter, which is distributed to local businesses, community members and interested stakeholders.

Notification of works are publicised on the NPWS alerts webpage as well as periodic media releases detailing the proposed activity.

4.2.3 Interest groups and/or notification

Interest groups were invited to a community information session in the Wolgan Valley in June 2022. Feedback was generally positive with no major issues raised.

Project progress updates are included in the NPWS Gardens of Stone newsletter, which is distributed to local businesses, community members and interested stakeholders.

Notification of works are publicised on the NPWS alerts webpage as well as periodic media releases detailing the proposed activity.

5. Consultation – Aboriginal communities

5.1 Native title notification requirements

The land is not subject to an Indigenous land use agreement. Native title has not been extinguished, or it is unclear if it has been extinguished.

The activity falls within an area of land subject to a registered native title claim under the Cth *Native Title Act 1993*: NC2018/002 – Warrabinga-Wiradjuri #7 Native Title Claim. Determination of this native title claim is pending.

The activity is:

- occurring on land that was reserved as park on or before 23 December 1996
- an act in accordance with the purpose of reservation
- a ‘public work’ (e.g. a building or other structure that is fixed to the landscape, a road or bridge, a well or a bore, or involves major earthworks, carried out by a public authority).

Therefore, it may be validated under the Native Title Act via the procedures of subdivision 24J of that Act.

Consultation was undertaken with Warrabinga Wiradjuri Native Title Claimants Aboriginal Corporation in February 2023 (see Appendix I, Kelleher Nightingale Consulting 2023). No objections or recommendations to the proposal were received.

5.2 Parks under other joint management arrangements

The park’s management is not subject to another joint management arrangement such as a memorandum of understanding.

5.3 Other parks

Kelleher Nightingale Consulting undertook an assessment of the Glow Worm Tunnel upper car park and walking tracks and the Glow Worm Tunnel on 30 September 2022. Bathurst Local Aboriginal Land Council (LALC), and Mingaan and Warrabinga Wiriaduri groups were invited to attend. Bathurst LALC attended the site visit with Kelleher Nightingale consultants – no Aboriginal heritage constraints were identified, and the results are consistent with the previous assessment (see Appendix I).

6. Proposed activity (or activities)

6.1 Location of activity

Description of location: End of Glow Worm Tunnel Road, Newnes Plateau via Clarence, NSW.

Site commonly known as: Glow Worm Tunnel, Newnes Plateau

Park name: Wollemi National Park

Site reference: Easting: 241,304; Northing: 6,317,781; MGA zone: 56

6.2 Description of the proposed activity

6.2.1 The proposed activity: pre-construction, construction, operation and remediation

The activity involves works within the Glow Worm Tunnel and the western tunnel exit area in Wollemi National Park including:

- construction of a new double-brick-edged pedestrian path through the Glow Worm Tunnel, approximately 400 m in length
- reconstruction and upgrade of the tunnel exit area, including walking tracks within the exit area footprint
- upgrade of the informal picnicking area at the tunnel exit, including installation of new seats and picnic tables
- rehabilitation of the ground areas at the tunnel exit where the ground has been significantly hardened or trampled
- the formalisation of a viewing area opposite the tunnel exit
- installation of new visitor information signage and integrated interpretation into the walking track surface at specific locations.

Tunnel path (Appendix A)

The proposed upgrade works aim to provide a safer, more visitor-friendly, memorable and enjoyable experience. The construction of a carefully designed, safe and proper pathway through the tunnel will fix the current difficult access as the tunnel floor surface is eroding, very uneven and can be wet and slippery. With no proper pathway, visitors currently trample the watercourse flowing through the tunnel, which directly impacts the glow-worms as their food source comes from prey insects within the watercourse. Additionally, without a formalised path, visitors (sometimes unknowingly) brush against the glow-worm larvae snares, tangling or destroying their webs.

The path design has been developed with extensive consideration to the management and protection of the natural (glow-worms) and cultural (historic heritage) values within the tunnel. The path design is a double-brick-edge path. The brick-edged pathway was chosen as the most sympathetic design. Various aspects of the pathway design enhance the heritage significance of the tunnel and its elements and minimise impacts on its glow-worm population. See Appendix A *Tunnel path: detailed designs* (NPWS 2023).

Tunnel exit area (Appendix B)

The tunnel exit area upgrade is designed to reinstate the tunnel exit surface area, which collapsed due to flooding events in 2021 and 2022. Visitors tend to congregate at this point, to view and take photos of the tunnel exit. Appropriately managing pedestrians and water flow from the tunnel exit, as well as a drip line from the cliff line above, are key design drivers in this location. See Appendix B *Tunnel exit: refined concept designs* (Environmental Partnerships 2023).

The proposed work adjacent to the tunnel exit includes a combination of formalising the walking track, installing new seating and tables, and rehabilitating areas that have been trampled and hardened by unregulated pedestrian traffic in this space.

To enhance the visitor experience in this space, integrated interpretation for the natural and historic values of the site will be included here. This interpretation will complement and align with the integrated interpretation provided at the track heads (the Glow Worm Tunnel car park and the proposed new Wolgan Valley car park).

A formalised viewing area opposite the tunnel exit is proposed to provide visitors with a great vantage point to view the tunnel exit. This area also provides for further integrated interpretation of the railway line alignment.

Pre-construction

- Communicate any site closures at least 2 weeks prior to commencement of work via the NPWS website and temporary signage on the Glowworm Tunnel Road, Newnes Plateau.
- Transport machinery, equipment and materials to the Glow Worm Tunnel car park and establish site storage areas within the car park area and areas outside the tunnel.
- Install sediment and erosion protection measures in accordance with the erosion and sediment control plan, which will be developed using specific advice for within the tunnel environment and the following documents:
 - *Managing urban stormwater: soils and construction* (Landcom 2004, also known as 'the blue book') – with reference to chapter 5 'Erosion control: management of water'
 - *Erosion and sediment control on unsealed tracks* (OEH 2012).
- Delineate and divert inflowing water away from the proposed path alignment to the inner wall using sandbags and rocks or similar materials. Use in situ rocks to create pools to slow the waterflow rate (to mimic the pre-construction state as closely as possible).
- Remove or reposition debris within the tunnel along the path alignment where required, with minimal disturbance to any mud.
- Prepare the tunnel exit area including the removal or repositioning of rock/boulders and debris.
- Prepare helipad loading and unloading sites within previously cleared/disturbed areas (Glow Worm Tunnel car park, receival sites near the Glow Worm Tunnel entrance/eastern end, and exit/western end).
- Install security fencing on the tunnel ends (eastern and western) – proposed design included in Appendix A.
- Establish and set-up photo monitoring cameras within the tunnel.
- Set-up portable battery-powered lighting within the tunnel (red-coloured LED or similar).
- Set-up site access for workers and equipment include temporary installation of fibreglass reinforced plastic for wheelbarrow use.

Construction works

Tunnel path

- Clear (and store away from the watercourse) materials removed from the hand-cut drain at entrance of tunnel on inner wall side from tunnel entrance to ~ 10 m.
- Move (and store away from the watercourse) rubble from tunnel floor, along the brick-edge alignment.
- Excavate bedrock along brick-edge alignment and culvert locations, creating a usable bed for brick basecourse/culverts, using battery-powered jackhammer or hand tools.
- Excavate footings for handrail using battery-powered core drill.
- Remove 'shelf rubble' along brick-edge alignment, including any shelf rubble that is wider than the edge alignment, using battery-powered jackhammer or hand tools.
- Line any existing shelf rubble with geofabric, separating it from imported materials.
- Bolster bricks to bedrock shape, for use in basecourse, containing all bolstered off materials within the path fill area or bag and remove from the tunnel.
- Create mortar bed on bedrock to lay basecourse/culverts.
- Lay brick-edge and install culverts.
- Install ag-pipe, aggregate and geofabric.
- Backfill path with stored onsite shelf rubble or imported sandstone crush.
- Install and compact path wear course (cement stabilised).
- Install handrails.
- Install integrated interpretation elements into the path, including metal strip to top course bricks.

Tunnel exit area

- Install sandstone retaining logs, aggregate drain and backfill with local or imported materials.
- Move existing boulders and install new natural rock boulders to dissipate water.
- Construct sandstone flagging area.
- Plant new low-level endemic ferns on and around new sandstone log retaining wall.

Area adjacent to tunnel exit

- Rough up the compacted and bare ground and revegetate with organic mulch and appropriate endemic ferns and other suitable plants.
- Install table seat platforms.
- Move existing boulders and install new natural rock boulders to strategic locations along the walking track edge and around table/seat, deterring access to vegetation or rehabilitated areas.

Walking tracks

- Refurbish and define walking track alignments with existing and new crush material.
- Install sandstone steps and drains on walking tracks.
- Move existing boulders and install new natural rock boulders to strategic locations along the walking tracks, deterring access to adjacent vegetation or rehabilitated areas.

Picnic area

- Use existing large logs to define picnic area boundary within existing cleared area.
- Install table seats.

Viewing spot

- Prune existing tree fern vegetation as necessary and transplant a large mature fern from the railway abutment area opposite the tunnel exit.
- Construct sandstone flagging area and sandstone steps.
- Install balustrade and integrated interpretation of rail to flagged surface.

Post-construction

- Remove all sediment and erosion controls.
- Return watercourse flow and alignment to pre-construction condition.
- Remove all other construction materials and site clean-up.

6.2.2 The activity footprint (size of the area of impact)

The activity footprint is approximately 1,176 m², including:

- **tunnel path:** 760 m² (1.9 m wide x 400 m long)
- **tunnel exit area:** 416 m².

6.2.3 Proposed construction methods, materials and equipment

- Works will primarily be undertaken manually and using battery-powered tools (e.g. jackhammer, bandsaw), hand tools, small plant such as a mini excavator (only to be used outside in the tunnel exit area), generators, and a mobile gantry crane. No large plant is to be used.
- **Only** battery-powered tools or hand tools are to be used within the tunnel.
- Red LED lighting on stands is to be used to provide safe access to the activity section of the tunnel for workers. Headtorches will be used by workers to focus the required light on the area of work.
- Materials will be stockpiled at the Galah Mountain Intersection, the Glow Worm Tunnel car park or outside the tunnel on the existing walking track alignment in clear areas. Materials, tools and equipment will be long-lined by helicopter to the tunnel ends on an as-needed basis, within 2 m of the track verge consistent with site surveys for significant vegetation.
- Heavy materials (such as structural steel) and tools will be flown in and out by helicopter.

