6. Environmental assessment

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

- Potential impacts on matters of national environmental significance under the EPBC Act
- The factors specified in the guidelines Is an EIS required? (DUAP 1995/1996) as required under Section 171 of the Environmental Planning and Assessment Regulation 2021 and the *Roads and Related Facilities EIS Guideline (DUAP 1996)*. The factors specified in Section 171 of the Environmental Planning and Assessment Regulation 2021 are also considered in Appendix A.

Site-specific safeguards and management measures are provided to mitigate the identified potential impacts.

6.1 Surface water and groundwater

The potential impacts on surface and groundwater during construction and operation of the proposal have been assessed as part of the *Surface Water and Groundwater Technical Assessment Working Paper* (Aurecon, 2022b), provided in Appendix D.

6.1.1 Methodology

The methodology for the surface water and groundwater assessment included:

- a review of relevant planning instruments, Blue Mountains City Council management plans/strategies, licencing, or approval requirements
- a review of potential constraints and considerations relevant to key legislation and government policy, including:
  - *Environmental Planning and Assessment Act 1979*
  - *Water Management Act 2000*
  - NSW State Groundwater Quality Protection Policy (1998)
  - NSW Groundwater Dependent Ecosystems Policy (2002)
  - *Protection of the Environment Operations Act 1997*
  - NSW Aquifer Interference Policy (2012)
- a desktop review and description of key relevant physical features and baseline environmental conditions within the study area (a one-kilometre buffer around the proposal area) (see Figure 6-1), including summary of:
  - catchment context
  - local climate and weather conditions
  - local hydrology
  - flow gauging stations and flow records
  - local surface water receiving environments
  - baseline water quality data for receiving surface waters intersected by the proposal
  - soil landscape characteristics and modelled soil properties
  - geological and hydrogeological landscape characteristics
  - boreholes, groundwater dependent ecosystems and groundwater users within the study area

- a climate change assessment comprising a high-level local climate assessment
- an assessment of potential construction and operational impacts from the proposal
- recommendation of management measures to address potential construction and operational impacts of the proposal.

6.1.2 Existing environment

Climate

Rainfall data from the closest weather observation station (Katoomba, Farnells Road) shows that there is a variable annual rainfall rate, with January, February and March identified as the wettest months on average between 1886 and 2017. The long term 50 year mean rainfall was 1140 millimetres of rain per year, with as little as 800 millimetres and as much as 2100 millimetres recorded in some years.

Temperature near the proposal area varies between mild to warm summers (average maximum temperatures between 20 and 24 degrees Celsius) and cold winter periods with average maximum temperatures below 15 degrees Celsius. In winter, minimum temperatures average around three degrees Celsius.

Topography

Topography is varied across the study area. Natural slope gradients range from around two per cent on plateau surfaces and ridgelines to around 35 per cent. Within the proposal area, steep slopes are located near the twin bridges and on the Woodlands Road ancillary facility site. Steep slopes (greater than 20 per cent) significantly increase the risk of erosion on disturbed ground.

The proposal area is within the elevated Blue Mountains, with the Great Western Highway traversing multiple undulating hills. The elevation of the Katoomba to Medlow Bath section is between 1029 metres in Australian Height Datum (mAHD) at the southern end to 1061 mAHD at the northern end of the proposal. The Medlow Bath to Blackheath section occurs along the crest of a hill, with elevation ranging from roughly 1048 mAHD at the southern end to 1071 mAHD towards the northern end of the proposal.

Surface water

Catchment and waterways

The proposal is located within the Hawkesbury-Nepean catchment, the longest coastal catchment in NSW, draining around 21,400 square kilometres. There are no water bodies within the proposal area.

No major watercourses occur within the proposal area. There are, however, several surface waterways which intersect the study area including the Megalong Creek, Back Creek, Adams Creek and Relton Creek (refer to Figure 6-1).

The creeks on the eastern side of the Great Western Highway are tributaries of the Grose River while the creeks on the western side are tributaries of Coxs River. The Grose River and Coxs River are both perennial rivers that are part of the Hawkesbury-Nepean catchment.

The creeks on the eastern side of the Katoomba to Medlow Bath and Medlow Bath to Blackheath sections flow into the Upper Cascade Creek Dam and Lake Medlow respectively. These dams are located within the Katoomba and Blackheath Special Catchment Areas respectively.

Water sharing plan and drinking water catchments

The proposal is located within the Water Sharing Plan for the Greater Metropolitan Region Unregulated River Water Sources 2011. To the west of the proposal is the Upper Nepean and Upstream Warragamba Water Source and to the east of the proposal is the Hawkesbury and Lower Nepean Rivers Water Source. The proposal also intercepts the Sydney Drinking Water Catchment as defined by State Environmental Planning Policy (Sydney Drinking Water Catchment) 2011.

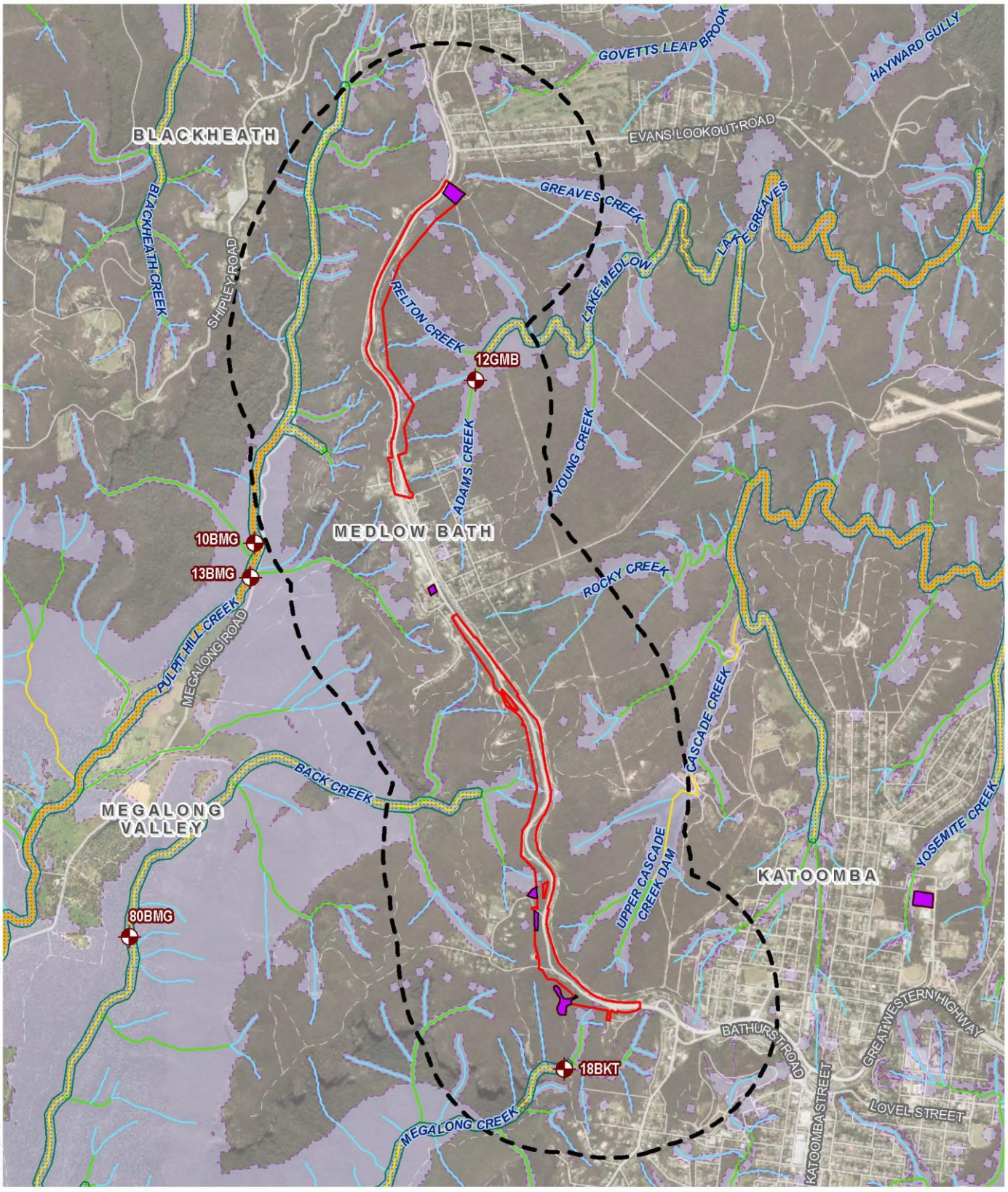
The Katoomba to Medlow Bath section passes through the Katoomba Special Catchment Area, while the Medlow Bath to Blackheath section passes through the Blackheath Special Catchment Area (refer to Section 4.2.12). Special and Controlled Areas are declared under the *Water NSW Act 2014* and WaterNSW regulates certain activities in these areas through the Water NSW Regulation 2020. The Special Catchment Areas are mostly native bushland around water storages and infrastructure. Public access and activities are restricted to protect water quality in these areas. However, it is noted that the Special Catchment Areas that intersect the proposal also cover some residential areas and road and rail infrastructure.

Sensitive receiving environments

The proposal is near the Blue Mountains National Park and much of the surface water that runs off or is discharged from the proposal area (particularly from the Medlow Bath to Blackheath section) would flow into the Blue Mountains National Park and the identified special catchment areas.

Key Fish Habitats (as defined in the *Fisheries Management Act 1991*) are present within waterways identified in the study area, including Megalong Creek, Back Creek, Pulpit Hill Creek and Adams Creek, however no Key Fish Habitats are present within the proposal area (Figure 6-1).

The biodiversity assessment carried out for the proposal identified one threatened ecological community within the proposal area. This is the Blue Mountains Swamp TEC (Plant Community Type 1078). Refer to Section 6.3 for further details.



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- Proposal area
- Study area
- Proposed ancillary facilities
- Key fish habitat
- High Ecological Value waterways and water dependent ecosystems
- Council surface water monitoring locations

Strahler Stream Order

- 1
- 2
- 3
- 4

Source: Aurecon, LPI, DPIE, BoM

1:40,000 @A4

0 500 1,000 m

Great Western Highway East **Review of Environmental Factors**

Projection: GDA2020 MGA Zone 56

FIGURE 6-1: Key surface water features

Hydrogeology

Aquifers and aquifer properties

In the study area, higher permeability areas are present in Banks Wall sandstone. In these areas, shallow aquifers form and groundwater flows are predominantly horizontal with vertical flow occurring via fissures/fractures that cross-cut bedding. These are local groundwater flow systems of typically fresh groundwater, and relatively short flow paths and residence times. Regional groundwater flow direction is expected to be consistent with the topography, flowing generally to the west and east of the Great Western Highway towards the creeks on either side of the highway.

Hydrogeological landscape

Hydrogeological Landscapes (HGL) are defined by similar areas of salt stores and pathways for salt mobilisation and are characterised by geology, soils, slope, regolith depth and climate. The proposal is located on Hawkesbury Sandstone HGL, with Megalong Valley HGL to the west of the study area. These HGLs are described in Table 6-1.

Table 6-1: Descriptions of hydrogeological landscapes within the study area

HGL	Description
Hawkesbury Sandstone	• Characterised by plateau, scarps, benches and hills on sandstone. • Moderately weathered, comprising consolidated sedimentary rocks from the Triassic period. • Contains the following key lithologies; Hawkesbury Sandstone, Narrabeen Group and Volcanic diatremes. • Groundwater flow is unconfined along structural features (bedding, joints, faults etc) in the fractured bedrock and through interbedded sandstone and sandstone fracturing. • Lateral flow occurs through unconsolidated colluvial sediments on slopes. • Hydraulic conductivity is high. • Transmissivity is moderate to high. • Depth to water table is deep (more than eight metres below ground level). • No salt observed in this landscape. • Groundwater is high quality and relatively fresh.
Megalong Valley	• Characterised by flat lying Permo-Triassic sandstone, claystone, coal, conglomerate and shale within the Hartley and Lithgow Valleys. • Moderately weathered • Layered stratigraphy of bedded and fractured siliceous sandstone, claystone and shale of the Shoalhaven, Illawarra and Narrabeen Groups. • Groundwater flow is unconfined along structural features (bedding, joints, faults etc) in the fractured bedrock and through interbedded sandstone and sandstone fracturing. • Lateral flow occurs through unconsolidated colluvial sediments on slopes. • Depth to water table is deep (more than ten metres below ground level). • No salt observed in this landscape. • Groundwater is high quality and relatively fresh.

Groundwater supply and quality

The proposal occurs across two groundwater sources, with the Sydney Basin Blue Mountains Groundwater Source to the east and the Sydney Basin Coxs River Groundwater Source to the west.

According to Realtime Water NSW, in July 2021, there were 27 registered boreholes within the surface water and groundwater study area. 25 of these boreholes are used for stock, domestic or general use water supply. The registered bores have groundwater levels between 11 and 60 metres below ground level.

One registered groundwater bore was identified within the Katoomba to Medlow Bath section on the Bureau of Meteorology Australian Groundwater Explorer register. This bore is used for stock and domestic water supply. No bores were identified within or near the Medlow Bath to Blackheath section.

No historic groundwater quality data is available for the proposal area.

Groundwater dependent ecosystems

The Groundwater Dependent Ecosystems (GDE) Atlas (Bureau of Meteorology, 2021) was reviewed on 30 July 2021 to identify GDEs within the study area. The identified GDEs included “aquatic” ecosystems that rely on the surface expression of groundwater, and “terrestrial” ecosystems that rely on the subsurface presence of groundwater.

There are numerous terrestrial and aquatic potential GDEs on both sides of the proposal, including Blue Mountains Swamp threatened ecological community (TEC) and other TECs. The swamps are identified as a TEC, the Temperate Highland Peat Swamps on Sandstone, which are listed as endangered under the *Environment Protection and Biodiversity Conservation Act 1999*.

One swamp is located in and adjacent to the proposal area under the proposed twin bridges in the Katoomba to Medlow Bath section. They occur on steep valley sides or cliffs and are mostly reliant on groundwater discharge that seeps out along bedding planes and low-permeability layers in the sandstone. Swamps occur at the interface between higher and lower permeability sandstone layers.

There were also many terrestrial GDEs identified on the western side of the study area, with GDE potential ranging from Low to High. No subterranean GDEs are present within the study area or downstream from it.

6.1.3 Potential impacts

Construction

The key potential construction impacts of the proposal on surface water and groundwater include:

- surface water quality impacts due to sediment laden runoff being released to waterways during construction activities such as vegetation removal, earthworks, stockpiling, bridge construction (Katoomba to Medlow Bath section only) and transportation of materials
- potential localised interception of groundwater and resulting groundwater quality impacts to GDEs near construction activities
- surface water and groundwater quality impacts as a result of accidental leaks and spills.

To minimise these potential impacts, a Soil and Water Management Plan (SWMP) would be prepared and implemented during construction. This plan would include the requirement for several erosion and sediment control measures to be maintained during construction.

Surface water

Table 6-2 provides further detail on the potential surface water impacts during construction of the proposal.

Table 6-2: Summary of potential surface water impacts during construction of the proposal

Construction activity	Potential impacts
Vegetation, topsoil removal and earthworks	Removal of vegetation, stripping of topsoil and earthworks, along the entire length of the proposal could potentially lead to erosion of soils and mobilisation of sediment to nearby creeks and unnamed tributaries. This may lead to increased turbidity and other water quality impacts in the following creeks: • Katoomba to Medlow Bath section – Megalong Creek and Back Creek, which are identified as key fish habitats and are located within the Sydney Drinking Water Catchment (Coxs River) and pass through Blue Mountains National Park. • Medlow Bath to Blackheath section – Adams Creek (which drains directly into Lake Medlow, the local water drinking resource), which is identified as key fish habitat downstream to the proposal and is located within the Sydney Drinking Water Catchment (Grose River) and Blue Mountains National Park. Removal of vegetation and earthworks due to the proposal, especially near these creeks, presents the greatest risk to water quality impacts. A Preliminary Erosion and Sedimentation Assessment (PESA) was carried out to assess the erosion hazard of the proposal area. The PESA found that both sections of the proposal represent a high erosion risk (Appendix D).
Construction near or across waterways	Construction activities, including the construction of drainage basins, are expected to occur near or adjacent to waterways within the proposal area and may impact these waterways. There is a risk of blockages of the waterways and drainage lines due to earthworks and other construction activities. Diversion of drainage lines may also create localised areas of flooding and scour. These impacts are expected to be temporary and minor and would be managed through the implementation of standard construction techniques and mitigation measures discussed in Section 6.1.4. The construction of new concrete twin bridges within the Katoomba to Medlow Bath section would cross a tributary to Back Creek. If not managed appropriately, overland flow could wash construction materials, fuels and chemicals into the natural drainage line from the areas of the bridge construction and adjacent road work construction. The downstream environment is within the Katoomba Special Catchment Area, which is a sensitive receiving environment and at high risk of contamination without appropriate safeguards. The removal of vegetation and earthworks at this location would also increase the erosion and sedimentation risk of this tributary causing water quality issues. Removal of vegetation and the construction work would increase the area of impervious surfaces increasing the possibility of scouring for the tributary below the bridge. These impacts and risks also apply to the tributary of Megalong Creek at the south of the Katoomba to Medlow Bath section. For the Medlow Bath to Blackheath section, overland flow could wash construction materials, fuels and chemicals into the natural drainage line from the areas of road work construction if not appropriately managed. The downstream environment is within the Blackheath Special Catchment Area, which is a sensitive receiving environment and at high risk of contamination without appropriate safeguards. Five construction basins are proposed along the length to capture runoff to manage this potential impact. Removal of vegetation and the construction work would increase the area of impervious surfaces increasing the possibility of scouring for the tributaries downstream of the section. Control measures would be installed in accordance with the Blue Book, to minimise any potential impacts.
Construction and use of ancillary facilities	The location and the topography of the Katoomba to Medlow Bath and Medlow Bath to Blackheath sections mean that runoff or leaks may end up in local waterways if not managed correctly. This would pose a risk to water quality if construction materials including fuel, chemicals and ablution from toilet facilities are mobilised by overland flows into adjacent waterways and appropriate procedures are not in place in regard to storage of materials including stockpiles. However, identified ancillary facilities are located more than 40 metres away from local waterways to avoid any potential impacts and management measures would be implemented (refer to Section 6.1.4).

Construction activity	Potential impacts
Stockpiles	If placed in an unsuitable position, stockpiles of raw materials or spoil may obstruct local flow paths and lead to the mobilisation of materials offsite. Stockpile site locations would be confirmed during detailed design and sediment management measures would be used on the stockpile sites to minimise the potential for sediment laden runoff to be discharged offsite and lead to sedimentation impacts to receiving waters.
Leaks and spills	There is the potential for harmful chemicals and substances to accidentally be released to the surface water environment during construction spills or as a result of maintenance work, refuelling and inappropriate storage or handling. Leakage from construction worker facilities or wastewater collection points may occur and produce runoff into receiving waterways. Contamination of exposed soils or mobilisation of contaminated soils and liquids into local watercourses could result in water quality impacts and impact sensitive receiving environments. Refer to Section 6.2.3 for further details. Measures to minimise the potential impacts associated with accidental leaks and spills during construction would be incorporated into a site-specific emergency spill plan.
Discharges	Discharges from the construction area have the potential to cause turbidity and other impacts in the receiving waterways which have been identified as drinking water catchments and sensitive receiving environments. To manage this issue, sediment basins form part of construction management measures to intercept stormwater flows and capture the sediments, before discharging to waterways. Further mitigation measures proposed to minimise or prevent impacts as a result of these discharges are discussed in Section 6.1.4.
Transportation of material	Spillage of waste or construction materials during transportation may lead to pollutants being conveyed in surface run-off to nearby drainage pathways and downstream waterways. Vehicle movements in the area also creates disturbances to sediment increasing the risk of sediment transport either immediately through vehicle movements or subsequently through wind and water runoff. Measures to manage materials during transport would be included within the future CEMP.
Flooding	The proposal area is not located within a floodplain. It runs along a ridgeline between two floodplains. While there would not be any impacts to flood behaviour or additional flood impacts, there is a risk of blockages of waterways and drainage lines due to erosion and sedimentation from earthworks or other activities. This may cause localised flooding and change the ultimate discharge location of overland flows into the receiving watercourses. These temporary impacts are expected to be minor and would be managed through the implementation of standard construction techniques.

Groundwater

Table 6-3 provides further detail on the potential groundwater impacts during construction of the proposal.

Table 6-3: Summary of potential groundwater impacts during construction of the proposal

Construction activity	Potential impacts
Earthworks, piling and dewatering	Groundwater is present at between 15 and 35 metres below ground level according to the search of registered bores within the study area. Earthworks associated with road construction are generally likely to be shallow and include cutting and filling of embankments, utility work and draining work so larger groundwater systems are unlikely to be intercepted during most construction activities. However, due to the potential for perched aquifers in the proposal, it is possible that groundwater could be intercepted in localised areas. Dewatering is not anticipated, however, where shallow groundwater is intercepted, the quality of the groundwater would be considered during groundwater dewatering, management, and release. Piling for bridge and retaining wall construction in the Katoomba to Medlow Bath section may be more likely to intercept groundwater resources due to the increased depth of ground penetration. Groundwater flow interruption is not anticipated due to the localised nature of the piling work during construction. If groundwater was to be intercepted during piling, construction contaminants may be introduced into the groundwater aquifers. These impacts would be short-term. Further monitoring would be carried out to evaluate the existing condition and monitor impacts of the proposal on groundwater, as discussed in Section 6.1.4.
Groundwater quality / GDE impacts	During construction, hydrocarbon spills or leaks may contaminate the perched aquifers or terrestrial GDEs downstream of the proposal. For the Katoomba to Medlow Bath section: • Aquatic GDEs and the Blue Mountains Swamp TEC within or near the proposal area have the potential to be impacted should groundwater contamination occur. However, groundwater contamination is not expected to occur with the proposed mitigation measures in place. These GDEs would also experience potential surface water impacts (including increased flow, reduction in water quality) as many of them are located within local waterways. • Potential impacts to the two aquatic GDEs located downstream of the bridge construction would be high due to potential of experiencing both surface and groundwater impacts if controls are not implemented. However, managing impacts to surface water and groundwater by implementing water quality treatment measures discussed in Section 6.1.4 would reduce the impacts to the aquatic GDEs. • Due to the hydrological soil type in the south of the section, potential for seepage is high and so there may be impacts as a result of seepage to groundwater to these aquatic GDEs. Contamination and spills would be managed within the SWMP and site-specific emergency spill plans as part of the CEMP as discussed in Section 6.1.4. For the Medlow Bath to Blackheath section: • Potential impacts due to construction work and potential leaks and spills to the identified GDE near the proposed northernmost drainage basin would be high due to potential of experiencing both surface and groundwater impacts if controls are not implemented. However, managing impacts to surface water and groundwater by implementing water quality treatment measures discussed in Section 6.1.4 would reduce the impacts to the aquatic GDEs. • Due to the hydrological soil type in this section, potential for seepage is low and so impacts on aquatic GDEs due to seepage of contaminants is low.

Operation

Surface water

The following operational activities could potentially lead to adverse impacts on groundwater and surface water:

- increased impervious surfaces as a result of the highway upgrade, including roadway and pavements, resulting in increased stormwater runoff volume, frequency and rate and associated increases in pollutant loading to receiving waterways.
- scour and erosion at new drainage outlets, downstream of new culverts and within grass drains and channel realignment work if poorly stabilised or if scour protection is poorly constructed
- accidental spills from motorists and personnel undertaking management tasks

The increase in pollutants could result in water quality impacts such as sedimentation, reduced water clarity, increased toxicant and nutrient concentrations and lower dissolved oxygen levels within the receiving waterways. Increases in frequency, rate and volume of flows due to an increase in impervious area may also impact waterway health.

To minimise these impacts, the proposal includes several Gross Pollutant Traps (GPT), water quality basins and swales to retain and treat stormwater runoff (refer to Section 3.2.3). The drainage design includes drainage pipes diverting dirty road water to six bioretention basins along the Katoomba to Medlow Bath section and five bioretention basins along the Medlow Bath to Blackheath section.

A high-level MUSIC model was developed to estimate the change in pollutant load and annual runoff volume as a result of the proposal with consideration to the proposed stormwater treatment strategy. These results are outlined for each section of the proposal in Table 6-4. The modelling found that that the proposal with no treatment would result in a major increase in TSS, total phosphorus (TP), total nitrogen (TN) and gross pollutant loads from the local drainage catchments. However, when the proposed water quality treatments were included in the modelling, the results identified a net beneficial effect on water quality, as per the neutral or beneficial effect on water quality (NorBE) assessment carried out for the proposal (refer to Appendix C).

The proposed water quality treatments would result in a major reduction in gross pollutant loads across both sections of the proposal. There would be a net reduction of 99.6 per cent of total gross pollutants for the Katoomba to Medlow Bath section and 99.2 per cent for the Medlow Bath to Blackheath section, when compared to the existing scenario. Across both sections of the proposal, this would comprise reductions of about:

- 90 per cent in TSS pollutant loads
- 70 per cent in TP pollutant loads
- 50 per cent in TN pollutant loads.

Both sections would meet and exceed Transport's Sustainable Design Guidelines targets.

Table 6-4: MUSIC modelling results

Section	Condition	Total Suspended Solids (kg/yr)	Total Phosphorous (kg/yr)	Total Nitrogen (kg/yr)	Total Gross Pollutants (kg/yr)
Katoomba to Medlow Bath section	Existing scenario	18,950	33.28	144.96	1,218.1
	With proposal (without treatment)	40,476	67.94	276.65	2,971.9
	With proposal (with treatment)	3,352	17.21	126.87	13.3
	% removal in average annual loads	91.7%	74.7%	54.1%	99.6%
Medlow Bath to Blackheath section	Existing scenario	37,820	66.20	286.20	2,404.0
	With proposal (without treatment)	53,600	93.80	398.10	4,229.0
	With proposal (with treatment)	7,051	30.37	207.40	34.4
	% removal in average annual loads	86.8%	67.6%	47.9%	99.2%

While not captured in the MUSIC modelling, the proposed water quality treatments would also reduce concentrations of heavy metals and hydrocarbons compared to existing levels.

Scour and erosion could occur within the local waterways near the proposal. If poorly stabilised or constructed, this could occur at:

- new drainage outlets
- downstream of the new culverts
- adjacent to the bridge pile caps (Katoomba to Medlow Bath section)
- within the grass drains
- near channel realignment work.

However, these features would be designed to minimise potential scour and erosion impacts.

The proposal could cause minor operational flood impacts downstream due to increases in volume, frequency and rate of stormwater runoff as a result of the increased road footprint. Downstream flooding impacts would be limited through the design of the proposal by using:

- detention basins downstream of some cross-drainage locations where the peak major flow rate arriving at the receiving watercourse would otherwise increase due to the proposal
- flow spreaders at discharge locations to limit the velocity of flows at receiving watercourses.

Accidental spills of oils or other chemicals by motorists or personnel carrying out maintenance work could lead to contaminants being released into drainage lines and the receiving waterways. Spills and water quality impacts would be contained within the drainage system and water quality treatment basins.

Groundwater

Operation of the proposal is unlikely to impact the groundwater in the study area. Minor potential operational impacts that may impact upon groundwater are related to hydrocarbon leakages from road users, which are likely to be short term and localised due to the soil type within the proposal area. Any impacts to groundwater, if not mitigated, have the potential to impacts the Blue Mountains Swamp TEC. However, these impacts are unlikely and would be limited due to the proposed water quality strategy implemented as part of the proposal, which includes hydrocarbon traps.

6.1.4 Safeguards and management measures

Safeguards and management measures for surface water and groundwater are outlined in Table 6-5.

Table 6-5: Safeguards and management measures – surface water and groundwater

Impact	Environmental safeguards	Responsibility	Timing	Reference
Soil and water	A Soil and Water Management Plan (SWMP) will be prepared and implemented as part of the CEMP. The SWMP will: • identify all reasonably foreseeable risks relating to soil erosion and water pollution, including runoff and the design and construction of waterway crossings • describe how these risks will be addressed during construction • include a construction surface water quality monitoring plan prepared in accordance with the Guideline for Construction Water Quality (Transport, n.d.) and Approved Methods for the Sampling and Analysis of Water Pollutants in NSW (NSW EPA, 2004) • include a construction groundwater monitoring plan, which will provide information on groundwater conditions for design, construction and operation of water quality basins and enable monitor pollution originating from the stormwater seeping into the groundwater The Soil and Water Management Plan (SWMP) will be reviewed by a soil conservationist on the Transport for NSW list of Registered Contractors for Erosion, Sedimentation and Soil Conservation Consultancy Services. The SWMP will then be revised to address the outcomes of the review.	Contractor	Detailed design / pre-construction	Section 2.1 of QA *G38 Soil and Water Management*
Soil and water	The preliminary Erosion and Sedimentation Management Plan (ESMR) and Erosion and Sedimentation Control Plans (ESCP) produced for the proposal (Appendix D to the REF) will be updated during the detailed design phase to confirm the erosion and sedimentation controls for both sections of the proposal, including the construction of progressive ESCPs and the continual updating of these plans.	Transport / Contractor	Detailed design / Pre-construction	Section 2.2 of QA *G38 Soil and Water Management*
Soil and water	An assessment of construction sediment basin discharges will be prepared during detailed design to assess the appropriate water quality limits for sediment basin discharges and ensure consistency with the Water Quality Objectives for this location or agreed upon guideline values in consultation with Blue Mountains City Council.	Transport	Detailed design	Additional safeguard
Soil and water	An assessment to determine appropriate water quality limits for sediment basin discharges will be undertaken as part of detailed design, with reference to the Water Discharge and Reuse Guideline (Transport, 2016b).	Transport	Detailed design	Additional safeguard
Soil and water	Periodic wet weather monitoring will be undertaken within the tributaries of Back Creek and Megalong Creek (Katoomba to Medlow Bath section) and Relton Creek and Adams Creek (Medlow Bath to Blackheath section) that intercept the proposal and the sedimentation discharge points, before and during construction.	Contractor	Pre-construction / Construction	Additional safeguard

Impact	Environmental safeguards	Responsibility	Timing	Reference
Soil and water	Where possible, permanent drainage structures will be installed as early as possible to facilitate effective separation of clean offsite and dirty onsite water.	Contractor	Construction	Additional safeguard
Soil and water	The water quality treatment system will be developed further during detailed design in consultation with Water NSW and Blue Mountains City Council. This will include: • layout and detail of the drainage system including outlet design • minimisation of discharge flows should also be minimised in the basin outflows, to limit scouring in the drainage channels • design within and around the waterways • assessment of culverts and stormwater inlets in the local waterways and recommendation for scour protection within the Medlow Bath to Blackheath section.	Transport	Detailed design	Additional safeguard

6.2 Soils and contaminated land

The potential impacts on soils and contaminated land during construction and operation of the proposal have been assessed as part of the REF.