6.2.4 Receipt, storage and onsite management for materials used in construction

- All imported materials to be received and stored at the Blackheath Walking Tracks depot and transported to the Glow Worm Tunnel car park and tunnel ends as required.

6.2.5 Earthworks or site clearing including extent of vegetation to be removed

- Mature ferns may be pruned and transplanted.
- Minimal earthworks using a mini excavator may be required at the tunnel exit area, mainly to prepare the hardened ground for rehabilitation or to achieve the required level changes for the walking track and picnic area works.
- Reclaimed materials from earthworks will be reused onsite to manage level changes.

6.2.6 Environmental safeguards and mitigation measures

Glow-worm population

NPWS engaged a specialist glow-worm consultant early in the project to ensure the whole project life cycle would mitigate, manage and where possible avoid negative impacts on the glow-worm population. Key aspects considered and possible mitigation measures include:

- people brushing against larvae or tangling/destroying webs – locate the path and include handrails to keep people away from glow-worms and out of the streamway
- possible toxicity of fumes and noise in the tunnel – use battery-operated equipment, restrict construction to 8 hours per day and select materials that minimise construction
- watercourse disturbance – avoid disturbing the streamway where feasible, return streamway to pre-construction state after completion, and consider impact of leaching from building materials on stream water quality
- extraneous light – use red light where feasible
- education and interpretation about possible visitor impacts – educate visitors about the tunnel's ecosystem and importance of the streamway as source of prey for glow-worms, impacts of touching the glow-worms, impacts of direct prolonged light on the glow-worms, and to encourage the use of red headlights or hand torches
- ongoing monitoring – where feasible, undertake ongoing monitoring of the glow-worm population before, during and after construction.

Historic heritage

NPWS engaged an archaeologist early on in the planning phase to advise on heritage elements and mitigation measures for historic heritage with the preparation of a statement of heritage impact (Appendix G). As a result, the works have been designed to:

- minimise excavation extent and depth within the tunnel
- position the path alignment so that the existing inner hand-cut drain will be exposed along its length and its function partially restored
- delineate existing slope-wash (i.e. existing floor material within the tunnel that is not considered in situ heritage fabric) above the outer drain from introduced fill
- be visually recessive
- be reversible in nature.

6.2.7 Sustainability measures – including choice of materials and water/energy efficiency

- Material selection was based on minimal impact when evaluated against impacts on water quality; duration and ease of construction; ease of transport and handling; ease of reshaping (reducing the amount of excavation of the tunnel floor); and to be visually recessive.
- Materials are sourced locally from approved quarry facilities. Block stone to be sourced within the Sydney Basin area.
- All removed natural materials to be reused onsite where possible, reducing the amount of required imported materials.

6.2.8 Construction timetable, staging and hours of operation

- Site preparation works will likely commence in August 2023. Construction works to commence in August 2023 with an intended completion date in December 2023 subject to weather and operational conditions. Works will occur between the hours of 6 am and 7 pm, 7 days a week.
- The walking tracks accessing the Glow Worm Tunnel as well as the Glow Worm Tunnel car park will need to be closed to the public during construction. Details of the track closures will be discussed with the Kanangra Area Manager and advertised via the NPWS alerts website.
- Temporary signage to signal area closures and works in progress will be erected prior to any construction works starting and will be removed following completion.

7. Reasons for the activity and consideration of alternatives

7.1 Objectives and reasons for the proposal

Tunnel path

The construction of a carefully designed, safe and proper pathway through the Glow Worm Tunnel that enables the protection of the glow-worm population is the main project objective.

Existing access through the tunnel is difficult as the tunnel floor surface is eroding, very uneven and can be wet and slippery. With no proper pathway, visitors currently trample the streamway through the tunnel, which directly impacts the glow-worms as their food source comes from prey insects within the watercourse. Additionally, without a formalised path, visitors (sometimes unknowingly) brush against the glow-worm larvae and snares in the tunnel walls, tangling or destroying their webs.

The Glow Worm Tunnel visitor precinct is experiencing increasing visitor numbers, driving the need to provide safe access through the tunnel and protection of the glow-worm population.

Tunnel exit

Flood events in 2021 and 2022 collapsed the area at the western tunnel exit. Previously this area was used extensively by visitors to pause to take photos and appreciate the tunnel exit area.

The area adjacent to the tunnel exit is significantly compacted and vegetation has been trampled due to ongoing, increased and unregulated pedestrian movement in this area. For the majority of visitor, this is the turnaround point for their short-walk experience.

The project objectives in the tunnel exit space are to:

- reinstate the tunnel exit area, enabling space for visitors to dwell at the tunnel exit
- provide a good vantage point to the tunnel exit
- provide formalised picnicking and seating spaces at the tunnel exit
- provide safe access in the tunnel exit area, and define the walking track in this space and through Penrose Gorge, where the walking track continues to the Wolgan Valley
- regenerate the trampled and compacted ground to enable vegetation regrowth near the tunnel exit and cliff face; and enhance the visitor experience by providing a more aesthetic, natural and healthy space in a busy visitor precinct.

7.2 Consideration of alternatives

Prior to finalisation of the design, NPWS investigated 5 options to ensure that the chosen path design would have the least impact on heritage fabric and the glow-worm population.

The 5 options were presented at an NPWS stakeholders onsite meeting held on 6 January 2023 and included:

- Option A: Boardwalk – a raised steel and fibreglass reinforced plastic (FRP) boardwalk prefabricated in sections and secured to the tunnel floor and walls through the length of the tunnel.

- Option B: Concrete path – a concrete path, using materials mixed outside the tunnel entrance and poured manually onsite.
- Option C: Edged path, backfilled – a brick-edged path, approximately 400 mm in height, where required, backfilled with excavated rubble and imported crush.
- Option D: Combination – a combination of concrete or brick-edged path and a raised FRP boardwalk, depending on the path alignment and the watercourse.
- Option E: Do nothing – construct nothing inside the tunnel and leave the site as it currently is.

Additional informal stakeholder discussions were also held by NPWS in December 2022 and January 2023 with Mark Langdon, local historian, who visited the site, and Dr David Merritt, a glow-worm specialist.

Further information about the 5 options assessed are included in section 7 of Appendix G. The preferred option is option C: Edged path, backfilled.

7.3 Justification for preferred option

Protection of glow-worms

The *Baseline report: infrastructure in the Glow Worm Tunnel, Newnes* (Merritt 2023, at Appendix D) provided essential glow-worm species and habitat information to inform the path design considerations and selection of the preferred option, option C (edged path, backfilled). Key criteria considered and achievable within option C include:

- design and location of pathway – align to keep people away from significant numbers of glow-worms in certain areas and use the shelf-like bank along the outer wall, allowing the path to be slightly raised and avoid the path work blocking or rerouting the stream
- tunnel topography – design path to prevent people from trampling in the streamway and minimise permanent changes to the stream flow in the tunnel. Where this is unavoidable, the streamway should be returned to its pre-disturbed state where possible
- construction – kept construction phase as short as possible because the associated disturbance is regarded as high-level and frequent. It is important to avoid physically brushing against glow-worm snares or exposing them to volatile chemicals or smoke.

Heritage considerations

Following consultation with stakeholders and an analysis of the above options, option C (edged path, backfilled) was chosen as the preferred path design. From an historic heritage perspective, this was largely due to its reversible nature, the ability to separate original fabric from introduced fill and protect the tunnel floor.

Excavation to construct the path would be minimal. The deepest excavation would be 70 mm diameter core holes for the handrails. These would be excavated 300 mm deep into bedrock. A maximum of 40 mm of deposit would need to be removed to establish a level for the base course of the brick walls. In some areas, excavation may not be required for the base course, and mortar could be used to reach the level required. Water would be kept away from the path edge throughout the length of the tunnel to reduce erosion and protect the heritage significance and fabric.

Slope-wash from within the tunnel would be used to backfill the path. The hand-cut drain on the inner (south) wall would be cleared of rubble so that it can be viewed more clearly and partially operate as a drain as originally designed. Rubble from this drain would also be used to backfill the path.

8. Description of the existing environment

8.1 Overview of the project area

Wollemi National Park covers an area of about 488,620 ha of rugged dissected plateau located on the north-west fringe of the Sydney Basin. The proposal is located within the south-west portion of the park and falls within the Wollemi subregion of the Sydney Basin IBRA bioregion, near the Capertee Uplands subregion in the Wolgan Valley/Newnes side.

The activity is sighted along an old railway line forming part of the Newnes Shale Oil Refinery Ruins/Glow Worm Tunnel precinct which provides an excellent example of the early industrial and mining efforts in this area. The Wolgan Railway Complex – Newnes Railway is listed on the NSW State Heritage Register as one of the ‘Blue Mountains Walking Tracks’. Wollemi National Park forms part of the Greater Blue Mountains World Heritage Area, listed on the National Heritage List and World Heritage List.

The site sits within the Newnes Plateau, which is capped by the early Triassic-age Banks Wall Sandstone, a predominantly quartzose sandstone with occasional conglomerate beds and numerous claystone layers. The Banks Wall Sandstone is the main cliff-forming unit that outcrops along the perimeter of Wolgan Valley. Steep cliffs and talus slopes dominate the area surrounding the Glow Worm Tunnel.

The Glow Worm Tunnel is within the original Wolgan Valley Railway alignment and has been used and maintained as a walking track since the railway line was decommissioned in the 1930s. Continuous access to the Glow Worm Tunnel has been provided from the Glow Worm Tunnel car park as well as the Old Coach Road and Wolgan Road (informal) car parks.

8.2 Natural values

8.2.1 Geology, geomorphology and topography

Wollemi National Park lies on the western edge of the Sydney Basin, with the Newnes Plateau capped by the early Triassic-age Banks Wall Sandstone (Figure 2), which is a predominantly quartzose sandstone with occasional conglomerate beds and numerous claystone layers. The Banks Wall Sandstone is the main cliff-forming unit that outcrops along the perimeter of Wolgan Valley. Preferential erosion of weaker, softer claystone layers produces sandstone overhangs that eventually topple away from the cliff face, with kinematic release provided by subvertical joints, or producing slabs that can delaminate along horizontal bedding (see Jacobs Group [Australia] 2022, at Appendix J).