6.2.1 Methodology

The methodology for this assessment included:

- a desktop review of the proposal area on 10 June 2021, including a review of:
  - historical aerial mapping sourced from the NSW Department of Customer Service and Aerometrex Pty Ltd
  - land-use zoning information
  - geology, soil, topography and registered groundwater bore maps
  - acid sulfate soil (ASS) and salinity risk maps
  - NSW Environment Protection Authority (EPA) databases on the contaminated land record and *Protection of the Environment Operations Act 1997* (POEO Act) licences for the site and the Blue Mountains LGA
  - NSW EPA priority per- and polyfluoroalkyl substances (PFAS) investigation risk sites within five kilometres of the proposal area
  - NSW Department of Primary Industries (DPI) former livestock dip locations and mapping
  - Department of Defence unexploded ordnance risk mapping
  - previous contamination reports, previous contamination registers and records, potential contamination issues and records of illegal dumping or earthworks for the proposal area
- a site inspection of the study area (a 200-metre buffer around the proposal area) on 14 July 2021 for visual assessment of surface filling, dumped wastes, land uses, contamination risks that could constrain the proposal
- development of a Conceptual Site Model (CSM) to evaluate the potential risks to human health and the environment during construction and operation of the proposal
- a preliminary risk assessment, which aims to identify risks to be minimised through design of the proposal and areas for further assessment prior to construction of the proposal
- recommendation of management measures to address identified risks.

6.2.2 Existing environment

The existing environment of topography, surface water and hydrogeology related to the assessment of soils and contamination is discussed in Section 6.1.2.

Study area

A summary of the features of the study area used the assessment of soils and contaminated land, including land zoning, transport corridors, structures and infrastructure and open spaces is outlined in Table 6-6. The surrounding land uses within a 200 metre radius of the proposal have been outlined in Table 6-7.

Table 6-6: Study area setting

Location	Land zone/s	Transport corridors	Buildings or structures	Open spaces
Katoomba to Medlow Bath section	C2 – Environmental Conservation C3 – Environmental Management C4 – Environmental Living SP2 – Infrastructure	Great Western Highway	Rural living properties Rail corridor	Vegetated and undeveloped lots
Medlow Bath to Blackheath section	SP2 – Infrastructure C2 – Environmental Conservation C4 – Environmental Living	Great Western Highway	Rural living properties Rail corridor	Blue Mountains National Park Vegetated and undeveloped lots

Table 6-7: Surrounding land uses

Location	Direction	Land use details	Land use zones
Katoomba to Medlow Bath section	North	Great Western Highway Rail Corridor Rural living properties	SP2 – Infrastructure C2 – Environmental Conservation C3 – Environmental Management C4 – Environmental Living
	East	Rail Corridor Blue Mountains National Park Vegetated and undeveloped lots Residential housing	SP2 – Infrastructure C1 – National Parks and Nature Reserves C2 – Environmental Conservation C4 – Environmental Living
	South	Rural living properties Vegetated lots	C2 – Environmental Conservation C4 – Environmental Living
	West	Vegetated lots Rural living properties Rail radio communication tower	SP2 – Infrastructure C2 – Environmental Conservation C3 – Environmental Management C4 – Environmental Living
Medlow Bath to Blackheath section	North	Vegetated lots Great Western Highway	C1 – National Parks and Nature Reserves C2 – Environmental Conservation
	East	Blue Mountains National Park Rural living properties Vegetated and/or undeveloped lots Trails and unpaved roads	C1 – National Parks and Nature Reserves C2 – Environmental Conservation C4 – Environmental Living
	South	Rail corridor Great Western Highway Residential housing Medlow Bath Station Synonymous Café Blue Mountains Mazda Medlow Bath Rural Fire Brigade Vegetated lots	C2 – Environmental Conservation C4 – Environmental Living SP2 – Infrastructure SP3 – Tourist
	West	Rural living properties Vegetated lots Rail corridor	C2 – Environmental Conservation C4 – Environmental Living SP2 – Infrastructure

Historical aerial imagery

Interpretation of historical aerial imagery from between 1943 and 2021 has identified changes in land use within and near the proposal area.

Within the Katoomba to Medlow Bath section, the Great Western Highway and the surrounding vegetated lots and Blue Mountains National Park have been present since 1943. A small number of buildings, potentially rural living properties, have been removed since 1943, while additional properties were established, especially near Medlow Bath. A Caltex depot was present to the north of Foy Avenue from before 1943 and had been removed by 2002. Geotechnical investigations along the Great Western Highway confirmed the presence of fill within the road shoulders, with fill visible in historical aerials. A site inspection confirmed the general presence of fill across the proposal area, existing stockpiles and dumped items.

Within the Medlow Bath to Blackheath section, the Great Western Highway, rail corridor and the surrounding vegetated lots and Blue Mountains National Park have been present since 1943. Some earthworks and fill were present at the northern end of the proposal in 1943. A small number of buildings, potentially rural living properties, have been removed over the years. Geotechnical investigations along the Great Western Highway have confirmed the presence of fill within nature strips, the road reserve and road shoulders. A site inspection confirmed the general presence of fill across the proposal area and existing stockpiles.

Regulatory database searches

As part of the desktop review outlined in Section 6.2.1, the following databases were searched, and returned no results of contamination within the specified distances of the proposal:

- NSW EPA public register (notified sites and contaminated land record) – 500 metres
- NSW Government PFAS Investigation Program – five kilometres
- Department of Defence Unexploded Ordnance – five kilometres
- NSW DPI livestock dip site locator – five kilometres.

A review of the Environmental Protection Licenses (EPL) issued by the EPA under the POEO Act within 500 metres of the proposal identified the EPLs outlined in Table 6-8. The Katoomba Waste Management Facility was issued a clean-up notice in 2017 and has received a number of non-compliance notices.

Table 6-8: EPLs within 500 metres of the proposal

Licence Number	Licensee	Premises	Status	Scheduled activities	Location to proposal areas
211228	CPB Contractors Pty Limited	Blue Mountains Route Clearance, referring to “all railway stations between Falconbridge and Newnes Junction except Mt Victoria”	Surrendered	• Railway system activities	Medlow Bath Station, located about 80 m south of the Medlow Bath to Blackheath section
1436	Metromix Pty Limited	19 Twynham Street, Katoomba, NSW 2780	No longer in force	• Concrete work	250 m south of the Woodlands Road, Katoomba ancillary facility
5481	Ventia Utility Services Pty Limited	Katoomba Waste Management Facility 49-89 Woodlands	Surrendered	• Waste disposal by application to land	60 m north-east of the Woodlands Road, Katoomba ancillary facility

Licence Number	Licensee	Premises	Status	Scheduled activities	Location to proposal areas
		Road, Katoomba, NSW 2789			
10034	Blue Mountains City Council	Katoomba Waste Management Facility 49-89 and 70-78 Woodlands Road, Katoomba, NSW 2789	Issued	• Waste storage - other types of waste Waste disposal by application to land	60 m north-east of the Woodlands Road, Katoomba ancillary facility
13089	Blue Mountains City Council	Katoomba Waste Management Facility 49-89 and 70-78 Woodlands Road, Katoomba, NSW 2789	Issued	• Waste storage - waste tyres • Waste Storage, Transfer, Separating or Processing • Waste storage - other types of waste • Non-thermal treatment of general waste • Composting	60 m north-east of the Woodlands Road, Katoomba ancillary facility

Site inspection

A preliminary Conceptual Site Model (CSM) was prepared to identify areas of potential environmental concern (APECs) within the proposal area. A summary of the findings of the CSM are outlined in Table 6-9.

Table 6-9: Areas of potential environmental concern within the proposal area

Location	APEC
Katoomba to Medlow Bath section	• Roads and associated emissions from vehicle exhausts and runoff sediments from the Great Western Highway and adjoining rail corridor • Filling and incidental renovations within rural living properties and road reserves • Historical and existing stockpiles, including those adjacent to the rail corridor • Historical Caltex fuel depot located to the north of Foy Avenue which was established prior to 1943 and removed by 2002, with fill and stockpiles present on site. • Illegal dumping, which has been identified throughout the proposal area including on private property and adjacent to the rail corridor.
Medlow Bath to Blackheath section	• Roads and associated emissions from vehicle exhausts and runoff sediments from the Great Western Highway and adjoining rail corridor • Filling and incidental renovations within rural living properties, road reserves and nature strips • Four known stockpiles present adjacent to 12 Coachhouse Lane, Medlow Bath
Woodlands Road, Katoomba ancillary facility	• Roads and associated emissions from vehicle exhausts and runoff sediments from Woodlands Road • Historical development of the site • Proximity of three EPLs and one clean-up noticed issued to the Katoomba Waste Management Facility, 127 metres to the north. One EPL issued to Metromix Concrete, 245 metres to the south.
Great Western Highway, Medlow Bath ancillary facility	• Roads and associated emissions from vehicle exhausts and runoff sediments from the Great Western Highway and adjoining rail corridor • The United Petroleum Medlow Bath service station at 90-92 Great Western Highway, Medlow Bath, located directly north of the site • Historical and existing filling and stockpiles on the site

6.2.3 Potential impacts

Construction

The preliminary risk assessment conducted for the proposal is outlined in Table 6-10. This assessment considered the potential risk factors, pathways and receptors for contaminants near the proposal and the potential exposure to contaminants of potential concern (CoPCs) during construction. The risk ratings applied in the assessment are defined as:

- **Negligible** – the presence of the identified source does not give rise to the potential to cause significant harm.
- **Low** – it is possible that harm could arise to a designated receptor from an identified source though this is likely to be mild.
- **Moderate** – it is possible that harm could arise to a specific receptor, but it is unlikely that such harm would be significant.
- **High** – a designated receptor is likely to experience significant harm from an identified source without remedial action.
- **Very high** – there is a high probability that severe harm could arise to a designated receptor from an identified source without appropriate remedial action.

The assessment found that there may be CoPCs present within fill and stockpiles across the proposal area. Potential risks to the local environment would be managed through implementation of a Construction and Environmental Management Plan (CEMP) during construction as well as other safeguards and management measures outlined in Section 6.2.4.

The surface and groundwater quality impacts related to soils and contamination are discussed in Section 6.1.3.

Table 6-10: Preliminary risk assessment

Location	Potential sources	Potential receptors	Assessment of potential impact	Risk rating
Katoomba to Medlow Bath section	• Roads and associated emissions from vehicle exhausts and runoff sediments • Filling and incidental renovations within rural living properties and road reserves • Historical and existing stockpiles • Historical fuel depot • Illegal dumping	**Human** • Future construction workers • Residents during construction • Workers and visitors to the nearby businesses **Environmental** • Surface water • Groundwater	There may be CoPCs present within fill, stockpiles and dumped present across the section. There may be impacts to the soil and groundwater from the historical Caltex depot, located near Foy Avenue. Given the age of the depot and that it has been removed, it is unlikely that there are elevated CoPC concentrations in the study area near the former depot location. CoPCs may be encountered in soil and groundwater during construction phase As intrusive investigations have not been undertaken along the section, it is possible that CoPCs at concentrations above the applicable Tier I screening guidelines and/or waste classification criteria are present in the study area. Areas of cut and / or any spoil produced should be assessed to inform necessary waste management practices.	Low – Moderate (due to known fill and historical fuel depot)
Medlow Bath to Blackheath section	• Roads and associated emissions from vehicle exhausts and runoff sediments • Filling and incidental renovations within rural living properties, road reserves and nature strips. • Stockpiles	**Human** • Future construction workers • Residents during construction • Workers and visitors to the nearby businesses **Environmental** • Surface water • Groundwater	There may be CoPCs present within fill and stockpiles present across the proposal which may be encountered during excavations and construction. As contamination investigations have not been undertaken along the proposal, it is possible that CoPCs at concentrations above the Tier I screening guidelines and/or waste classification criteria are present in the study area. Areas of cut and / or any spoil produced should be assessed to inform necessary waste management practices.	Low – Moderate (due to known fill)
Woodlands Road, Katoomba ancillary facility	• Roads and associated emissions from vehicle exhausts and runoff sediments • Historical development of the site • EPL facilities	**Human** • Future construction workers • Residents during construction	There may be CoPCs present within fill and stockpiles present across the ancillary facility which may be encountered during excavations and construction. However, previous studies of this ancillary facility have not investigated the full extent of the site. As such, further investigations are required to identify any unknown CoPCs and the potential risks to the local environment should be carried out if the compound site is to be used. There is also a risk that potential impacts from the EPL licenced Katoomba Resource Recovery and Waste Management Facility have mobilised into soils,	Risk rating subject to further investigation

Location	Potential sources	Potential receptors	Assessment of potential impact	Risk rating
		• Workers and visitors to the nearby businesses **Environmental** • Surface water • Groundwater	surface water and groundwater. However, given the distance and local topography, there is a low risk that the ancillary facility would be impacted by the facility.	
Great Western Highway, Medlow Bath ancillary facility	• Roads and associated emissions from vehicle exhausts and runoff sediments • Service stations • Historical and existing filling and stockpiles	**Human** • Future construction workers • Residents during construction • Workers and visitors to the nearby businesses **Environmental** • Surface water • Groundwater	There may be CoPCs present within fill and stockpiles present across the ancillary facility which may be encountered during excavations and construction. There may be impacts to the soil and groundwater from the United petrol station located adjacent to the ancillary facility from historical surficial leaks and spills. There is also a risk of underground storage tanks, which store petrol and other fuels, to have potentially leaked and impacted the surrounding soils and groundwater. These could pose a risk to construction workers and the environment should any spills or leaks be encountered during construction work. As contamination investigations have not been undertaken at the ancillary facility, it is possible that CoPCs at concentrations above the Tier I screening guidelines and/or waste classification criteria are present in the study area. Areas of cut and / or any spoil produced should be assessed to inform necessary waste management practices.	Low – Moderate (due to known fill on site and the nearby service station)

Operation

During operation of the proposal, contamination would be expected to mainly occur due to exhaust particles and discharges from vehicle engines, litter and vehicle waste or accidental spills. These potential contamination sources are already present in the area due to the existing highway. The proposal would not result in a change to the existing situation.

6.2.4 Safeguards and management measures

Safeguards and management measures for soils and contamination are outlined in Table 6-11. Other safeguards and management measures that would address soils and contamination impacts are identified in Section 6.1.4.

Table 6-11: Safeguards and management measures – soils and contamination

Impact	Environmental safeguards	Responsibility	Timing	Reference
Contaminated land	A Contaminated Land Management Plan will be prepared in accordance with the *Guideline for the Management of Contamination* (Transport, 2013a) and implemented as part of the CEMP. The plan will include, but not be limited to: • capture and management of any surface runoff contaminated by exposure to the contaminated land • further investigations required to determine the extent, concentration and type of contamination • management of the remediation and subsequent validation of the contaminated land, including any certification required • an unexpected finds protocol for incidental potential contamination finds during earthworks (such as illegally dumped wastes and stockpiles) • the work methodology to identify, manage, handle and dispose of any contaminated materials or wastes as part of the work • measures to ensure the safety of site personnel and local communities during construction.	Contractor	Detailed design / Pre-construction / Construction	Section 4.2 of QA *G36 Environment Protection*
Accidental spill	A site-specific emergency spill plan will be developed and include spill management measures in accordance with the Transport for NSW *Code of Practice for Water Management* (Roads and Traffic Authority, 1999) and relevant EPA guidelines. The plan will address measures to be implemented in the event of a spill, including initial response and containment, notification of emergency services and relevant authorities (including Transport for NSW and EPA officers).	Contractor	Detailed design / Pre-construction	Section 4.3 of QA *G36 Environment Protection*
Contaminated land	Ancillary facility sites that have been historically developed should be subject to intrusive investigations to identify any contaminants of potential concern on the site to assess the suitability of the site and whether activities that would be undertaken on the site will warrant additional controls.	Contractor	Pre-construction / Construction	Additional safeguard
Contaminated land	Areas of cut material in the proposal area will be assessed through an intrusive investigation to inform a likely waste classification of materials to be excavated (if required), suitability for reuse and/or if offsite disposal is required.	Contractor	Pre-construction / Construction	Additional safeguard
Waste management	Any spoil produced during the construction phase will be assessed in accordance with the NSW EPA (2014) *Waste Classification Guidelines* and *Resource Recovery Order / Exemption under the Protection of Environment (Waste) Operations Act 2000* to determine necessary waste management practices.	Contractor	Pre-construction / Construction	Additional safeguard

Impact	Environmental safeguards	Responsibility	Timing	Reference
	The CEMP will include the following hierarchy for reuse, recycling or disposal of spoil produced during construction: • If spoil produced during construction will remain within the Lot and DP from which it was produced, it can be reused if CoPC concentrations are below the applicable NEPM 2013 Tier I screening values for evaluation of potential risk to human health and the environment. • Spoil produced during construction can be reused within the Lot and DP boundaries from which it was produced or on another Transport or third party site if it meets the definition of virgin excavated natural material / excavated natural material in accordance with the applicable *Resource Recovery Order / Exemption under the Protection of Environment (Waste) Operations Act 2000*. • Spoil that does not meet either of the above definitions should be transported to an appropriately licenced facility for recycling if all CoPC concentrations are below the NSW EPA (2014) Waste Classification Guidelines contaminant threshold 1 (CT1) values for General Solid Waste. The soil can be recycled at an appropriately licenced facility in accordance with any current Transport contractual arrangements. • If CoPC concentrations are above the CT1 values, the soil waste should be classified per the Waste Classification Guidelines and disposed at an appropriately licenced facility			
Contaminated land	The risk of potentially impacted soil migrating from the future upgrade work including dust generation and runoff will be minimised utilising standard practices such as dust suppression, and erosion and sedimentation control. These measures along with other measures will be included in the CEMP. Other controls will include proper use of work health and safety equipment and monitoring of work where asbestos or other contamination is identified.	Contractor	Pre-construction / Construction	Additional safeguard

6.3 Biodiversity

The potential impacts on biodiversity during construction and operation of the proposal have been assessed as part of the *Great Western Highway Upgrade East Biodiversity Assessment Report* (BAR) (Transport, 2022), provided in Appendix E.

6.3.1 Methodology

The methodology for the BAR included:

- identification of the biodiversity study area as the area that would be subject to direct impacts (proposal area) and some areas of potential habitat beyond that boundary (refer to Figure 6-2)
- a review of relevant literature, databases and existing vegetation mapping to identify vegetation, threatened flora and fauna and Threatened Ecological Communities (TECs) that are listed under both NSW and Commonwealth legislation, with potential to occur within a 10 kilometre radius of the study area, including:
  - Department of Planning and Environment (DPE) BioNet, Atlas of NSW Wildlife
  - Department of Agriculture, Water and Environment (DAWE) *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) Protected Matters Search Tool
  - Threatened Biodiversity Data Collection
  - Directory of Important Wetlands of Australia published by Environment Australia
  - Bureau of Meteorology Atlas of Groundwater Dependent Ecosystems (GDE)
  - Species Profile and Threats database for EPBC listed threatened species and communities
  - Biodiversity Assessment Method Calculator (BAM-C) for prescribed and candidate threatened biodiversity
- field surveys of the study area to identify and assess biodiversity values in accordance with the Biodiversity Assessment Methodology (BAM) and relevant threatened biodiversity survey guidelines
- an assessment of 'likelihood of occurrence' following the collation of database records and species and community profiles
- assessing the potential impacts to flora, fauna and migratory species within the proposal area including assessments of significance where required
- identification of construction and operational management measures as well as the need for biodiversity offsets.

Biodiversity field surveys for the proposal were carried out for the following seasons:

- Spring/Summer 2020 (14 October – 17 December 2020)
- Winter 2021 (15 – 20 June 2021)
- Spring 2021 (13 – 18 September 2021)
- Summer 2021 (6 December 2021 – 11 January 2022)
- Autumn 2022 (11 March 2022).

These surveys were carried out in accordance with the BAM and included:

- floristic and BAM plots to determine Plant Community Type (PCT) and condition
- habitat mapping (hollow-bearing tree survey, watercourses, rocky outcrops, fallen woody debris and ground refugia, feed trees, nests)
- spotlighting for nocturnal mammals and birds (Winter 2021 and Spring 2021 survey)
- stagwatching (hollow watching) for nesting Glossy Black-Cockatoos (Spring 2021 survey)
- stagwatching (hollow watching) for nesting Gang-gang Cockatoos (Summer 2021 survey)
- terrestrial and arboreal baited camera trapping (Spring 2020 and Summer 2021 survey)

- anabat deployment and analysis (Spring 2020 and Summer 2021 survey)
- opportunistic fauna observations
- targeted threatened flora surveys
- dry pitfall trapping for Blue Mountains Water Skink (*Eulamprus leuraensis*) in Blue Mountains Swamp habitat (Summer 2021 survey)
- targeted survey for Giant Dragonfly (*Petalura gigantea*) in Blue Mountains Swamp habitat (Summer 2021 survey).

The field survey methodology for the proposal is explained further in Section 2 of the BAR, attached to the REF as Appendix E.

6.3.2 Existing environment

The proposal is located in the Wollemi subregion of the Sydney Basin bioregion. The existing environment of topography, geology and soils, surface water and hydrogeology related to the assessment of biodiversity is discussed in Section 6.1.2.

The study area is surrounded by native vegetation to the north, north-east, west and south-west and is moderately to well-connected to the adjoining Blue Mountains National Park. However, parts of the study area have been previously impacted by historical land clearing, residential and commercial development and existing infrastructure. This has slightly reduced the vegetation connectivity in parts of the study area.

Native vegetation

There is 68.80 hectares of native vegetation and 15.11 hectares of non-native vegetation within the study area. Three PCTs were recorded within the study area:

- PCT 1248 – *Sydney Peppermint – Silvertop Ash heathy open forest on sandstone ridges of the upper Blue Mountains, Sydney Basin Bioregion*
- PCT 967 – *Narrow-leaved Peppermint – Silvertop Ash – Mountain Grey Gum shrubby open forest of the upper Blue Mountains, Sydney Basin Bioregion*
- PCT 1078 – *Prickly Tea-tree – sedge wet heath on sandstone plateaux, central and southern Sydney Basin Bioregion.*

Different vegetation condition classes were identified where obvious differences in structure and quality occurred, resulting in three PCTs and six vegetation conditions. A summary of PCTs and associated vegetation conditions is presented in Table 6-12.

PCT 1078 was recorded in one location on intermittently waterlogged soils in a moderate condition with a variety of common wet ferns, sedges and shrubs. This PCT was the only PCT recorded which corresponded to a TEC listed under the *Biodiversity Conservation Act 2016* (BC Act) (Blue Mountains Swamps in the Sydney Basin Bioregion vulnerable ecological community) and EPBC Act (Temperate Highland Peat Swamps on Sandstone endangered ecological community), referred to collectively as Blue Mountains Swamp TEC.

Areas of PCT 967 were mostly aligned with creeks or depressions and had a greater diversity and abundance of more mesic understorey species compared to surrounding vegetation communities. PCT 1248 is widely distributed and variable across much of the study area. Areas highly disturbed by development, powerlines and maintenance access were of lower condition and had less canopy cover, lower species diversity and typically higher abundance of exotic species.

All six vegetation zones reflected the edge effects from the existing road, including weed occurrence, sedimentation, erosion and some debris. Historical and current clearing is evident across the site.

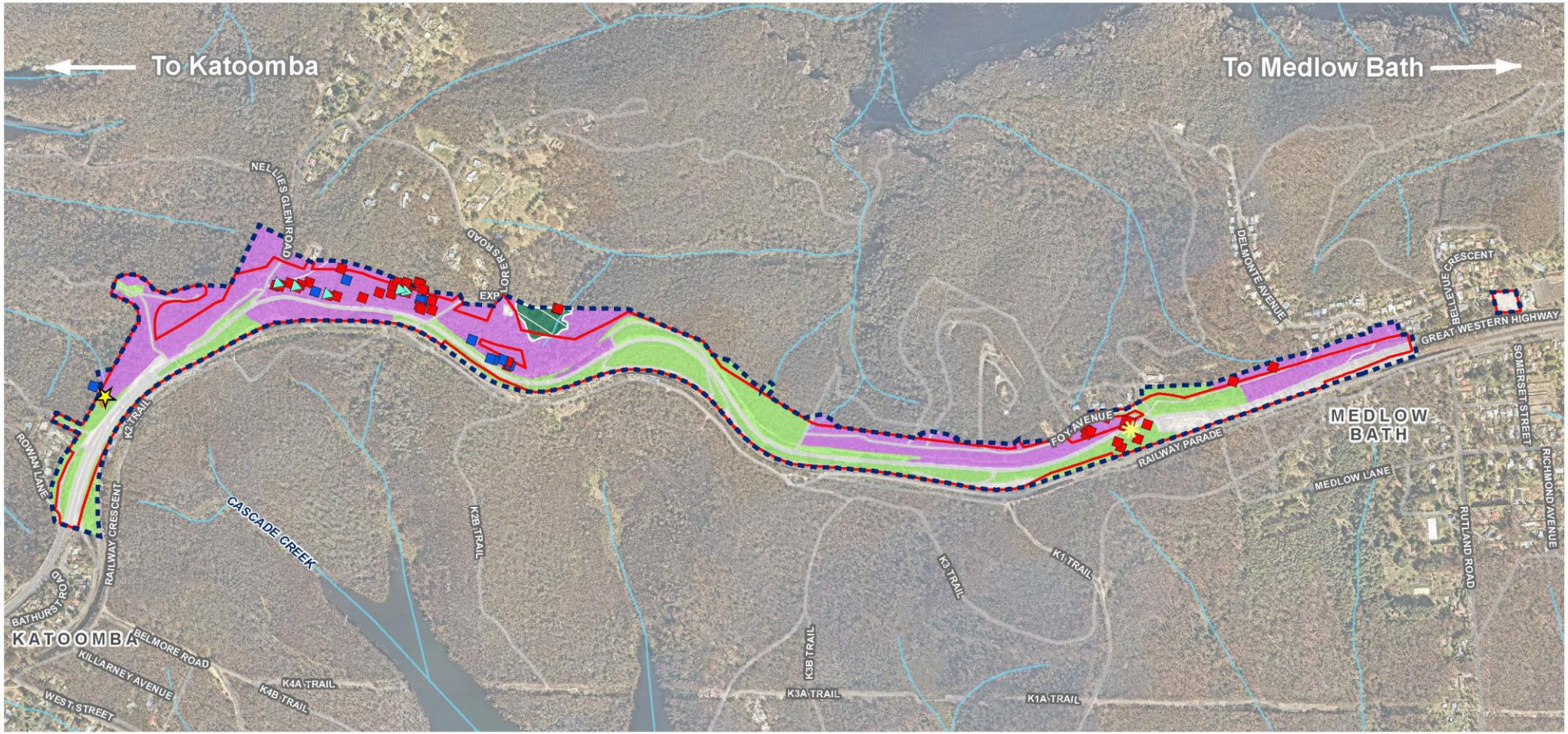
No potential GDEs were identified within the study area that are listed in the Bureau of Meteorology Atlas of GDEs. However, it is known that PCT 1078 is reliant on a combination of surface and groundwater flows. PCT 1078 are formed via groundwater that seeps through permeable sandstone layer and are reliant on groundwater discharge.

The extent of vegetation within the study area is shown in Figure 6-2.

Table 6-12: Plant community types

Vegetation Zone	Vegetation Condition (BAM-C)	Threatened Ecological Community	PCT Cleared Extent	Area within the study area (ha)
PCT 1248	Moderate	Does not align to any TEC	20	43.33
PCT 1248	Low			23.50
PCT 1248	Degraded			0.30
PCT 967	Moderate	Does not align to any TEC	5	0.90
PCT 967	Low			0.06
PCT 1078	Moderate	• Blue Mountains Swamps in the Sydney Basin Bioregion listed as Vulnerable under the BC Act. • Forms part of the TEC Temperate Highland Peat Swamps on Sandstone listed as Endangered under the EPBC Act.	-	0.71
Total native vegetation				68.80
Total non-native vegetation / cleared areas*				15.11
Total area				83.91

* Non-native vegetation / cleared areas comprise areas of planted vegetation or cleared areas including: the existing Great Western Highway, services, footpaths.