The Glow Worm Tunnel forms one of 2 tunnels created for the Wolgan Valley Railway line, consisting of an unlined arch tunnel within the Banks Wall Sandstone rock unit. The method of construction is assumed to be drill, blast and manual excavation. The tunnel is in generally good condition with few geotechnical hazards observed. The walls and crown (roof) are undulating but relatively smooth with no defects of concern observed. The tunnel invert is characterised with an irregular surface within the sandstone and scattered loose rocks.

A quantitative risk assessment as per the NPWS *Landslides and rockfalls procedure* (DPIE 2020) was undertaken in March 2022 (Appendix J). Three hazards were identified within the tunnel, including 2 potential small block falls and one medium topple hazard.

The location of the path does not pass directly under the hazards, therefore only monitoring by visual inspection every 2 years for signs of crack opening (joint dilation) is recommended. All specific hazards are assessed as acceptable risk level.

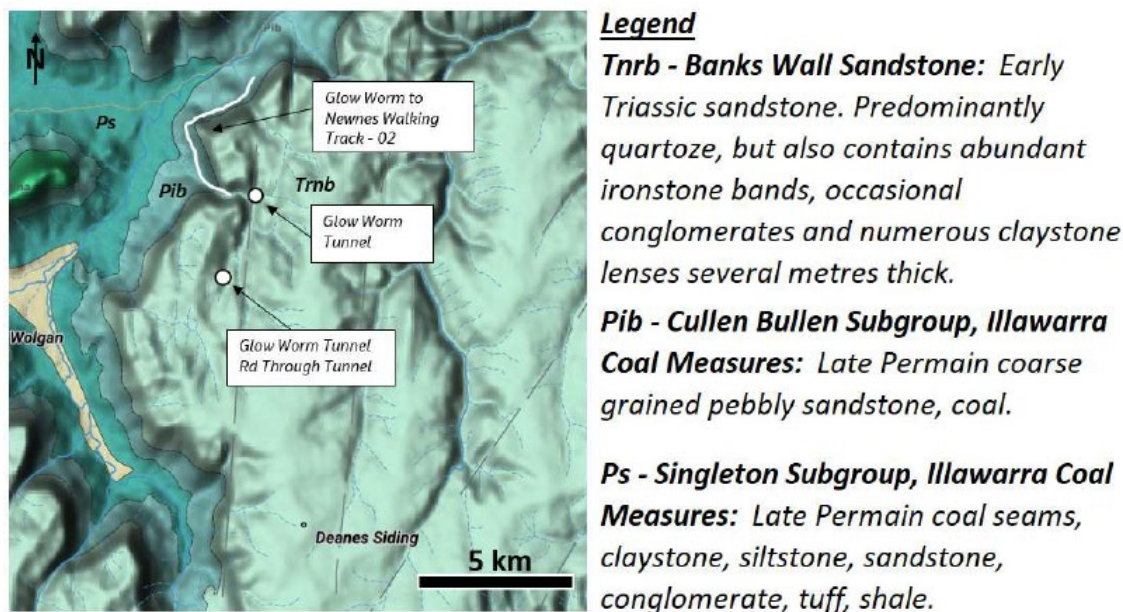


Figure 2 Geology of the project area, extracted from NSW Seamless Geology mapping

Reference material:

- Appendix J *Glow Worm Tunnel: three sites quantitative risk assessment* (Jacobs Group [Australia] 2022)

8.2.2 Soil types and properties (including contamination)

The site falls within the Warragamba Soil Landscape. The area is dominated by shallow to moderately deep (25 to <100 cm), rapidly drained siliceous sands and lithosols and well-drained earthy sands. The soils are shallow, complex, with poor moisture availability and are non-cohesive. Localised rock outcrop hazards with widespread rockfall, mass movement, localised gully erosion, sheet erosion and localised high run-on present precautions to development.

8.2.3 Watercourses, waterbodies and their catchments

Water seeps into the Glow Worm Tunnel cutting from a minor ephemeral watercourse and discharges into Penrose Gorge, an upper tributary of Tunnel Creek, which flows to the Wolgan River. See Figure 3.

Most of the water entering the tunnel comes from the eastern side of the entrance cutting. This appears to be predominantly subsurface flows from a mapped drainage line. This creek is moderately incised and potentially has been modified to form a catch drain when the railway was constructed. The distance between the creek and the cutting is less than 3 m and there appears to have been some erosion at one point. The resulting channel is still capable of carrying moderate to high flows but may overtop the bank at peak time of concentration after very heavy rain. Low levels of seepage on the western wall were also noted, along with a surface flow near the tunnel entrance following recent rains.

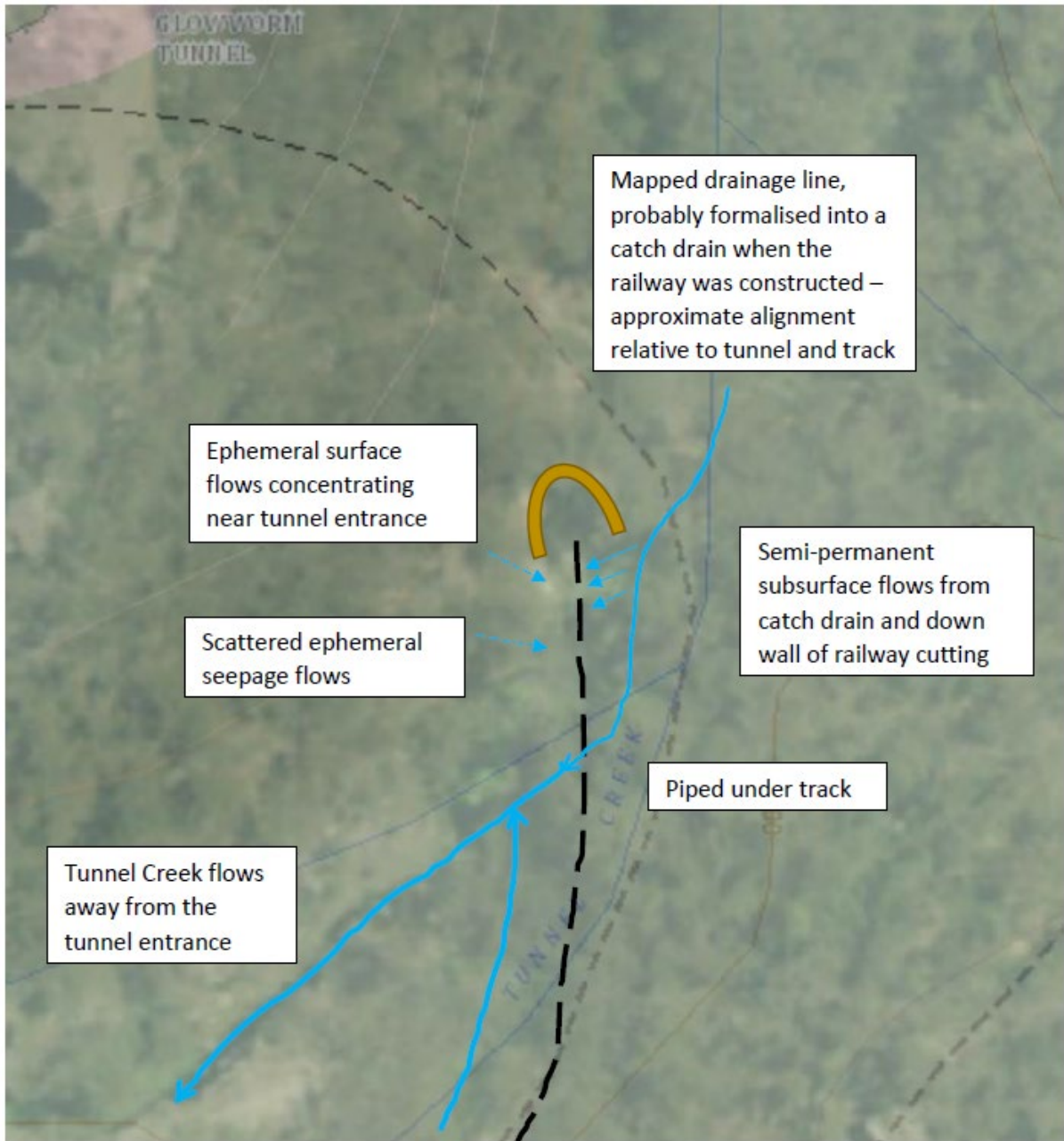


Figure 3 Localised hydrology around the eastern entrance to the Glow Worm Tunnel at Newnes

Glow-worms are reliant on catching flying prey in their webs (snares). The most common food prey items in a cave or tunnel are the flying adult stages of insects which have aquatic larval stages that are carried in by stream flow. It is possible that a complete life cycle of prey species takes place within the tunnel as seepage seems to be the main water source with only occasional significant stream inflow (Merritt 2022, at Appendix D).

Reference material:

- Appendix D *Baseline report: infrastructure in the Glow Worm Tunnel, Newnes* (Merritt 2022)
- Appendix F *Preliminary investigations 2: Glow Worm Tunnel survey, Newnes, Wollemi National Park* (Applied Ecology 2021)

8.2.4 Coasts and estuaries

Not applicable.

8.2.5 Biodiversity

Overview of terrestrial and aquatic biodiversity

Merritt (2023, at Appendix E) describes the glow-worm population in the Glow Worm Tunnel as being colonised by glow-worms (*Arachnocampa richardsae*) after the Wolgan Valley Railway was closed in 1932. Female glow-worms from forest colonies, common in Wollemi National Park, would have found their way into the tunnel, which is ideal habitat due to the high humidity and the presence of a stream. The tunnel's predictable and stable conditions have led to a permanent glow-worm population. For a species that relies on bioluminescence to attract prey, a permanently dark environment potentially increases the chances of catching prey leading to the establishment of permanent populations.

Terrestrial invertebrates including insects such as glow-worms are not protected by law unless they are listed as threatened under the BC Act. The species of glow-worm at the Newnes Glow Worm Tunnel, *Arachnocampa richardsae*, is not listed as threatened.