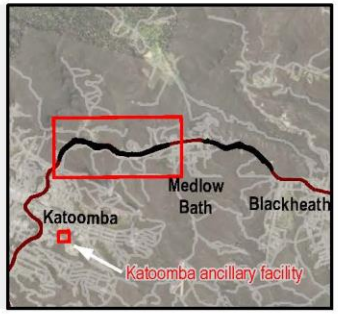
Proposal area
Study area
Culvert
Hollow-bearing stag
Hollow-bearing tree
Fallen timber
Potential cockatoo nest trees (as defined by the BAM)

TEC

1078, Moderate

Validated vegetation and condition (PCT)

0, Non-native / cleared areas
967, Low
1078, Moderate
1248, Moderate
1248, Low



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Source: Aurecon, Mott MacDonald, LPI, Nearmap, Niche

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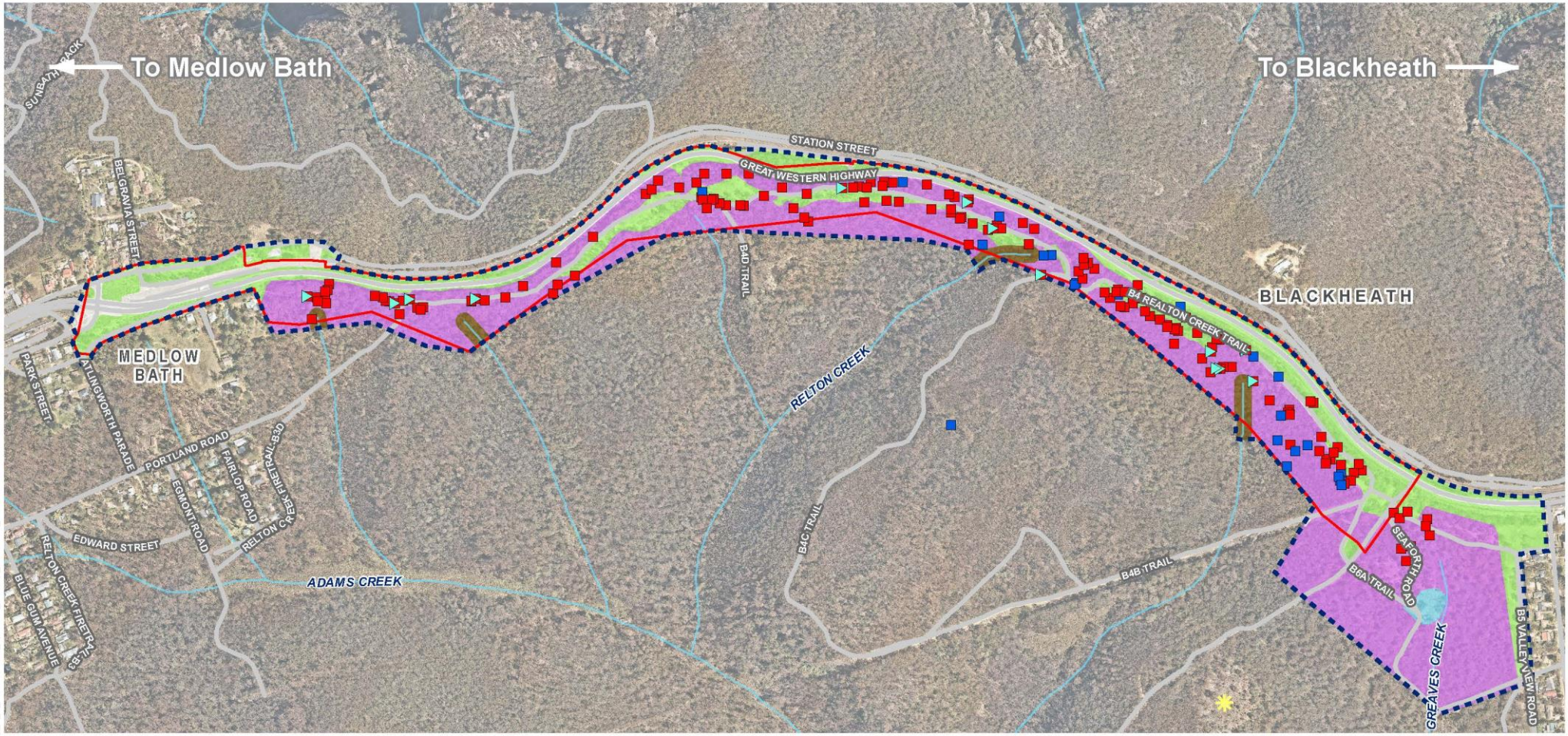
Projection: GDA2020 MGA Zone 56

Great Western Highway East **Review of Environmental Factors**

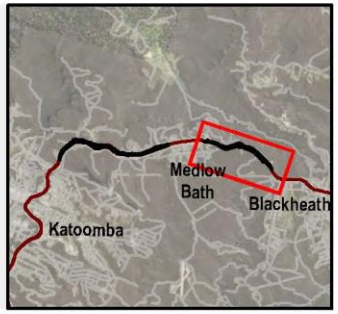
FIGURE 6-2a: Threatened species survey locations



Proposal area
Study area
Culvert
Hollow-bearing stag
Hollow-bearing tree
Fallen timber
Potential cockatoo nest trees (as defined by the BAM)

Validated vegetation and condition (PCT)

0, Non-native / cleared areas
967, Moderate
1248, Moderate
1248, Low
1248, Degraded



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Source: Aurecon, Mott MacDonald, LPI, Nearmap, Niche

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0 100 200m

Projection: GDA2020 MGA Zone 56

Great Western Highway East **Review of Environmental Factors**

FIGURE 6-2b: Threatened species survey locations

Threatened fauna species and habitat

The desktop searches carried out for the proposal identified 67 threatened fauna species as occurring or having potential habitat within the study area or generated by the BAM-C. Forty four threatened fauna species were considered in the biodiversity assessment due to there being a moderate to high likelihood of occurrence of the species within the study area or the species being identified by the BAM-C. This includes:

- 31 species listed under the BC Act only
- one species listed under the EPBC Act only
- 12 species listed under both the BC Act and EPBC Act.

A total of 66 fauna species were recorded during field surveys, comprising three reptiles, 29 birds, 33 mammals and one frog. Eight threatened fauna species were recorded during the field surveys including:

- Eastern Pygmy-possum (*Cercartetus nanus*)
- Large Bentwing-bat (*Miniopterus orianae oceanensis*)
- Little Bentwing-bat (*Miniopterus australis*)
- Gang-gang Cockatoo (*Callocephalon fimbriatum*)
- Greater Broad-nosed Bat (*Scoteanax rueppellii*)
- Eastern Freetail Bat (*Micronomous norfolkensis*)
- Yellow-bellied Sheathtail Bat (*Saccolaimus flaviventris*)
- Brown Treecreeper (eastern subspecies) (*Climacteris picumnus victoriae*).

The locations where the threated species were recorded during the field surveys are shown in Figure 6-3.

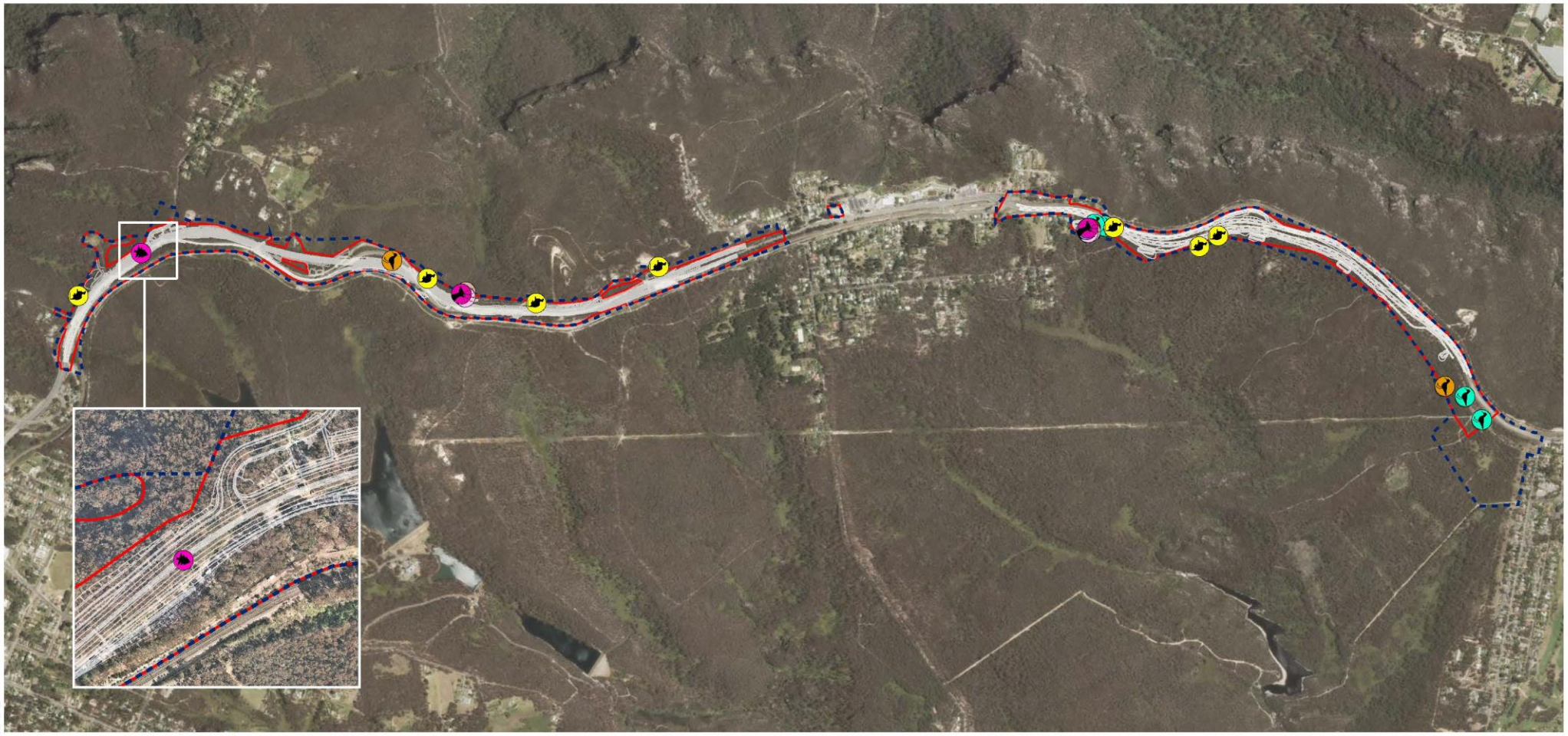
The habitats that occur within the study area consist of moderately to highly connected woody/forest habitat types comprising the PCTs discussed in the previous section. These occupy about 90 per cent of the study area. Some of these areas are mildly disturbed by edge-effects and fragmentation from existing and previous urban encroachment. However, forest habitats within the study area have moderate to high connectivity with large patches of native vegetation especially within the Blue Mountains National Park in the Medlow Bath to Blackheath section. They are considered likely to support a high diversity of both sedentary and transient native fauna species, including birds, reptiles, mammals and frogs.

The fauna habitats that occur within the study area consist of woodland habitat types comprising of the PCTs discussed in the previous section. Mid-storey vegetation across native vegetation ranged from moderately dense to patchy and consisted primarily of native species. The study area generally supports a good amount of ground cover for small mammals and reptiles, fallen woody debris, thick to patchy leaf litter cover and an abundance of feed trees. The habitats facilitate fauna movement throughout the region. The study area is included within a recognised ‘fauna corridor’ under the *Blue Mountains Local Environment Plan 2015*. However, the existing Great Western Highway road corridor is likely to prevent most terrestrial and arboreal species reaching connected habitat in surrounding areas.

There were also 231 hollow-bearing trees identified within the study area. The diameter at breast height (DBH) of hollow-bearing trees was observed to be between 15 and 250 centimetres. The hollow-bearing trees were predominantly *Eucalyptus sieberi* and *Eucalyptus oreades*, with the size of the hollows ranging from less than 5 to 30 centimetres. The only fauna species observed leaving any hollows during the survey were Rainbow Lorikeets (*Trichoglossus haematodus*) and Sulphur-crested Cockatoo (*Cacatua galerita*). There are 18 hollow-bearing trees that have potential to be Gang-gang Cockatoo nest trees.

One culvert (500-millimetre pipe) that could provide fauna habitat was identified in the Katoomba to Medlow Bath section and was considered to provide marginal habitat for roosting bats.

Threatened species habitats are shown on Figure 6-2. Areas of habitat close to the road edges, are likely to be subject to a high level of noise and light pollution. These factors likely limit these areas to only being suitable for highly urban tolerant species.



Design
Proposal area
Study area

Threatened species recorded

Brown Treecreeper (eastern subspecies)
Eastern Freetail Bat
Eastern Pygmy-possum
Gang-gang Cockatoo (foraging only)
Greater Broad-nosed Bat
Large Bentwing-bat
Little Bentwing-bat
Yellow-bellied Sheathtail Bat
Persoonia acerosa

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Source: Aurecon, Mott MacDonald, LPI, Nearmap, Niche

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0 300 600m

Projection: GDA2020 MGA Zone 56

FIGURE 6-3: Threatened species recorded

Threatened flora species

The desktop searches carried out for the proposal identified that 37 threatened flora species have the potential to occur or have habitat within the locality. This includes:

- 14 species listed under the BC Act only
- 23 species listed under both the BC Act and EPBC Act.

Of the 37 subject species, one threatened flora species was recorded within the proposal area. Needle Geebung (*Persoonia acerosa*) was recorded within the proposal area during pre-clearing surveys for geotechnical investigations as part of the proposal. Needle Geebung is listed as Vulnerable under the BC Act and EPBC Act.

The remaining species were either surveyed (and not detected) or have been excluded due to lack of suitable habitat within the proposal area.

Weeds

Weeds that were recorded throughout the field investigations collected that are regarded as 'High Threat Weeds', include the following: *Ligustrum sinense* (Small-leaved privet), *Rubus fruticosus* sp. *agg.* (Blackberry), *Bidens pilosa* (Cobblers pegs), and *Juncus acutus*.

6.3.3 Potential impacts

Construction

Impacts to vegetation

The proposal would result in direct impacts on biodiversity from the removal of up to 47.56 hectares of native vegetation (refer to Table 6-13). The largest area of impact would be PCT 1248, with up to 46.8 hectares of this PCT subject to direct impacts due to the proposal. A small area of PCT 967 near waterways on the eastern side of the Medlow Bath to Blackheath section (up to 0.76 hectares) would also be directly impacted by the proposal. While the proposal design has avoided direct impact to the Blue Mountains Swamp TEC (PCT 1078) near the twin bridges in the Katoomba to Medlow Bath section, there may be indirect impacts to 0.12 hectares of the swamp located within the proposal area.

Up to 207 hollow-bearing trees have the potential to be directly impacted. These values are upper limits and would be reduced wherever possible and practical during detailed design.

The proposal would result in indirect impacts to parts of the Blue Mountains National Park and Water NSW Blackheath Special Catchment Area to the east of the Medlow Bath to Blackheath section. Indirect impacts may include:

- increased noise, dust and light from the construction and operational activities
- loss of connectivity and fragmentation of habitats at a regional scale through clearing of native vegetation within the proposal area
- erosion or sedimentation in areas adjoining construction and operational activities
- increased spreading of weed propagules
- increased edge-effects for surrounding vegetated areas.

While there would be no direct impacts to the Blue Mountains Swamp TEC, there may be indirect impacts to the swamp from the construction of the twin bridges. This may include indirect impacts to 0.12 hectares of the swamp within the proposal area due to its proximity to the area required for construction of the

proposed twin bridges. These impacts would be managed through the implementation of targeted mitigation measures. A buffer area of at least five metres between the proposal area and boundary of the Blue Mountains Swamp TEC would be established and lined with sediment fencing to minimise indirect impacts to the swamp near the twin bridges. Other construction erosion and sedimentation controls have been designed to minimise the potential for impacts to the swamp (refer to Section 6.1.4). As such, it is unlikely that run-off from the detention basin would negatively impact the swamp habitat. During construction, dirty water from the bridge deck would also be drained away from the swamp to avoid water flowing into the swamp.

Indirect impacts from construction would generally have a short to medium timeframe and would be minimised through implementation of safeguards and management measures in accordance with the CEMP (refer to Section 7.2).

Table 6-13: Summary of potential impacts to native vegetation during construction of the proposal

Vegetation Zone	Vegetation Condition (BAM-C)	Status (BC Act)	Area within proposal area (ha)	Area subject to direct impacts (ha)	Number of hollow bearing trees directly impacted
PCT 1248	Moderate	Not listed	27.74	27.74	165
PCT 1248	Low	Not listed	19.06	19.06	41
PCT 967	Moderate	Not listed	0.70	0.70	1
PCT 967	Low	Not listed	0.06	0.06	0
PCT 1078	Moderate	• Blue Mountains Swamps in the Sydney Basin Bioregion listed as Vulnerable under the BC Act. • Forms part of the TEC Temperate Highland Peat Swamps on Sandstone listed as Endangered under the EPBC Act.	0.12	0	0
Total			**47.68**	**47.56**	**207**

Impacts to threatened species

The removal of native vegetation would result in impacts to threatened species, including a loss of fauna habitat (refer to Table 6-14). This would impact one threatened flora species and 25 threatened species of fauna.