While glow-worms are not protected in New South Wales by legislation, this REF considers and assesses any impacts on glow-worms by the proposed activity.

KHS Ecology & Bushfire (2022, at Appendix C) identifies the vegetation community surrounding the activity area as the following plant community types (PCT):

- On the sandstone plateau areas from the gorge to areas above (east of) the Glow Worm Tunnel:
 - PCT 1127 Sandstone cliff-face soak
 - PCT 1630 Sydney peppermint – grey gum heathy open forest on sandstone ranges of the Sydney Basin
 - PCT 3687 Newnes Plateau peppermint–ash tall forest.
- Tunnel Creek gully (Penrose Gorge):
 - MU3 Hillslope talus mountain gum – brown stringybark – grey gum – broad-leaved hickory moist forest. This community is mapped in the sheltered south-facing slopes in the Tunnel Creek gully, just below Glow Worm Tunnel, which is the eastern limit of the mapping. This community is representative of the tall gully forests observed on sheltered slopes in this study.

Reference material:

- Appendix C *Flora and fauna assessment: Glowworm Tunnel walking tracks and car parks upgrade works, Wollemi National Park* (KHS Ecology & Bushfire 2022)

Areas of outstanding biodiversity value or critical habitat

No areas of outstanding biodiversity value or critical habitat exist within or adjacent to the activity area.

Environmental assets of intergenerational significance

No areas associated with assets of integrational significance exist within or adjacent to the activity area.

Threatened ecological communities

Survey undertaken by KSH Ecology & Bushfire (2022, at Appendix C) concluded that no threatened ecological communities exist within or adjacent to the activity area.

Reference material:

- Appendix C *Flora and fauna assessment: Glowworm Tunnel walking tracks and car parks upgrade works, Wollemi National Park* (KSH Ecology & Bushfire 2022)

Threatened species and populations

The flora and fauna assessment included a larger study area (i.e. the broader Glow Worm Tunnel precinct including walking tracks) than the area included in the tunnel path and exit proposed works being assessed by this REF.

Flora

None of the locally recorded threatened flora species were found during the site assessment of the area. It is therefore concluded that no threatened flora species will be impacted by the proposal. The threatened flora species that were a focus of the survey include those listed in Table 4.

Table 4 Threatened flora species targeted in the broader precinct assessment

Common name	Scientific name	BC Act status	EPBC Act status
Biconvex paperbark	<i>Melaleuca biconvexa</i>	Vulnerable	Vulnerable
Clandulla geebung	<i>Persoonia marginata</i>	Vulnerable	Vulnerable
Evans grevillea	<i>Grevillea evansiana</i>	Vulnerable	Vulnerable
Klaphake's sedge	<i>Carex klaphakei</i>	Endangered	
Mount Vincent mint-bush	<i>Prostanthera stricta</i>	Vulnerable	Vulnerable
Smooth bush pea	<i>Pultenaea glabra</i>	Vulnerable	
Wollemi mint-bush	<i>Prostanthera cryptandroides</i> subsp. <i>cryptandroides</i>	Vulnerable	Vulnerable
	<i>Eucalyptus cannonii</i>	Vulnerable	
	<i>Darwinia peduncularis</i>	Vulnerable	
	<i>Veronica blakelyi</i>	Vulnerable	

Fauna

Potential threatened fauna species have been considered in relation to whether suitable habitat is present in the works areas. The species considered are listed in Table 5.

Table 5 Threatened fauna species considered during assessment

Common name	Scientific name	BC Act status	Comments
Eastern false pipistrelle	<i>Falsistrellus tasmaniensis</i>	Vulnerable	Prefers moist habitats, with trees taller than 20 m. This species generally roosts in eucalypt hollows.
Gang-gang cockatoo	<i>Callocephalon fimbriatum</i>	Vulnerable	Forages from time to time, feeding on eucalypt seeds.
Koala	<i>Phascolarctos cinereus</i>	Endangered	Koalas occur in Wollemi National Park and there are some records for the species within 10 km of the activity site. Suitable habitat exists at the works sites in the form of favoured feed trees including <i>Eucalyptus cypellocarpa</i> and <i>E. punctata</i> .
Powerful owl Barking owl Sooty owl	<i>Ninox strenua</i> <i>Ninox connivens</i> <i>Tyto tenebricosa</i>	Vulnerable Vulnerable Vulnerable	Forest owls breed in large hollows in forest trees, usually requiring >20 cm diameter hollows.
South-eastern glossy black-cockatoo	<i>Calyptorhynchus lathami lathami</i>	Vulnerable	Feeds almost exclusively on the seeds of several species of she-oak (<i>Casuarina</i> and <i>Allocasuarina</i> species) and nests in large hollow-bearing eucalypts.
Southern greater glider	<i>Petauroides volans</i>	Endangered	Occurs in moist eucalypt forests with diverse eucalypt species due to the need to vary its diet throughout the year. The species is known on the Newnes Plateau.

The proposed works included in this REF do not involve the removal of any trees, therefore there will be no impact on any threatened fauna species through the loss of suitable habitat.

Legislative requirements relating to glow-worms

While all native birds, reptiles, amphibians and mammals (except the dingo) are protected in New South Wales by the Biodiversity Conservation Act, terrestrial invertebrates including insects such as glow-worms are not protected by law unless they are listed as threatened. The species of glow-worm at the Newnes Glow Worm Tunnel, *Arachnocampa richardsae*, is not listed as threatened. It is probably more widely distributed than is reported in observation databases, such as iNaturalist, because habitats are relatively inaccessible and glow-worms are only detected at night (Merritt 2023, at Appendix E).

Reference material:

- Appendix C *Flora and fauna assessment: Glowworm Tunnel walking tracks and car parks upgrade works, Wollemi National Park* (KSH Ecology & Bushfire 2022)
- Appendix E *Impact assessment: infrastructure in the Glow-worm Tunnel, Newnes* (Merritt 2023)

8.3 Cultural values

8.3.1 Aboriginal cultural heritage

Wollemi National Park contains many Aboriginal sites and places that represent a direct link to Aboriginal cultural heritage and values. The landscape and its relationship to sites is significant and provides a cultural link to the land. Such connections form part of cultural identity in the relationship between a place and a story.

Kelleher Nightingale Consulting archaeologists undertook an assessment of the site in September 2022 in accordance with NSW *Due diligence code of practice for the protection of Aboriginal objects in New South Wales* (DECCW 2010); and to identify Aboriginal objects or sites and assess the potential of the archaeologically sensitive landforms identified within the activity area to contain Aboriginal objects. The inspection indicated that the majority of the study area was located in a modified and disturbed context and that no Aboriginal archaeological sites containing Aboriginal objects or areas of potential archaeological deposit exist within the Glow Worm Tunnel precinct walking tracks (Kelleher Nightingale Consulting 2022, at Appendix I). Their assessment also indicates the closest recorded site within the Aboriginal Heritage Information Management System is located 1.4 km to the south-west of the activity area.

Kelleher Nightingale Consulting undertook a site assessment of the Glow Worm Tunnel upper car park and walking tracks and the Glow Worm Tunnel on 30 September 2022 (Appendix I). Bathurst LALC, and Mingaan and Warrabinga Wiriaduri groups were invited to attend. Bathurst LALC attended the site visit with Kelleher Nightingale consultants – no Aboriginal heritage constraints were identified, and the results are consistent with the previous assessment (Matthew Kelleher pers. comm.).

Reference material:

- Appendix I *Letter RE: Glowworm Tunnel precinct walking tracks, Newnes Plateau: Aboriginal heritage assessment* (Kelleher Nightingale Consulting, 27 February 2023)

8.3.2 Historic heritage values

The precinct is of technological importance for remains of retorts, refineries, coke ovens, railway alignments and railway station. The activity is located within the listed Wolgan Railway Precinct, identified as State Heritage item ID 5014091 'Blue Mountains Walking Tracks' sub-item 33 'Wolgan Railway Complex Newnes Railway' s170 ID 3900332 (Heritage NSW n.d.). The railway complex is also listed on the NPWS Historic Heritage Information Management System and s 170 Heritage and Conservation Register (Item ID 11084). In 2006 the *Tracks into history conservation management plan* (Smith et al. 2006) was developed to guide future management of the site.

A statement of heritage impact (Mountains Heritage 2023, at Appendix G) prepared for the proposed activity details the historic heritage values. To inform the statement of heritage impact, an archaeological survey of the tunnel (referred to as Tunnel #2 in the heritage documents and listings) was undertaken. The survey identified 11 historic heritage elements: 9 inside the tunnel and 2 outside the tunnel entrances (see Table 6).

Table 6 Summary of heritage elements identified within, and in close proximity to, the Glow Worm Tunnel (Tunnel #2)

Heritage element	Location	Description and interpretation	Classification
Hand-cut safety refuges	Inside the tunnel	10 refuges (5 pairs) cut into the tunnel walls. The refuges vary in size. Installed to ensure pedestrian safety during construction and operation of the tunnel.	Work
Hand-cut linear side drains	Inside the tunnel	Two linear drains on the outside edges of the tunnel floor. Established to ensure water drained away from the railway track. The drains vary in size, depending on erosion and water movement. West end: 540–550 mm wide x 220 mm deep. East end: 400–450 mm wide by 150 mm deep.	Work
Small circular post holes	Inside the tunnel	Numerous post holes spaced roughly 3 m apart on tunnel walls, measuring 50 mm in diameter. Vary in height (depending on the level of the floor) from 1.7 m to 1.3 m. Likely prop holes for timber supports, used during construction of the tunnel.	Work
Metal hook and small holes in the roof of the tunnel	Inside the tunnel	Likely associated with former lights hung from the roof. Installed during construction of the tunnel.	Work
A small hand-cut niche, including ash deposit, in the north outer tunnel wall	Inside the tunnel	Associated with lighting, likely installed during construction of the tunnel.	Work
Remnant whole and damaged sleepers	Inside the tunnel	Occasional debris. Not in situ.	Moveable heritage
Negative imprint of sleepers, including degraded timber	Inside the tunnel	Near the east tunnel entrance. The deposit directly around the former sleepers is introduced (i.e. slope-wash). The timber within the voids is likely in situ. The sandstone ballast below the sleepers is likely in situ.	Work (in situ timber only)
Disturbed deposit of crushed sandstone ballast	Inside the tunnel	This in situ deposit was introduced to ensure adequate drainage along the Wolgan Valley Railway. It sits below introduced deposits (slope-wash) within the tunnel.	Work
Patches of hand-pecked rock	Inside the tunnel	Identified on the tunnel walls and at the tunnel entrances, particularly at the east tunnel entrance.	Work
Metal culverts	Outside the tunnel	Two identified along the track. Constructed of old boiler shells. Used to divert water away from the former railway alignment.	Work
Small bridge	Outside the tunnel	Constructed of metal frames from a former shay locomotive – sitting above concrete pillars.	Work + moveable heritage

Reference material:

- Appendix G *Glowworm Tunnel, Newnes Plateau, proposed pathway: statement of heritage impact* (Mountains Heritage 2023)

8.4 Social values

8.4.1 Recreation values

The rugged terrain of Wollemi National Park and its relative inaccessibility have been strong determining factors on both the style and location of recreational use of the park. Accordingly, most recreational activity occurs around the edges of the park.