Table 6-14: Potential impacts to threatened species

Threatened species	Status (BC Act)	Status (EPBC Act)	Habitat or individuals to be impacted
Flora			
Needle Geebung (*Persoonia acerosa*)	Vulnerable	Vulnerable	1 individual identified within the proposal area, which would be impacted by loss of habitat through vegetation clearing, weed incursion, and indirect habitat disturbance
Fauna			
Large-eared Pied Bat (*Chalinolobus dwyeri*)	Vulnerable	Vulnerable	Up to 47.56 ha potential foraging habitat
Koala (*Phascolarctos cinereus*)	Vulnerable	Endangered	Up to 47.56 ha potential foraging habitat

Threatened species	Status (BC Act)	Status (EPBC Act)	Habitat or individuals to be impacted
Grey-headed Flying fox (*Pteropus poliocephalus*)	Vulnerable	Vulnerable	Up to 47.56 ha potential foraging habitat
Gang-gang Cockatoo (*Callocephalon fimbriatum*)	Vulnerable	Endangered	Up to 47.56 ha confirmed foraging habitat
Spotted-tailed Quoll (*Dasyurus maculatus*)	Vulnerable	Endangered	Up to 47.56 ha potential foraging habitat and impacts to connectivity across the widened road corridor
Rosenberg's Goanna (*Varanus rosenbergi*)	Vulnerable	-	Up to 47.56 ha potential habitat (foraging, sheltering, breeding)
Eastern Pygmy Possum (*Cercartetus nanus*)	Vulnerable	-	Up to 47.56 ha confirmed foraging habitat and up to 207 hollow-bearing trees (which provide potential nesting/breeding resources)
Greater Glider (*Petauroides volans*)	-	Vulnerable	Up to 47.56 ha of potential foraging habitat, and up to 207 hollow-bearing trees (which may provide potential nesting/breeding resources)
Squirrel Glider (*Petaurus norfolcensis*)	Vulnerable	-	Up to 47.56 ha of potential foraging habitat, and up to 207 hollow-bearing trees (which may provide potential nesting/breeding resources)
Threatened hollow-dependant bats • **Eastern Coastal Free-tailed Bat (*Micronomous norfolkensis*)** • **Greater Broad-nosed Bat (*Scoteanax rueppellii*)** • **Yellow-bellied Sheath-tailed Bat (*Saccolaimus flaviventris*)** • **Eastern False Pipistrelle (*Falsistrellus tasmaniensis*)**	Vulnerable	-	Up to 47.56 ha confirmed foraging habitat and 63 hollow-bearing trees that are considered suitable as potential roosting habitat for these species.
Threatened cave-dependant bats • **Little Bent-winged Bat (*Miniopterus australis*)** • **Large Bent-winged Bat (*Miniopterus orianae oceanensis*)** • **Eastern Cave Bat (*Vespadelus troughtoni*)**	Vulnerable	-	Up to 47.56 ha of confirmed foraging habitat
Threatened woodland birds • **Brown Treecreeper (eastern subspecies) (*Climacteris picumnus*)** • **Varied Sittella (*Daphoenositta chrysoptera*)** • **Diamond Firetail (*Stagonopleura guttata*)** • **Gilbert's Whistler (*Pachycephala inornate*)**	Vulnerable	-	Up to 47.56 ha of confirmed foraging habitat and removal of potential nesting habitat (including up to 207 hollow-bearing trees to be removed and cup nests)

Threatened species	Status (BC Act)	Status (EPBC Act)	Habitat or individuals to be impacted
• **Black-chinned Honeyeater (*Melithreptus glumaris gularis*)** • **Little Lorikeet (*Glossopsitta pusilla*)**			
Threatened woodland robins • **Flame Robin (Petroica phoenicea)** • **Scarlet Robin (Petroica boodang)** • **Hooded Robin (Melanodryas cucullate)**	Vulnerable	-	Up to 47.56 ha of potential foraging habitat and indirect removal of potential nesting habitat (e.g., cup-nests, sheltered sites and shallow tree cavities)

Operation

Direct impacts

Operation of the proposal has the potential to result in fauna injury and death. Threatened fauna most at risk include terrestrial species such as the Koala, Eastern Pygmy-possum, Spotted-tailed Quoll and the Greater Glider. Spotted-tailed Quolls and Eastern Pygmy-possums have been identified close to the road corridor. One recent Koala record (from 2020) has also been identified as road kill near the existing highway about nine kilometres west of the study area.

While fauna are currently at risk of vehicle strikes along the existing highway, the proposal would result in an increased road crossing distance (from about 30 metres to about 100 metres in some locations) and increased volume of traffic. Despite existing obstruction to fauna movement, the ability for gliding and terrestrial fauna to safely cross the Great Western Highway may become constrained due to this increased separation of habitats.

These changes would increase the risk of injury and mortality to local fauna. Fauna mitigation measures to provide safe passage across the road, such as glider poles for the Greater Glider, would be investigated and included as part of a Fauna Connectivity Strategy during detailed design of the proposal. This would also consider the use of fauna fencing to deter fauna from accessing the road corridor and reduce the potential for injury or mortality. Monitoring of road kill during construction and operation of the proposal would also allow any indirect impacts to threatened species to be identified and mitigated where required.

Indirect impacts

Edge effects (such as erosion, dust, intensive light spill and sedimentation) and weed incursion would be likely to occur during operation of the proposal. This impact area would include parts of the Blue Mountains National Park and the Water NSW Blackheath Special Catchment Area to the east of the Medlow Bath to Blackheath section. This area is not currently adjacent to a road corridor and so would experience edge effects for the first time. Parts of the Blue Mountains National Park have tested positive to *Phytophthora cinnamomi* (Phytophthora), which may also spread due to the proposal. Measures to minimise the likelihood of indirect impacts to sensitive receiving environments as a result of the proposal are outlined in Section 6.3.4. Streetlighting would only be installed at the three intersections within the Katoomba to Medlow Bath section and would include ecologically sensitive lighting design. This would minimise indirect impact to surrounding sensitive receiving environments.

Shading from the bridge may result in indirect impacts to the Blue Mountains Swamp TEC due to floristic responses to changes in light and temperature. The greatest shading impact is likely to occur on the

eastern side of the swamp during the morning. However, any shading impacts would be temporal in nature as the area in shadow would shift with the sun during the day as it moves from east to west. There would not be any section of the swamp permanently in shadow and most of the swamp would remain unaffected by shadow.

Altered hydrology may affect sensitive receiving environments near the proposal. This may lead to extended periods of drying or waterlogging, weed incursion or increase in weed abundance and changes in floristics and habitat suitability for dependant flora and fauna at the Blue Mountains Swamp TEC. The proposed water quality and drainage network would result in a beneficial impact on water quality due to the proposal (refer to Section 3.2.3 and Section 6.1.3). This would minimise hydrologic impacts to surrounding sensitive environments, including the Blue Mountains Swamp TEC habitat.

Significance of impacts

Assessments of significance have been carried out for threatened species which were identified with potential to occur within the proposal area. These assessments found that the proposal would not have a significant impact on threatened biota. Significant impacts would be avoided through the implementation of mitigation measures, including the implementation of a Flora and Fauna Management Plan.

As such, the proposal is not likely to significantly impact threatened species or ecological communities or their habitats:

- within the meaning of the *Biodiversity Conservation Act 2016* or *Fisheries Management Act 1994* and therefore a Species Impact Statement or Biodiversity Development Assessment Report is not required.
- within the meaning of the *Environment Protection and Biodiversity Conservation Act 1999*.

The proposal's response to Transport's checklist for significance of impacts is outlined in Table 6-15.

Table 6-15: Significance of impacts assessment checklist

Item	Proposal response
Is there a real chance that the activity threatens the long-term survival of nationally listed biodiversity matters?	No
Has the consistency of the activity with relevant recovery plans, threat abatement plans, conservation advices and guidelines provided by the Australian Government been considered?	Yes
Can suitable offsets be secured?	Yes

Eastern Pygmy-possums have been identified at seven camera trap locations within the study area during targeted surveys in 2021. While no survey data exists to demonstrate the extent of the local population, a local population is likely to be widespread due to the extent of high-quality habitat around the proposal (K Madden DPE 2021, personal communication). On this assumption, the proposal is not considered likely to significantly impact a local population of the Eastern Pygmy-possum. To support this conclusion, further surveys for the Eastern Pygmy-possum are proposed to better understand the size and extent of the population within the surrounding area. Following the completion of the monitoring program, a final assessment of significance for the Eastern Pygmy-possum would be generated and mitigation measures further refined.

6.3.4 Safeguards and management measures

Safeguards and management measures for biodiversity are outlined in Table 6-16.

Table 6-16: Safeguards and management measures – biodiversity

Impact	Environmental safeguards	Responsibility	Timing	Reference
Biodiversity	A Flora and Fauna Management Plan will be prepared in accordance with Transport's *Biodiversity Guidelines: Protecting and Managing Biodiversity on Projects* (Roads and Traffic Authority, 2011a) and implemented as part of the CEMP. It will include, but not be limited to: • plans showing areas to be cleared and areas to be protected, including exclusion zones around the proposal (including a five-metre exclusion zone around the Blue Mountains Swamp TEC), protected habitat features and revegetation areas • requirements set out in the *Landscape Guideline* (Roads and Maritime, 2008) • pre-clearing survey requirements, vegetation removal and habitat removal in line with Transport's vegetation clearance protocol • directions for survey, monitoring and management of key threatened species known or considered to be potentially impacted by the proposal • development of a habitat replacement or nest box strategy • procedures for re-establishment of native vegetation • procedures for unexpected threatened species finds and fauna handling • procedures addressing relevant matters specified in the *Policy and guidelines for fish habitat conservation and management* (DPI Fisheries, 2013) • commitments relating to threatened species management, pest and weed management, and site hygiene practices.	Transport / Contractor	Detailed design / pre-construction / construction	Section 4.8 of QA *G36 Environment Protection*
Biodiversity	Measures to further avoid and minimise the construction footprint and native vegetation or habitat removal will be investigated during detailed design and implemented where practicable and feasible.	Transport / Contractor	Detailed design / pre-construction	Additional safeguard
Biodiversity	Fencing and/or the use of highly visible rope or tape boundaries will be used to delineate the boundary of vegetation clearing at the edge of the proposed construction boundary. A buffer area of at least five metres will be established between the proposal area and boundary of the swamp.	Contractor	Construction	Additional safeguard

Impact	Environmental safeguards	Responsibility	Timing	Reference
	Signposting will be used to inform project personnel and site visitors of areas of conservation value to restrict entry or inform behaviour that will reduce incidental interactions with fauna.			
Biodiversity	The Needle Geebung (*Persoonia acerosa*) individual identified during field surveys will be translocated prior to construction.	Contractor	Pre-construction	Additional safeguard
Biodiversity	For flora species such as Needle Geebung (*Persoonia acerosa*), seed collection will be carried out in an effort to minimise impacts to the species and aid in re-establishment of individuals within protected areas in the vicinity of the study area. This would form part of the seed collection planned by Transport to occur across the Great Western Highway Upgrade Program.	Contractor	Construction / pre-construction	Additional safeguard
Vehicle strike	Transport will monitor road kills along Great Western Highway before, during and after commencement of the proposal.	Transport / Contractor	Pre-construction / construction / operation	Additional safeguard
Indirect impacts on native vegetation and habitat	Measures to further avoid and minimise the area of direct impact on all native vegetation will be investigated during detailed design and implemented where practicable and feasible, especially in sensitive environments and near the Blue Mountains National Park.	Transport	Detailed design	Additional safeguard
Indirect impacts on native vegetation and habitat	Installation of stormwater/sediment and erosion control mechanisms to prevent sediment or dirty water discharging into the Blue Mountain Swamp TEC.	Contractor	Construction	Additional safeguard
Wildlife connectivity, habitat fragmentation and fauna injury and mortality	A Fauna Connectivity Strategy will be developed for the proposal during detailed design to minimise the impacts of the proposal on connectivity. This will include consideration of: • fauna mitigation measures to provide safe passage across the road • fauna fencing.	Transport	Detailed design	Additional safeguard
Changes to hydrology	Changes to existing surface water flows will be minimised during detailed design and mitigated via preparation and implementation of the following: • preparation of progressive Erosion and Sediment Control Plans (ESCPs) and their continual revision and update • preparation of a Storm Water Management Plan and other aspects of the Construction Environment Management Plan to manage water quality impacts during construction of the proposal • preparation of Water Quality Management Plan (surface and groundwater) to describe water quality monitoring before and during construction • design of scour protection at new stormwater outlets and culverts and drainage basins	Transport	Detailed design	Additional safeguard

Impact	Environmental safeguards	Responsibility	Timing	Reference
	• stormwater drainage design which incorporated a treatment trains and drainage basing to achieve a neutral or beneficial effect on the surrounding waterways.			
Fragmentation of identified habitat corridors	Connectivity measures will be implemented in accordance with the *Wildlife Connectivity Guidelines for Road Projects* (Roads and Traffic Authority, 2011c). Any connectivity measures implemented will be installed under the supervision of an experienced ecologist.	Transport / Contractor	Detailed design / pre-construction / construction	Additional safeguard
Invasion and spread of pathogens and disease	• Any excavated earth will be either disposed or reused appropriately with care taken to avoid spreading propagules of weeds or infested soil or plant material. • Correct plant hygiene will be minimised to minimise spread of weeds, Phytophthora and other contaminants, including wash down when moving between weedy and non-weedy parts of the proposal. • All weed material removed during the construction works will be disposed of in a suitable waste facility and not mulched onsite to avoid the reintroduction and further spread of weeds and pathogens in the area.	Contractor	Construction	Additional safeguard
Noise, light and vibration	Shading and artificial light impacts on sensitive areas or areas adjacent to the Blue Mountains National Park will be minimised during detailed design.	Transport	Detailed design	Additional safeguard
Threatened ecological community (TEC)	• During construction, dirty water from the bridge deck would be drained away from the Blue Mountains Swamp TEC and not flow over into the swamp. • pH levels of water in the nearby water quality basins will be monitored near the Blue Mountains Swamp TEC during construction.	Contractor	Construction	Additional safeguard
Groundwater dependent ecosystems	Interruptions to water flows associated with groundwater dependent ecosystems (e.g. Upland Swamp) will be minimised through detailed design.	Transport	Detailed design	Additional safeguard
Biodiversity offsets	Where required, Transport would offset vegetation removal in accordance with the Transport 'Guideline for Biodiversity Offsets' (Roads and Maritime, 2016b). Offsets would be sought for both this proposal and any other projects within the Great Western Highway Upgrade Program for which biodiversity impacts have not separately been offset.	Transport	Detailed design	Additional safeguard

Other safeguards and management measures that would address biodiversity impacts are identified in Section 6.1.4.