Walking tracks provide park visitors with the opportunity to experience the natural and wilderness recreational settings of the park and to reach particular destinations. The Glow Worm Tunnel visitor precinct is popular for picnicking and bushwalking. The recreational use of the precinct is predicted to increase as the demand for outdoor recreation increases, particularly self-reliant and adventure activities in natural settings. The development of recreational opportunities within the adjoining and recently gazetted Gardens of Stone State Conservation Area is also likely to significantly increase the use of the Glow Worm Tunnel visitor precinct. The precinct's unique features are considered a regionally significant tourism attraction.

8.4.2 Scenic and visually significant areas

The weathering of the sandstones of the park has resulted in a scenic landscape of deeply dissected plateaus, cliffs and narrow gorges. The activity is located within both the plateau and a deeply incised valley dominated by tall eucalyptus. These features offer a visually significant contrast to the greater landscape.

8.4.3 Education and scientific values

Wollemi National Park contains a range of important scientific values, from rare species to unique geological formations and significant cultural history. The landscape in the location of the proposed activity was heavily modified during the early railway formation. The engineering features of the area resulted in significant modifications to the environment which now provide a unique insight into the recovery of historically impacted landscapes.

8.4.4 Interests of external stakeholders

The Glow Worm Tunnel visitor precinct is used by commercial tourism operators and local tourism businesses for day use recreational activities.

8.5 Matters of national environmental significance

A protected matters report was created in January 2023 (Appendix K) and identified several protected matters potentially within and adjacent to the activity area, including:

- one World Heritage property, namely the Greater Blue Mountains Area World Heritage property, also listed on the Commonwealth National Heritage List
- 3 threatened ecological communities
- 43 listed threatened species
- 12 listed migratory species.

It is considered that the activity is not likely to result in the loss or significant reduction of a specific example of the genus *Eucalyptus* and eucalypt-dominated vegetation that may impact values of Criterion (ix) (UNESCO 2000) of the Greater Blue Mountains Area World Heritage property. The activity is also unlikely to modify a habitat or plant communities that will result in significant impacts to species or ecosystem diversity of the World Heritage property under Criterion (x) (UNESCO 2000) given its small footprint.

The Greater Blue Mountains Area is taken to meet the National Heritage criteria in accordance with sub-item 1A(3) of Schedule 3 of the *Environment and Heritage Legislation Amendment Act (No.1) 2003*, as the World Heritage Committee has determined that this place meets World Heritage criteria (ix) and (x).

Significant impact criteria for the Greater Blue Mountains Area National Heritage place are consistent with those of the World Heritage property. The assessment of World Heritage values of properties above therefore applies equally to the National Heritage place. The activity is therefore not likely to significantly impact the values associated with Greater Blue Mountains Area National Heritage place (see Appendix G, sections 6.4, 6.5 and 7).

A survey by KHS Ecology & Bushfire (2022, at Appendix C) identified no flora species or threatened ecological communities listed under the EPBC Act within or adjacent to the activity footprint.

The small size of the activity footprint suggests that an adverse effect on the life cycle of additional potential species is unlikely. The disturbance is also neither likely to fragment or isolate habitat, nor have a significant impact on habitat of specific importance to the long-term survival of identified species given the activity is proposed along existing and disturbed tracks. It is likely that the works will result in a net positive outcome to the area, where mitigation measures are adopted through stabilisation of the track surface and reduction of erosion and sedimentation into the surrounding habitat.

Reference material:

- Appendix C *Flora and fauna assessment: Glowworm Tunnel walking tracks and car parks upgrade works, Wollemi National Park* (KSH Ecology & Bushfire 2022)
- Appendix G *Glowworm Tunnel, Newnes Plateau, proposed pathway: statement of heritage impact* (Mountains Heritage 2023)

9. Impact assessment

This section includes assessments (including likely impacts, the level of impact, and mitigation measures) during all stages of the activity for the following impacts:

- physical and chemical impacts (Table 7)
- biodiversity impacts (Table 8)
- community impacts (Table 9)
- natural resource impacts (Table 10)
- Aboriginal cultural heritage impacts (Table 11)
- other cultural heritage impacts (Table 12)
- impacts on matters of national environmental significance (Table 13)
- cumulative impacts (Table 14).

9.1 Physical and chemical impacts during all stages of the activity

Table 7 Impact assessment: physical and chemical impacts

Is the proposed activity likely to...	Applicable?	Impact level	Reasons	Safeguards/mitigation measures
1. impact on soil quality or land stability?	Yes	Low, adverse	<p>The activity area is within existing walking track alignments. The tunnel path and exit area works will reduce the loss of soil from water erosion and reduce the risk of land instability, particularly at the tunnel exit, through appropriate management of surface water within the Glow Worm Tunnel.</p> <p>A quantitative risk assessment (QRA) as per the NPWS <i>Landslides and rockfalls procedures</i> (DPIE 2020) was undertaken in September 2022 (Appendix J). Recommendations and remediation actions will be undertaken as per the QRA with works to be undertaken with appropriately qualified specialists.</p>	<p>Implement track works to minimise impacts to adjoining native vegetation, trees, rock features and watercourses.</p> <p>Implement erosion and sediment control techniques as per section 5 ‘Tracks and related structures’ of the <i>Parks facilities manual</i> (NPWS 2016a) as they apply to each specific location.</p> <p>Apply all geotechnical recommendations applicable to tracks works within the activity area as detailed in the QRA.</p> <p>Only remove required vegetation, maintaining the ground cover vegetation where possible.</p> <p>Schedule works outside of predicted heavy rain periods.</p> <p>Stop work during and after heavy rainfall to reduce risk of mobilising sediment.</p>
2. affect a waterbody, watercourse, wetland or natural drainage system – either physically or chemically (e.g. due to runoff or pollution)?	Yes	Low, adverse	<p>The activity includes works within the tunnel watercourse area and the tunnel exit area that discharges into Tunnel Creek.</p> <p>Merritt (2023, at Appendix E) notes the following regarding stream water quality and glow-worms: ‘Maintenance of the characteristics and quality of the stream water is important. Loss or major</p>	<p>Delineate the work site from the tunnel watercourse from the seepage point, approximately 10 m from the tunnel entrance (eastern end), through to the tunnel exit (western end).</p> <p>Return streamway to pre-construction state after completion.</p>

Is the proposed activity likely to...	Applicable?	Impact level	Reasons	Safeguards/mitigation measures
			<p>damage to this base of the glow-worm food-chain could result in gradual loss or reduction of the colony in the cave. The stream inside the tunnel is slow-moving due to the small elevational difference between entrances (a vertical drop of 10.6 m over 387 m) and is comprised of a series of pools. It is most likely that aquatic insect larvae would be living and developing in these shallow pools so it is important to prevent people trampling the pools and not to permanently change the nature of the pools with infrastructure. A preliminary survey of stream invertebrates carried out by Applied Ecology indicated that macroinvertebrate diversity was low but included some pollution-sensitive groups, indicating high water quality. The identified prey taxa — mayflies, caddisflies, midges — were similar to those seen in caves of Tasmania ... and New Zealand'</p> <p>Additionally, Merritt (2023) notes:</p> <p>'During construction, it is desirable to minimise changes to the stream flow in the tunnel because it is the source of glow-worm prey. Where this is unavoidable, the streamway should be returned to its pre-disturbed state where possible. It was pointed out that for historical display considerations it might be desirable to return a section of the tunnel gutters to their original, unobstructed state, especially near the eastern entrance where light penetrates. This is deemed to be acceptable.'</p>	<p>Consider impact of leaching from building materials on stream water quality.</p> <p>Imported soil or gravel material is not recommended to be used in drainage lines, to avoid risk of introducing soil pathogens.</p> <p>All machinery and equipment brought onto site needs to be clean of all soil material, which could carry soil pathogens, weed propagules or contaminants.</p> <p>Install and maintain erosion and sediment controls during the construction phase to ensure potential soil erosion and weed spread into watercourses and surrounding vegetation are minimised and controlled.</p> <p>Regularly monitor controls and inspect after heavy rainfall. Repair/reinstall controls as required.</p> <p>Store all chemicals in appropriate bunding/storage systems.</p> <p>Ensure appropriate spill kits, shovels and buckets are carried with the equipment, and if a small spill occurs quickly shovel the contaminated soil into the bucket and dispose of appropriately.</p>

Is the proposed activity likely to...	Applicable?	Impact level	Reasons	Safeguards/mitigation measures
3. change flood or tidal regimes, or be affected by flooding?	No		Not applicable	Not applicable
4. affect or be affected by coastal processes and coastal hazards, including those under climate change projections (e.g. sea level rise)?	No		Not applicable	Not applicable
5. involve the use, storage or transport of hazardous substances, or use or generate chemicals which may build up residues in the environment?	No		Not applicable	Not applicable
6. involve the generation or disposal of gaseous, liquid or solid wastes or emissions?	Yes	Low, adverse	<p>Generation of some solid waste and its disposal will result from the works. Waste generation is likely to include unusable rubble from within the tunnel, soil or vegetation waste and general construction waste (packaging).</p> <p>Equipment fumes in the tunnel could cause possible toxicity to the glow-worm population.</p>	<p>Waste materials to be reused, recycled or disposed of at an appropriate waste facility where suitable.</p> <p>Use battery-operated equipment (for in-tunnel works) where feasible.</p>
7. involve the emission of dust, odours, noise, vibration or radiation?	Yes	Medium, adverse	<p>Merritt (2023) notes the following regarding glow-worms and sensitivity to noise and vibrations: ‘Sudden, loud noises or sudden substrate vibration in an otherwise quiet environment will cause glow-worms to brighten. When sound or</p>	<p>The construction phase should be kept as short as possible (because the associated disturbance is regarded as high-level and frequent).</p>

Is the proposed activity likely to...	Applicable?	Impact level	Reasons	Safeguards/mitigation measures
			<p>vibration are more extreme, larvae will switch off ... Prolonged drilling produces substantial vibration so I anticipate that drilling for path installation would cause larvae to switch off. As mentioned above, this will be temporary, and recovery will occur through the night. Physical disturbance, such as brushing against the webs or displacing larvae is most damaging because larvae are delicate and must completely rebuild their snares, meaning there is a metabolic cost which in turn means that more prey are required to complete the life cycle.'</p> <p>During construction of the path, exposure to noise, vibration and lighting are unavoidable.</p> <p>Merritt (2023) notes the impact of noise, vibration and light within the tunnel would:</p> <p>'...cause temporary dimming or switching off. The glow-worm bioluminescence system is most effective at night so larvae affected by construction during the day should be able to recover and feed at night. It is important to avoid physically brushing against glow-worm snares or exposing them to volatile chemicals or smoke.'</p> <p>Extraneous light causes dousing of bioluminescence of glow-worms, impacting prey capture.</p>	<p>Restrict construction to 8 hours per day. Use red light where feasible.</p>

9.2 Biodiversity impacts during all stages of the activity

Table 8 Impact assessment: biodiversity impacts

Is the proposed activity likely to...	Applicable?	Impact level	Reasons	Safeguards/mitigation measures
1. affect any declared area of outstanding biodiversity value or critical habitat or environmental asset of intergenerational significance?	No		Not applicable	Not applicable
2. result in the clearing or modification of vegetation, including ecological communities and plant community types of conservation significance? ^	Yes		A tree fern will be transplanted locally as part of the proposed activity.	Implement the NSW Government Saving our Species <i>Hygiene guidelines</i> (EES 2020).
3. endanger, displace or disturb terrestrial or aquatic fauna, including fauna of conservation significance, or create a barrier to their movement? ^	Yes	Medium, adverse	<p>Merritt (2023, at Appendix E) summarises the glow-worm impact assessment as: ‘Glow-worms have very specific habitat requirements, so they are sensitive to environmental changes as well as more direct physical disturbance. The environmental conditions in the Glow Worm Tunnel are currently well-suited to maintaining populations; however, such environments are subject to inadvertent microclimate changes or changes that affect the food supply.’</p> <p>Sensitivity factors include: Planning phase</p>	<p>Planning phase</p> <p>The works include the implementation of the preferred option, Option C. During design, the planning phase sensitivity factor mitigation measures drove the design and planning of the tunnel path:</p> <ul style="list-style-type: none"> • Design and locate pathway to keep people away from the glow-worms and out of the streamway. • Avoid unnecessary modification of walls, floors, entrances. • Utilise existing shelf-like ‘desire path’ on tunnel floor for constructed pathway. <p>Construction phase</p> <ul style="list-style-type: none"> • Use battery-operated equipment where feasible.

Is the proposed activity likely to...	Applicable?	Impact level	Reasons	Safeguards/mitigation measures
			<ul style="list-style-type: none"> • proximity of human activity to glow-worms • unnecessary disturbance of physical features of the tunnel and stream <p>Construction phase</p> <ul style="list-style-type: none"> • equipment noise and fumes • streamway disturbance, trampling, muddying • extraneous light <p>Operative phase</p> <ul style="list-style-type: none"> • touching disturbance • artificial light • streamway disturbance, trampling, muddying. 	<ul style="list-style-type: none"> • Restrict operations to 8 hours per day. • Avoid disturbing the streamway where feasible. • Return streamway to pre-construction state after completion. • Consider impact of leaching from building materials on stream water quality. • Use red light where feasible. <p>Operative phase</p> <p>Implement interpretation that educates visitors about:</p> <ul style="list-style-type: none"> • impacts of touching the glow-worms • impact of direct, prolonged light on the glow-worms • encourage the use of red headlights or hand torches • the tunnel's ecosystem and importance of streamway as source of prey.
4. result in the removal of protected flora or plants or fungi of conservation significance? ^	No		Not applicable	Not applicable
6. contribute to a key threatening process to biodiversity or ecological integrity?	No		Not applicable	Not applicable

Is the proposed activity likely to...	Applicable?	Impact level	Reasons	Safeguards/mitigation measures
7. introduce weeds, pathogens, pest animals or genetically modified organisms into an area?	Yes	Low, adverse	Vehicle and pedestrian movements into the area may introduce weed species. Imported construction materials also have the potential to transport introduced species.	<p>NPWS to continue to monitor and manage pests and weeds in accordance with the NSW Government Saving our Species <i>Hygiene guidelines</i> (EES 2020).</p> <p>Weed control is recommended before, during and after the works, including ongoing monitoring to ensure the control of any inadvertent weed spread.</p> <p>All machinery, equipment and materials brought onto the site need to be clean of all soil material, which could carry soil pathogens, weed propagules or contaminants.</p>

^ Refer to the results of any tests of significance in Appendix C.

9.3 Community impacts during all stages of the activity

Table 9 Impact assessment: community impacts

Is the proposed activity likely to...	Applicable?	Impact level	Reasons	Safeguards/mitigation measures
1. affect community services or infrastructure?	Yes	Low, adverse	During construction, the Glow Worm Tunnel and surrounding walking tracks will be closed.	Prepare and implement key messaging regarding closures and closure notifications.
2. affect sites important to the local or broader	Yes	Positive	During construction, the Glow Worm Tunnel and surrounding walking tracks will be closed.	Not applicable

Glow Worm Tunnel path and exit: review of environmental factors

Is the proposed activity likely to...	Applicable?	Impact level	Reasons	Safeguards/mitigation measures
community for their recreational or other values or access to these sites?			The proposed upgrades to the visitor precinct will provide increased amenity and accessibility for recreational users of the area and the associated walking tracks.	
3. affect economic factors, including employment, industry and property value?	Yes	Positive	<p>During construction there is expected to be minor disruptions to commercial tour operators that use the Glow Worm Tunnel precinct as part of their tour offerings.</p> <p>Operationally the proposed upgrades to the visitor precinct will provide increased amenity for recreational users and are anticipated to increase visitation to the area.</p> <p>The activity proposes upgrades to ensure the long-term sustainable use of the Glow Worm Tunnel precinct.</p>	Not applicable
4. have an impact on the safety of the community?	Yes	Low, adverse Positive	<p>During construction, helicopters and trucks will deliver materials and equipment to the worksites. The site will be closed for the duration of works. The works will result in safer visitor access through the Glow Worm Tunnel.</p>	<p>Temporary signage detailing closures will be placed prior to works commencing. Signage will be removed following construction. NPWS will advise the public of the temporary closures via the NPWS website and media releases.</p>
5. cause a bushfire risk?	No		The activity does not increase any bushfire risks. Historical use of the site suggests bushfire risks from recreation in the area are negligible.	Not applicable
6. affect the visual or scenic landscape?	Yes		<p>All works are designed to be visually sympathetic to the surrounding environment and blend in. Mountains Heritage (2023, at Appendix G) states: 'Visually, the new pathway would result in a minor impact to the aesthetic values of the</p>	The use of blond bricks with matching mortar should ensure that the pathway remains visually recessive in the tunnel environment.

Glow Worm Tunnel path and exit: review of environmental factors

Is the proposed activity likely to...	Applicable?	Impact level	Reasons	Safeguards/mitigation measures
			<p>tunnel. However, the extent of erosion across the tunnel floor has already detrimentally impacted the heritage significance of the tunnel and prevention of further damage is considered a positive heritage outcome.'</p>	

9.4 Natural resource impacts during all stages of the activity

Table 10 Impact assessment: natural resources

Is the proposed activity likely to...	Applicable?	Impact level	Reasons	Safeguards/mitigation measures
1. result in the degradation of the park or any other area reserved for conservation purposes?	No		Not applicable	Not applicable
2. affect the use of, or the community's ability to use, natural resources?	No		Not applicable	Not applicable
3. involve the use, wastage, destruction or depletion of natural resources including water, fuels, timber or extractive materials?	No		Not applicable	Not applicable
4. provide for the sustainable and efficient use of water and energy?	No		Not applicable	Not applicable

9.5 Aboriginal cultural heritage impacts during all stages of the activity

Table 11 Impact assessment: Aboriginal cultural heritage

Is the proposed activity likely to...	Applicable?	Impact level	Reasons	Safeguards/mitigation measures
1. disturb the ground surface or any vegetation likely to contain culturally modified trees?	Yes	Low, adverse	<p>Yes, the proposed activity will disturb the ground surface.</p> <p>No, the proposed activity will not disturb any culturally modified trees.</p>	
2. affect or occur near known Aboriginal objects, Aboriginal places or an Aboriginal cultural asset of intergenerational significance? If so, can impacts be avoided? How?	No		<p>No, a search of the Heritage NSW Aboriginal Heritage Information Management System was conducted on 27 February 2023 to identify any registered (known) Aboriginal sites or Aboriginal places within or adjacent to the study area.</p> <p>Kelleher Nightingale Consulting (2023, at Appendix I) states:</p> <p>‘The closest registered AHIMS site, Glowworm Tunnel 1; Wollemi NP; (AHIMS 45-1-0098) is registered approximately 1.4 kilometres southwest of the southern boundary of the study area. The site was recorded in a small open valley on a high rocky plateau. The site consisted of a rockshelter site with art. The rockshelter was a very open shelter with the rear wall curving gently overhead to form a slight shelter. The height of the shelter was four metres and the maximum depth two metres. One single white pigment hand stencil was recorded on the rear wall, approximately one metre above ground level. No artefacts or areas of archaeological potential were identified at the site.</p>	