6.3.5 Biodiversity offsets

Although efforts have been made to avoid, minimise and mitigate potential ecological impacts associated with the proposal, some residual impacts would occur. Transport would provide biodiversity offsets or, where offsets are not reasonable or feasible, supplementary measures for impacts that exceed the thresholds listed under Transport's *Guideline for Biodiversity Offsets* (Transport, 2016b).

The *Guideline for Biodiversity Offsets* refers to BioBanking and the Framework for Biodiversity Assessment. These have been replaced by the Biodiversity Offset Scheme and use of the Biodiversity Assessment Method (BAM) Calculator (BAM-C) to determine offset requirements for unavoidable impacts to biodiversity under the BC Act. As such, the BAM-C has been used to determine the offset requirement for this proposal.

Biodiversity offset thresholds relevant to the proposal and the resulting credit requirements are summarised in Table 6-17. Based on impact to 47.56 hectares of native vegetation, as per the BAM-C, the proposal requires:

- 924 ecosystem credits for impact to known habitat of seven NSW listed threatened ecosystem credit species (Gang-gang Cockatoo, Brown Treecreeper, Large Bentwing-bat, Little Bentwing-bat, Greater Broad-nosed Bat, Eastern Coastal Free-tailed Bat, Yellow-bellied Sheathtail-bat).
- 1233 species credits for impacts to known habitat for the Eastern Pygmy-possum (species credit species under the BAM).

Table 6-17: Transport offset thresholds

Description of activity or impact	Consider offsets or supplementary measures	Relevant to the proposal?	Offsets required
Activities in accordance with Roads and Maritime Services Environmental assessment procedure: Routine and Minor Works (Roads and Traffic Authority, 2011b)	No	No	Not applicable
Works on cleared land, plantations, exotic vegetation where there are no threatened species or habitat present	No	No	Not applicable
Works involving clearing of vegetation planted as part of a road corridor landscaping program (this includes where threatened species or species comprising listed ecological communities have been used for landscaping purposes)	No	No	Not applicable
Works involving clearing of national or NSW listed critically endangered ecological communities (CEEC)	Where there is any clearing of an CEEC in moderate to good condition	No	Not applicable
Works involving clearing of nationally listed threatened ecological community (TEC) or nationally listed threatened species habitat	Where clearing >1 ha of a TEC or habitat in moderate to good condition	Yes. Clearing of 1 individual of *Persoonia acerosa.*	Area of occupation less than 1 ha. No offsets required.

Description of activity or impact	Consider offsets or supplementary measures	Relevant to the proposal?	Offsets required
Works involving clearing of NSW endangered or vulnerable ecological community	Where clearing > 5 ha or where the ecological community is subject to an SIS	No	Not applicable
Works involving clearing of NSW listed threatened species habitat where the species is a species credit species as defined in the OEH Threatened Species Profile Database	Where clearing > 1ha or where the species is the subject of an SIS	Yes. Clearing of 47.56 ha of known habitat for the Eastern Pygmy-possum.	1233 Eastern Pygmy-possum species credits
Works involving clearing of NSW listed threatened species habitat and the species is an ecosystem credit species as defined in OEH's Threatened Species Profile Database	Where clearing > 5ha or where the species is the subject of an SIS	Yes. Clearing of 47.56 ha of known habitat for 7 NSW listed threatened ecosystem credit species: • Gang-gang Cockatoo • Brown Treecreeper • Large Bentwing-bat • Little Bentwing-bat • Greater Broad-nosed Bat • Eastern Coastal Free-tailed Bat • Yellow-bellied Sheathtail-bat.	924 ecosystem credits
Type 1 or Type 2 key fish habitats (as defined by NSW Fisheries)	Where there is any net loss of habitat	Not applicable	Not applicable

A Biodiversity Offset Strategy (BOS) would be developed by Transport and identify how the offset obligations would be met. The BOS would be updated, and the offset calculations finalised, once detailed design is complete. This would include consideration of offset requirements for both this proposal and any other projects within the Great Western Highway Upgrade Program for which biodiversity impacts have not separately been offset.

6.4 Non-Aboriginal heritage

The potential impacts on non-Aboriginal heritage during construction and operation of the proposal have been assessed as part of the *Statement of Heritage Impact – Great Western Highway East* (Niche Environment and Heritage, 2022), provided in Appendix F.

6.4.1 Methodology

The methodology for the Statement of Heritage Impact (SOHI) included:

- a review of literature and databases, including:
  - Heritage NSW Inventory (World Heritage Register List, State Heritage Register, State Heritage Inventory (SHI), Transport – Roads S170 Register)
  - City of Blue Mountains Heritage Review 2016
  - City of Blue Mountains Local Environmental Plan 2015
  - City of Blue Mountains Development Control Plan 2015
  - Commonwealth heritage registers (Australian Heritage Database, Commonwealth Heritage List, and former Register of the National Estate)
  - previous historical heritage studies and reports within or near the proposal area
- a site inspection in June 2021, which:
  - confirmed places already identified from previous studies or re-evaluated those lists
  - identified physical evidence that could indicate archaeological evidence, structures or other work that may not have been identified in other sources within or near the proposal area
- assessment of the potential non-Aboriginal heritage impacts during construction and operation of the proposal
- the provision of mitigation measures to manage the potential impacts on non-Aboriginal heritage identified.

The SOHI adopted the approach and terminology outlined in the Charter for Places of Cultural Significance (Australia ICOMOS, 2013) (*the Burra Charter*). In addition, this report has been prepared in accordance with the following heritage guidelines and policy documents:

- Cultural Heritage Guidelines (Transport, 2015a)
- Statements of Heritage Impact (Heritage Council of NSW, 2002)
- NSW Heritage Manual (NSW Heritage Office and Department of Urban Affairs and Planning, 1996)
- Assessing Heritage Significance (Heritage Office, 2001)
- Assessing Significance for Historical Archaeological Sites and 'Relics' (Heritage Council of NSW, 2009).

6.4.2 Existing environment

Historical context

The regional historical context of the Blue Mountains has been shaped by both the Gundungurra and Dharug Aboriginal people and European exploration west of the Great Dividing Range. Non-Aboriginal heritage across the Blue Mountains has been predominantly about crossing the mountains. Progressively developed transport connections across the Blue Mountains enabled the growth of key settlements in the region.

The local historical themes of *Early Exploration*, *The Western Road*, *The Railway*, *Recreation, Health and Tourism* and *Industry* have influenced the local historical context of the proposal area. This historical context is summarised in Table 6-18.

Table 6-18: Historic context of the proposal

Year	Event
1813	Gregory Blaxland, William Charles Wentworth and William Lawson, assisted by an Aboriginal guide and three convicts were the first Europeans to successfully cross the Blue Mountains. It is believed that Explorers Tree was engraved on this expedition. Explorers Tree was located within the Katoomba to Medlow Bath section and the stump remained in place until February 2021, when it was removed due to safety concerns.
1814 – 1815	Cox's Road (the foundation for what eventually became the Great Western Highway) was constructed over a period of about six months by convict labour. Pulpit Hill, within the Katoomba to Medlow Bath section, was identified as a key point on Cox's Road. Later, Pulpit Hill was also identified as a rest area for drovers, stock and travellers following the construction of the road west, making it another tourist drawcard from the late 19th century until the 21st century.
1831	The area of Blackheath was initially referred to a 41 Mile Tree. The first building in the area was 'The Scotch Thistle Inn', built in 1831 by Andrew Gardener.
1832 – 1835	In 1832, Andrew Murray applied for the purchase of land near Pulpit Hill to construct an inn. The inn was licensed in 1833 as the 'Poor Man's Inn', with licensee Michael Leeson. From 1835 it was licenced as the 'Shepherd and His Flock Inn' by Andrew Murray.
1844	A large convict stockade was built in Blackheath to house convicts engaged in road construction.
1862	On the orders of the Colonial Architect, a lock-up was built near Pulpit Hill in 1862 to hold chained gangs on the march between Bathurst and Sydney (SHI #1170813).
1867	The Gatekeeper's Cottage in Medlow Bath was built by Larkin and Wakeford (SHI # 1170283) and was known as Cottage No. 11.
1868	The Main Western Railway was completed to Mount Victoria, providing a railway connection between Sydney and the proposal area. Following the opening of the railway, townships began to develop around the constructed rail stations, which were located near the early inns, country estates and available water supply. Halt stops were established at Blackheath and Medlow Bath in 1868. The Blackheath halt stop was upgraded to a platform in 1869.
1860s and 1870s	The area of Katoomba was originally known as the 'Crushers', named after a train stop near ballast stone associated with a quarry operation that operated from the 1860s. Katoomba remained a primarily industrial area into the late 1870s, when the Katoomba Coal Mine and coal and shale mining in the nearby Megalong Valley was established.
1880s	The township of Medlow Bath remained small and focused around the sawmill industry until 1902, when Mark Foy took over the Belgravia Hotel and later opened the Hydro Majestic Hotel on the site.
1885	While the first building was built in 1831, the township of Blackheath was declared in 1885.
1888	The lot on which The Pines is located was granted to D. Miller in 1888. Miller, worked at a local sawmill and built himself a house on the lot (SHI # 1170289), making The Pines one of the few 19th century houses in Medlow Bath.
1890s	By the 1890s, Katoomba had seen a shift from a mining town, into a popular tourist centre. This led to subdivision of land and sale into residential lots, with cottages built on much of the land by the turn of the 20th century.
1891	Bonnie Doon Reserve was opened in 1891 and formed the second largest privately constructed track network in the Upper Blue Mountains, after Medlow Bath.
1902	Following duplication in 1898, the railway was extended to Katoomba in 1902.
1900s onwards	In the early 20th century, Blackheath became one of the principal tourist destinations in the mountains. In the interwar period, Blackheath saw a commercial boom with many of the main commercial buildings constructed during this time.
1918	Industrial development within the greater Blue Mountains was limited and largely associated with mining. A quarry was opened by the then Blue Mountains Shire Council at Medlow Bath with the purpose of sourcing sandstone and conglomerate gravel. This later became the Mountain Gravel Co.

Year	Event
	Quarry in 1920. The quarry was closed in 1969 and resumed as part of the Water NSW Special Catchment Area in 1992.
1940s onwards	The popularity of the mountains as a tourist retreat waned in the years after World War II and many of the guesthouses fell into significant disrepair and neglect. In the later decades of the 20th century, the region once again gained popularity and has since maintained a tourist focus.
1951	The rail network was electrified through the proposal area.
1980s	Many of the Bonnie Doon tracks fell into disrepair through most of the 20th century and remained largely neglected for the latter half of the 20th century, with the lookouts restored in the late 1980s.

Heritage items

Heritage items within and adjacent to the proposal are identified in Table 6-19. State and local heritage items within Medlow Bath have not been assessed in this REF as they are not located in direct proximity to the proposal area and have been assessed in the SOHI prepared for the Medlow Bath Upgrade (RPS, 2021). Section 6.11.4 assesses cumulative impacts of the proposal and includes further assessment of the cumulative impacts of the proposal and the Medlow Bath Upgrade.

The potential heritage items within and near the proposal area identified in the historical assessment, previous assessments and the site inspection are listed in Table 6-20. These are not listed heritage items but could have heritage significance.

These items are mapped in Figure 6-4a-h.

Table 6-19: Heritage listings within and near the proposal area

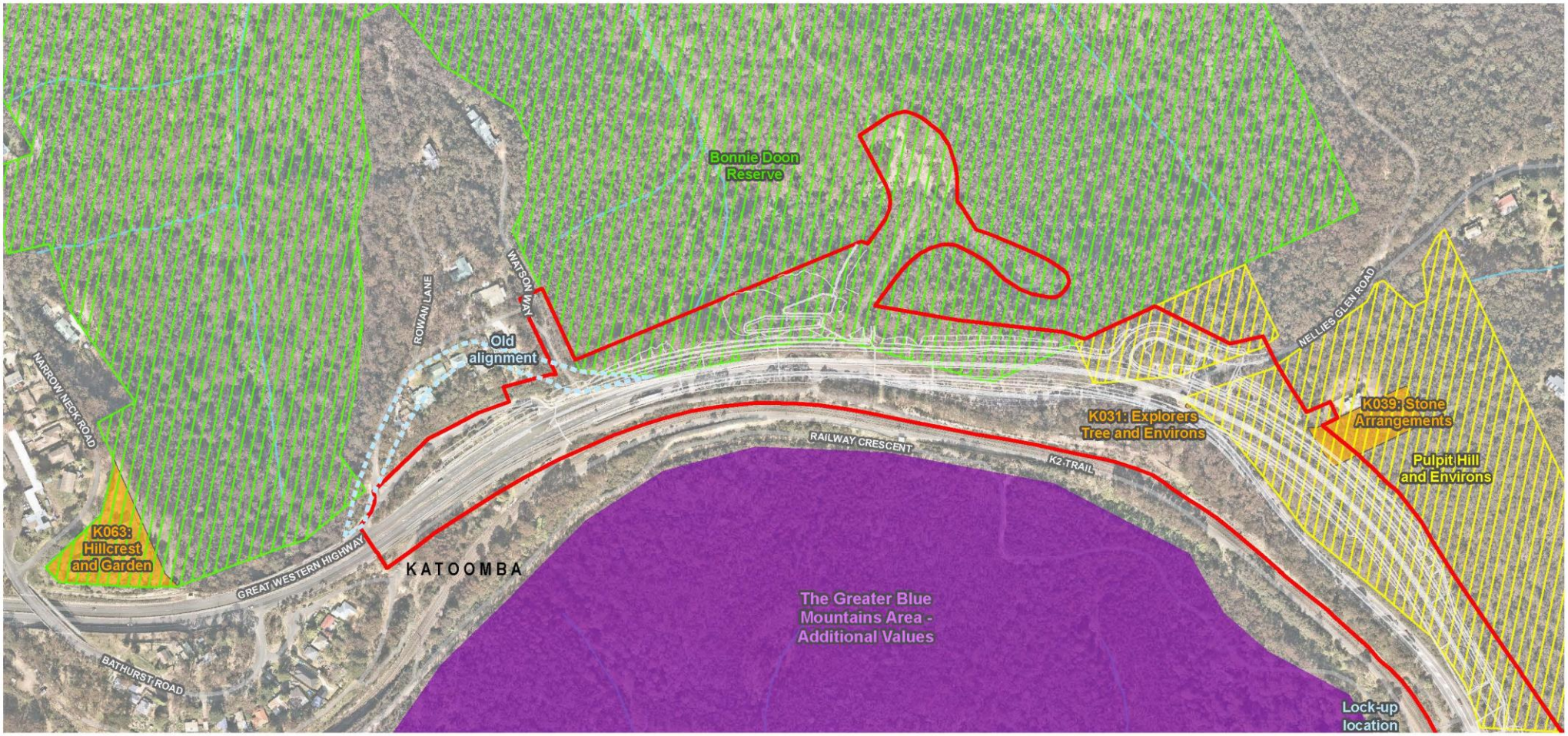
Item	Listing Number	Level of Significance	Description	Location
Greater Blue Mountains Area – Additional Values (Nominated)	105696	National – Nominated	The Greater Blue Mountains Area is a sandstone tableland that encompasses 1.03 million hectares of eucalypt-dominated landscape inland from Sydney. It is one of the largest and most intact tracts of protected bushland in Australia. Its exceptional biodiversity values are complemented by numerous others, including indigenous and post-European-settlement cultural values, geodiversity, water production, wilderness, recreation and natural beauty. The item Greater Blue Mountains Heritage Area – Additional Values is a nominated heritage item only, and not officially listed on the National Heritage List, however, it has been assessed for impacts due to the proposal to follow best practice.	Adjacent to Katoomba to Medlow Bath section Within Medlow Bath to Blackheath section
Bonnie Doon Reserve	K079	Local	Bonnie Doon Reserve has high aesthetic quality as a spectacular scenic backdrop for walkers on the Six Foot Track and Grand Cliff Top Walk, with much of its early track work intact. It was a major private effort to develop and maintain walking tracks for community appreciation of the natural landscape. The area has direct association with John Britty North, considered a founding father of Katoomba and the creator of the Bonnie Doon Reserve.	Within and adjacent to Katoomba to Medlow Bath section
Pulpit Hill and Environs including: **Lock-up** **Stockyard** **Elements of Cox's Road**	K166	Local (Recommended for State listing)	Pulpit Hill is a predominately natural bushland setting, comprising locally important areas of *Eucalyptus Oreades* open forest, an important ecological community. In the early 19th century, Pulpit Hill was an important rest area and a key part of the history and evolution of transport routes across the Blue Mountains The Pulpit Hill environs include sites of heritage significance, including potential historical archaeology associated with the early Cox's Road and early convict graves which have high social value. It is a place where the local community feels a tangible attachment to the early history of the Blue Mountains.	Within Katoomba to Medlow Bath section
Stone Arrangements (within Pulpit Hill curtilage)	K039	Local (Recommended for State listing)	The Stone Arrangements item falls within the larger Pulpit Hill curtilage and contains 22 possible stone arrangements. The possible graves/stone arrangements are located in a small clearing north of the former location of the Explorers Tree and Nellies Glen Road.	Within Katoomba to Medlow Bath section
Shepherd and His Flock Inn site	K082	Local	The Shepherd and Flock Inn served travellers along the Great Western Road in the 1830s. Inns are a significant class of item with historic and social significance as they were a characteristic feature of the Colonial period which exemplify the pattern of land settlement, transport and travel.	Adjacent to Katoomba to Medlow Bath section
Explorer's Tree and Environs	K031	Local	The Explorer's Tree was reputed to have been marked by the explorers Blaxland, Lawson and Wentworth during the First Crossing of the Blue Mountains in 1813. Although the historical authenticity of the tree is uncertain, since at least the 1870s the tree has been	Within Katoomba to Medlow Bath section