Is the proposed activity likely to...	Applicable?	Impact level	Reasons	Safeguards/mitigation measures
No Aboriginal archaeological sites or Aboriginal places were identified within the study area on the AHIMS database.'				
<p>3. affect areas:</p> <ul style="list-style-type: none"> - within 200 m of waters - within a sand dune system - on a ridge top, ridge line or headland - within 200 m below or above a cliff face - in or within 20 m of a cave, rock shelter or a cave mouth? <p>If so, can impacts be avoided? How?</p>	Yes	Low, adverse	<p>Yes, the study area traverses Tunnel Creek and its tributaries, and drainage tributaries of the Wolgan River. No, the study area is not located within a sand dune system, ridge top, ridge line or headland.</p> <p>A favourable landscape assessment (within 200 m of waterways) and the presence of known Aboriginal archaeological sites within the wider vicinity of the study area necessitated a visual inspection of the study area.</p> <p>Visual inspection was undertaken by Dr Matthew Kelleher (Kelleher Nightingale Consulting, KNC), Tristram Miller (KNC), Tina Scott (Bathurst Land Council), Patsy Riley (Mingaan Wiradjuri Aboriginal Corporation) and Lou Wallace (NPWS) on 30 September 2022. The visual inspection aimed to identify Aboriginal objects or sites and assess the potential of the archaeologically sensitive landforms identified within the study area to contain Aboriginal objects.</p> <p>No Aboriginal archaeological sites containing Aboriginal objects or areas of potential archaeological deposit were identified as a result of the visual inspection.</p>	<p>All contractors and staff to be given an Aboriginal site ID toolbox talk before work, including notification of statutory obligations for heritage under the NPW Act.</p> <p>Should any Aboriginal objects be uncovered by the work which is not covered by a valid Aboriginal heritage impact permit, excavation or disturbance of the area is to stop immediately and Heritage NSW is to be informed in accordance with the NPW Act. Works affecting Aboriginal objects on the site must not continue until Heritage NSW has been informed and the appropriate approvals are in place. Aboriginal objects must be managed in accordance with the NPW Act.</p>
<p>4. affect wild resources which are used or valued by the Aboriginal community or affect access to these resources?</p>	No		<p>Visual inspection was undertaken by Dr Matthew Kelleher (KNC), Tristram Miller (KNC), Tina Scott (Bathurst Land Council), Patsy Riley (Mingaan Wiradjuri Aboriginal Corporation) and Lou Wallace (NPWS) on 30 September 2022. The visual</p>	

Is the proposed activity likely to...	Applicable?	Impact level	Reasons	Safeguards/mitigation measures
			<p>inspection aimed to identify Aboriginal objects or sites and assess the potential of the archaeologically sensitive landforms identified within the study area to contain Aboriginal objects.</p> <p>No Aboriginal archaeological sites containing Aboriginal objects or areas of potential archaeological deposit were identified as a result of the visual inspection.</p>	
<p>5. affect access to culturally important locations?</p>	<p>No</p>		<p>Visual inspection was undertaken by Dr Matthew Kelleher (KNC), Tristram Miller (KNC), Tina Scott (Bathurst Land Council), Patsy Riley (Mingaan Wiradjuri Aboriginal Corporation) and Lou Wallace (NPWS) on 30 September 2022. The visual inspection aimed to identify Aboriginal objects or sites and assess the potential of the archaeologically sensitive landforms identified within the study area to contain Aboriginal objects.</p> <p>No Aboriginal archaeological sites containing Aboriginal objects or areas of potential archaeological deposit were identified as a result of the visual inspection.</p>	

9.6 Other cultural heritage impacts during all stages of the activity

Table 12 Impact assessment: other cultural heritage

Is the proposed activity likely to...	Applicable?	Impact level	Reasons	Safeguards/mitigation measures
1. affect or occur near places, buildings or landscapes of heritage significance?	Yes	Low, adverse	<p>The Glow Worm Tunnel is a former railway tunnel that forms part of the Wolgan Railway Complex; a state significant railway recognised for its historic, technical, associative and research heritage values. The Wolgan Railway Complex is listed on the NSW State Heritage Register as one of the 'Blue Mountains Walking Tracks' (State Heritage Register Listing No. 00980). Wolgan Railway Complex is also listed on the NPWS Historic Heritage Information Management System and s 170 Heritage and Conservation Register (Item ID 11084). Mountains Heritage (2023, at Appendix G) notes in the statement of heritage impacts for the proposed works:</p> <p>'The new brick edged pathway largely respects and enhances the significance of the Glowworm Tunnel. The pathway design actively avoids any direct impact on the heritage elements identified within the tunnel. Clearing of debris from the side cut drain below the inner (south) tunnel wall would enhance the visibility of an important heritage element and partially restore its original function. The laying of geofabric below the new pathway, prior to the introduction of fill would ensure that existing and new fabric can be distinguishable... Excavation has been minimised wherever possible and, given the degree of sediment movement there would be no impact on potential archaeological relics. Deeper excavation is only required to secure the handrail supports and this would be limited to the drilling of 70 mm wide ... Whilst this would result in a direct impact to the tunnel floor, the impact is minimal and necessary to ensure the safety of visitors. The only other aspect of the</p>	<p>The brick-edged pathway minimises direct impact on heritage elements within the Glow Worm Tunnel. These include hand-cut side drains, safety refuges, prop holes and remnants of former lighting. The new pathway requires minimal excavation and would be positioned so that the existing inner (south) hand-cut drain would be exposed along its length and its function partially restored. Geofabric will be placed above the outer (north) hand-cut drain to ensure existing slope-wash above the drain is distinguishable from introduced fill. Blond bricks bonded with matching mortar will be used to ensure the brick edging will be visually recessive. The works will be reversible in nature and durable, requiring very little maintenance. Comply with conditions of the s 60 Heritage Act approval (Appendix H).</p>

Is the proposed activity likely to...	Applicable?	Impact level	Reasons	Safeguards/mitigation measures
2. impact on relics or moveable heritage items, or an area with a high likelihood of containing relics?	Yes	As above	<p>proposal that has an indirect impact on the heritage values of the Glowworm Tunnel is the positioning of the path above the side cut drain below the outer (north) tunnel wall. This drain is largely covered with slope-wash at present and, while the addition of the pathway would cover the element more permanently, the work is largely reversible in nature.'</p> <p>An application under s 60 of the Heritage Act was approved on 6 July 2023 (Appendix H).</p>	As above
3. impact on vegetation of cultural landscape value (e.g. gardens and settings, introduced exotic species, or evidence of broader remnant land uses)?	No	As above	As above	Not applicable

9.7 Impacts on matters of national environmental significance during all stages

Table 13 Impact assessment: matters of national environmental significance (MNES)

Is the proposal likely to affect MNES, including:	Applicable?	Likely impact	Reasons	Safeguards/mitigation measures
1. listed threatened species or ecological communities)?	No		A survey by KHS Ecology & Bushfire (2022, at Appendix C) identified no flora species or threatened ecological communities listed under the EPBC Act within or adjacent to the activity footprint.	Not applicable
2. listed migratory species?	No		Not applicable	Not applicable
3. the ecology of Ramsar wetlands?	No		Not applicable	Not applicable
4. World Heritage values of World Heritage properties?	No		<p>The Greater Blue Mountains Area World Heritage property is significant for its natural heritage values. Given that the listing is largely based on natural heritage values, the proposed pathway in the Glow Worm Tunnel is highly unlikely to impact on the World Heritage and National Heritage values.</p> <p>The works would not result in one or more of the National Heritage values to be lost, degraded or damaged or notably altered, modified, obscured or diminished. No eucalypt or ancient relic species or rare and threatened fauna or flora species would be impacted, and the diversity and composition of plant and animal species would not be affected.</p>	Not applicable
5. the National Heritage values of National Heritage places?	No		As above	Not applicable

9.8 Cumulative impacts during all stages of the activity

Table 14 Impact assessment: cumulative impacts

When considered with other projects, is the proposed activity level to affect...	Applicable?	Impact level	Reasons	Safeguards/mitigation measures
1. natural landscape or biodiversity values through cumulative impacts?	No		<p>Other projects that have been approved within the vicinity of the proposal covered by this REF include the Glow Worm Tunnel precinct walking track upgrade works.</p> <p>There will be interaction between the walking track upgrade works and the tunnel path and exit works in both location and construction timeframes, with the walking track upgrades work in progress from May to December 2023.</p> <p>The assessment of cumulative impacts was assessed and considered through whole-of-site assessments covering natural and cultural values. Specialist assessment reports were undertaken for the whole precinct, ensuring a sufficient level of assessment and scrutiny is undertaken across the whole precinct upgrade proposal (including car park and walking track upgrade works and new infrastructure in the Glow Worm Tunnel and exit area).</p>	Whole-precinct values assessment reports, ensuring a sufficient level of assessment and scrutiny is undertaken across the whole precinct upgrade proposal.
2. cultural (Aboriginal, shared and historic heritage) values through cumulative impacts?	No		As above	

Glow Worm Tunnel path and exit: review of environmental factors

When considered with other projects, is the proposed activity level to affect...	Applicable?	Impact level	Reasons	Safeguards/mitigation measures
3. social (amenity, recreation, education) values through cumulative impacts?	Yes	Positive	The upgrade of the entire Glow Worm Tunnel visitor precinct will significantly improve the visitor experience through improved facilities and enhanced interpretation of the site's unique natural and cultural values.	
4. the community through cumulative impacts on any other part of environment (e.g. due to traffic, waste generation or perceived over-development)?	Yes	Low, adverse	The Glow Worm Tunnel precinct will require closures for prolonged periods, including school holiday and public holidays, due to the size of the cumulative works; car park upgrade works; 5.7 km walking track upgrade works; and a new path within the Glow Worm Tunnel.	Keep visitors and stakeholders informed of the upgrade works, including closures and updates on the progress of the works. Ensure site closures are minimised, where feasible.

10. Proposals requiring additional information

Under the *Guidelines for preparing a review of environmental factors* (DPE 2022), no additional information is required.

11. Summary of impacts and conclusions

Table 15 provides a summary of impacts and conclusions.

Table 15 Summary of impacts and conclusions

Environmental factor	Consideration	Significance of impact
(a) the environmental impact on the community	Social, economic and cultural impacts as described in sections 9.3, 9.5 and 9.6	Not significant
(b) the transformation of the locality	Human and non-human environment as described in sections 9.1, 9.2 and 9.4	Not significant
l the environmental impact on the ecosystems of the locality	Sections 9.1, 9.2 and 9.4 and, for nationally listed threatened ecological communities, in section 9.7.	Not significant
(d) reduction of the aesthetic, recreational, scientific or other environmental quality or value of the locality	Visual, recreational, scientific and other impacts as described in section 9.3.	Not significant
(e) the effects on any locality, place or building that has— (i) aesthetic, anthropological, archaeological, architectural, cultural, historical, scientific or social significance, or (ii) other special value for present or future generations	Impacts to Aboriginal and historic heritage associated with a locality (including intangible cultural significance), architectural heritage, social/community values and identity, scenic values and others, as described in sections 9.3, 9.5 and 9.6 and (for matters of national environmental significance and National Heritage places) section 9.7.	Not significant
(f) the impact on the habitat of protected animals, within the meaning of the Biodiversity Conservation Act	Impacts to all native terrestrial species, including but not limited to threatened species, and their habitat requirements, as described in section 9.2.	Not significant
(g) the endangering of a species of animal, plant or other form of life, whether living on land, in water or in the air	Impacts to all listed terrestrial and aquatic species, and whether the proposal increases the impact of key threatening processes, as described in section 9.2	Not significant
(h) long-term effects on the environment	Long-term residual impacts to ecological, social and economic values as described in all parts of section 9.	Not significant

Environmental factor	Consideration	Significance of impact
(i) degradation of the quality of the environment	Ongoing residual impacts to ecological, social and economic as described in section 9.4.	Not significant
(j) risk to the safety of the environment	Impacts to public and work health and safety, from contamination, bushfires, sea level rise, flood, storm surge, wind speeds, extreme heat, rockfall and landslip, and other risks likely to increase due to climate change as described in sections 9.1, 9.3 and 9.4.	Not significant
(k) reduction in the range of beneficial uses of the environment	Impacts to natural resources, community resources and existing uses as described in sections 9.3 and 9.4.	Not significant
(l) pollution of the environment	Impacts due to air pollution (including odours and greenhouse gases); water pollution (water quality health); soil contamination; noise and vibration (including consideration of sensitive receptors); or light pollution, as described in sections 9.1 and 9.3.	Not significant
(m) environmental problems associated with the disposal of waste	Transportation, disposal and contamination impacts as described in section 9.3.	Not significant
(n) increased demands on natural or other resources that are, or are likely to become, in short supply	Impacts to land, soil, water, gravel, minerals and energy supply as described in section 9.4.	Not significant
(o) the cumulative environmental effect with other existing or likely future activities	The negative synergisms with existing development or future activities as considered in section 9.8.	Not significant
(p) the impact on coastal processes and coastal hazards, including those under projected climate change conditions	Impacts arising from the proposed activity on coastal processes, and impacts on the proposed activity from those coastal processes and hazards, both current and future, as considered in section 9.1.	Not significant
(q) applicable local strategic planning statements, regional strategic plans or district strategic plans made under the Act, Division 3.1	Inconsistency with the objectives, policies and actions identified in local, district and regional plans, as considered in section 3.2.2.	Not significant
I other relevant environmental factors.	Any other factors relevant in assessing impacts on the environment to the fullest extent, such as native title.	Not significant

In conclusion:

There **is not** likely to be a significant effect on the environment and an environmental impact statement is **not** required.

- Reason(s): the nature of the activity will not result in a significant adverse impact on any environmental factors considered in the Environmental Planning and Assessment Act.

There **is not** likely to be a significant effect on threatened species, populations, ecological communities or their habitats and a species impact statement is **not** required.

- Reason(s): the activity will not have an effect on threatened species, populations, ecological communities or their habitats, summarised in Section 9 of this REF and conclusions made in Appendix C.

The activity **is not** likely to have a significant impact on matters of national environmental significance listed under the Cth Environment Protection and Biodiversity Conservation Act.

- Reason(s): It is considered that the activity is not likely to result in the loss or significant reduction of a specific example of the genus *Eucalyptus* and eucalypt-dominated vegetation that may impact values of Criterion (ix) (UNESCO 2000) of the Greater Blue Mountains Area World Heritage property. The activity is also unlikely to modify a habitat or plant communities that will result in significant impacts to species or ecosystem diversity of the Greater Blue Mountains Area under Criterion (x) (UNESCO 2000) given its small footprint.

The activity **will not** require certification to the Building Code of Australia, Disability (Access to Premises – Buildings) Standards 2010 or Australian Standards in accordance with the NPWS *Construction assessment procedures* (OEH 2011). The proposed activity is designed and will be undertaken in accordance with the NPWS *Park facilities manual* (NPWS 2016a).

12. Supporting documentation

Documentation supporting this application are listed in Table 16, including appendix number. Appendices are supplied as separate PDFs.

Table 16 Supporting documentation

Appendix	Document title	Author	Date
Appendix A	Tunnel path: detailed designs	NPWS	March 2023
Appendix B	Tunnel exit: refined concept designs	Environmental Partnerships	July 2023
Appendix C	Flora and fauna assessment: Glow Worm Tunnel walking tracks and carparks upgrade works, Wollemi National Park	KHS Ecology & Bushfire	August 2022
Appendix D	Baseline report: infrastructure in the Glow Worm Tunnel, Newnes	David Merritt, The University of Queensland	January 2022
Appendix E	Impact assessment: infrastructure in the Glow-worm Tunnel, Newnes	David Merritt, The University of Queensland	July 2023
Appendix F	Preliminary investigations 2: Glow Worm Tunnel survey, Newnes, Wollemi National Park	Applied Ecology	2021
Appendix G	Glowworm Tunnel, Newnes Plateau, proposed pathway: statement of heritage impact	Mountains Heritage	May 2023
Appendix H	Section 60 and s 65A: delegated approval letter	Heritage NSW	July 2023
Appendix I	Letter RE: Glowworm Tunnel Precinct walking tracks, Newnes Plateau: Aboriginal heritage assessment	Kelleher Nightingale Consulting	February 2023
Appendix J	Glow Worm Tunnel: three sites quantitative risk assessment	Jacobs Group (Australia)	April 2022
Appendix K	EPBC Act protected matters report	DCCEEW	January 2023

13. Fees for external proponents

Not applicable.

14. Declarations

As the person responsible for the preparation of the REF, I certify that, to the best of my knowledge, this REF is in accordance with the EP&A Act, the EP&A Regulation and the guidelines approved under section 170 of the EP&A Regulation, and the information it contains is neither false nor misleading.

Signature

Name (printed)

Joanne Cox

Position

Senior Project Officer, NSW National Parks and Wildlife Service

Date

27 July 2023

By endorsing the REF, the proponent confirms that the information in the REF is accurate and adequate to ensure that all potential impacts of the activity can be identified.

Signature

Name (printed)

Angela Lonergan

Position

Area Manager, NSW National Parks and Wildlife Service

Date

References

DECCW (Department of Environment, Climate Change and Water, NSW) (2010) 'Due diligence code of practice for the protection of Aboriginal objects in New South Wales', DECCW, Hurstville.

DEWHA (Department of the Environment, Water, Heritage and the Arts, Cth) (2013) 'Significance impact guidelines 1.1: matters of environmental significance', DEWHA, Canberra.

DPE (Department of Planning and Environment) (2022) 'Guidelines for preparing a review of environmental factors: How to assess the environmental impacts of activities within NSW national parks', DPE, Parramatta.

Department of Planning, Industry and Environment (DPIE) (2020) 'Landslides and rockfalls procedures', DPIE, Parramatta.

Environment, Energy and Science (2020) 'Hygiene guidelines: Protocols to protect priority biodiversity areas in NSW from *Phytophthora cinnamomi*, myrtle rust, amphibian chytrid fungus and invasive plants', Department of Planning, Industry and Environment, Parramatta.

Heritage NSW (n.d.) 'State Heritage Item ID 5014091 'Blue Mountains Walking Tracks'', Heritage NSW webpage.

Landcom (2004) 'Managing urban stormwater: soils and construction (4th Edition)', National Landcom, NSW Government.

NPWS (National Parks and Wildlife Service, NSW) (2001) 'Wollemi National Park plan of management', NPWS, Hurstville.

NPWS (2016a) *Parks facilities manual* [unpublished report], NPWS, Sydney.

NPWS (2016b) *Parks signage manual* [unpublished report], NPWS, Sydney.

OEH (2011) 'Construction assessment procedures: certification for new building and infrastructure works within lands reserved or acquired under the National Parks and Wildlife Act 1974', OEH, Sydney.

OEH (2012) 'Erosion and sediment control on unsealed roads: a field guide for erosion and sediment control maintenance practices on unsealed roads

Smith J, Deaver D and Betteridge C (2006) 'Tracks into history conservation management plan for walking tracks of state heritage significance in the Blue Mountains, part 1 [PDF 102MB], Department of Environment and Conservation, Sydney.

UNESCO (United Nations Educational, Scientific and Cultural Organization) (2000) 'Advisory Body Evaluation (IUCN).

More information

- **NPWS park policies:**
 - Landslides and rockfalls
 - Vehicle access policy
 - Walking tracks policy
- **Acts, regulations and environmental planning instruments:**
 - Biodiversity Conservation Act 2016
 - Environment and Heritage Legislation Amendment Act (No. 1) 2003 (Cth)

- Environmental Planning and Assessment Act 1979
- Environmental Planning and Assessment Regulation 2000, Schedule 3
- Environment Protection and Biodiversity Conservation Act 1999 (Cth)
- Heritage Act 1977
- National Parks and Wildlife Act 1974
- Native Title Act 1993 (Cth)
- Rural Fires Act 1997
- State Environmental Planning Policy (Planning Systems) 2021
- State Environmental Planning Policy (Resilience and Hazards) 2021
- State Environmental Planning Policy (Resources and Energy) 2021
- State Environmental Planning Policy (Transport and Infrastructure) 2021
- Greater Blue Mountains Area – UNESCO World Heritage Convention webpage
- Indigenous land use agreements – webpage