Item	Listing Number	Level of Significance	Description	Location
			viewed by visitors to the mountains since as a surviving relic from the 1813 expedition and as a memorial to the early explorers. While the Explorer's Tree was removed in February 2021 due to safety concerns, the environs retain heritage significance through the symbolic representation of the place and as part of the larger Blue Mountains cultural landscape.	
The Pines	MB016	Local	The Pines, 16 Great Western Highway, Medlow Bath is one of the earliest houses in Medlow Bath. It is a good intact example of a verandaed Victorian carpenter vernacular cottage typical of the early houses in the Blue Mountains.	Adjacent to Medlow Bath to Blackheath section
Gatekeeper's Cottage	MB006	Local	The Medlow Bath Gatekeeper's Cottage is one of only five level crossing keepers' cottages which are still habitable on their original site and one of only two which have preserved the original stone privy in the garden. The cottages were important in the interchange of rail and road between 1867 and 1902.	Adjacent to Medlow Bath to Blackheath section

Table 6-20: Non-listed heritage items within and near the proposal area

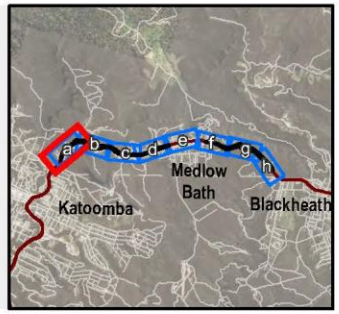
Item	Level of Significance	Description	Location
Great Western Highway	N/A	The Great Western Highway is the primary historical route west from Sydney, following the earliest European lines of exploration and migration over the Blue Mountains. The associated elements such as culverts, retaining, road cuttings and kerbing contribute to the significance of the road.	Within Katoomba to Medlow Bath and Medlow Bath to Blackheath sections
Alignment change	N/A	The alignment change of the Great Western Highway is about 350 metres north of Pulpit Hill and is currently in use as part of the Great Blue Mountains Trail. The trail is largely gravel and rock, with a grassed verge.	Within and adjacent to Katoomba to Medlow Bath section
Old alignment	N/A	The section of old alignment of the Great Western Highway is situated west of Katoomba, along the current Bathurst Road alignment and verge. The location consists of landscaped grass within the verge and several obtrusive service lines, with overgrown vegetation and grass in the area between the highway and Bathurst Road.	Within and adjacent to Katoomba to Medlow Bath section
Culvert XA6	Local (recommended)	Culvert XA6 is a sandstone culvert located on the eastern side of the highway between the road and the railway line and passes underneath the railway line.	Within Katoomba to Medlow Bath section
Culvert XA7	Local (recommended)	Culvert XA7 is a sandstone culvert located on the eastern side of the highway between the road and the railway line and passes underneath the railway line.	Within Katoomba to Medlow Bath section
Culvert XA7a	Local (recommended)	Culvert XA7a is a sandstone culvert located on the eastern side of the highway between the road and the railway line and passes underneath the railway line.	Within Katoomba to Medlow Bath section

Item	Level of Significance	Description	Location
House and Orchards (former Glenara Cottage)	N/A	The House and Orchards was likely used in the first decades of the establishment of the Medlow settlement.	Within Great Western Highway, Medlow Bath ancillary facility
Quarry	N/A	The Quarry is an important item for recognising the resources extracted in the 20th century and local industry in the Blue Mountains.	Within and adjacent to Medlow Bath to Blackheath section
Convergence of tracks	N/A	The large-scale clearing and the series of tracks near the Convergence of tracks is indicative of industrial activities in the area. However, this item was found to have no historic value and so has not been assessed further for this proposal.	Within Medlow Bath to Blackheath section



The design
Proposal area
Potential heritage sites
Blue Mountains LEP 2015
National heritage register (nominated)

Heritage items
Bonnie Doon Reserve
Pulpit Hill and Environs



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Source: Aurecon, Mott MacDonald, LPI, Nearmap, Niche

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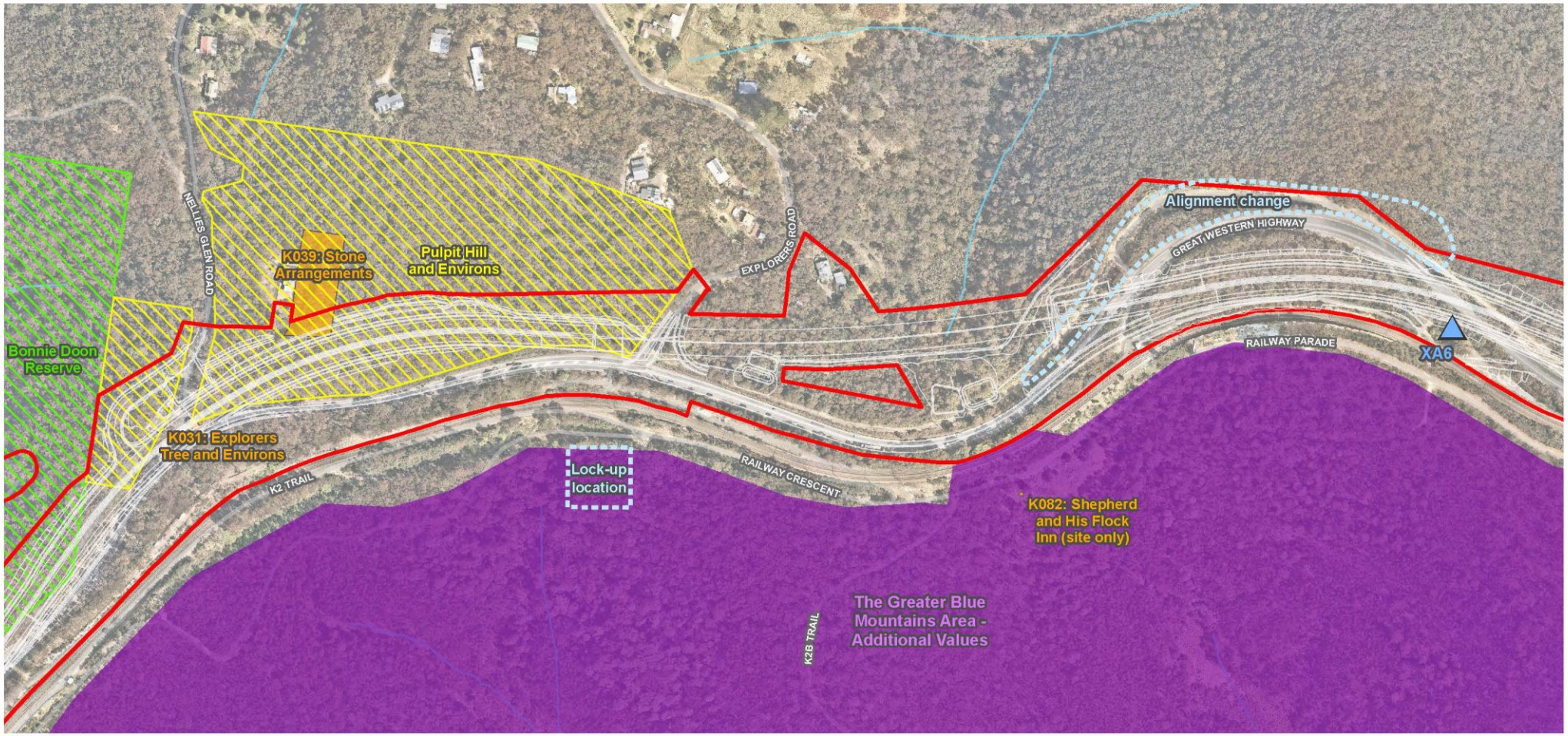
Projection: GDA2020 MGA Zone 56

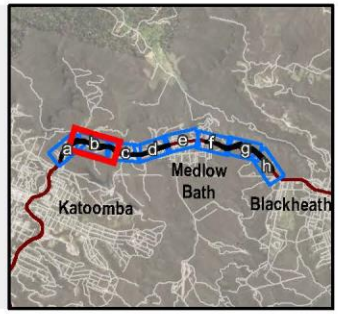
Great Western Highway East **Review of Environmental Factors**

FIGURE 6-4a: Heritage items within and near the proposal area



Culverts
The design
Proposal area
Potential heritage sites
Blue Mountains LEP 2015
National heritage register (nominated)

Heritage items
Bonnie Doon Reserve
Pulpit Hill and Environs



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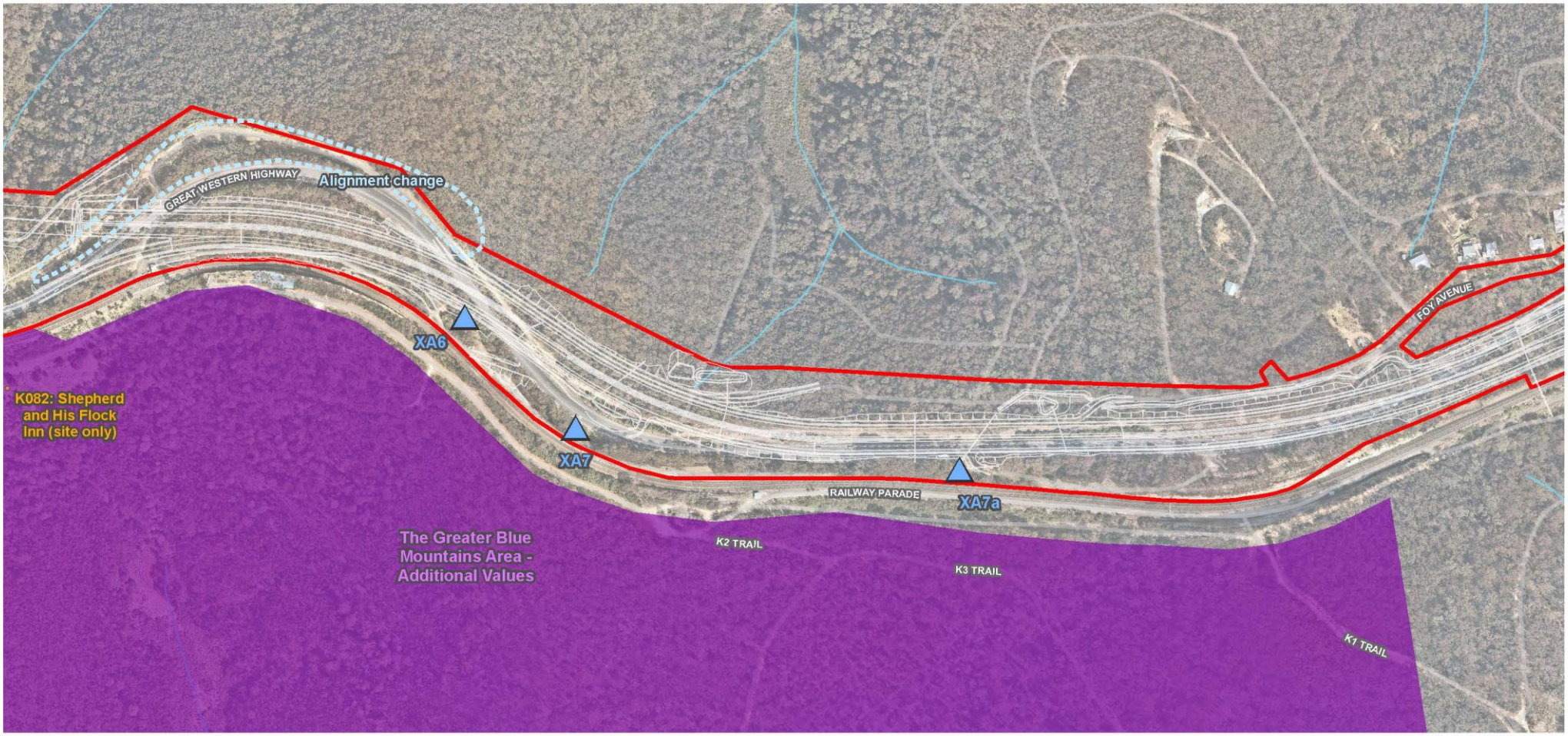
Source: Aurecon, Mott MacDonald, LPI, Nearmap, Niche

1:5,000@A4
0 50 100m

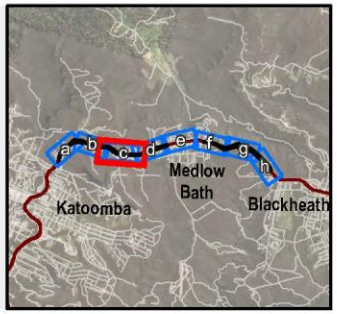
Projection: GDA2020 MGA Zone 56

Great Western Highway East **Review of Environmental Factors**

FIGURE 6-4b: Heritage items within and near the proposal area



Culverts
The design
Proposal area
Potential heritage sites
Blue Mountains LEP 2015
National heritage register (nominated)



Source: Aurecon, Mott MacDonald, LPI, Nearmap, Niche

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0 50 100m

Projection: GDA2020 MGA Zone 56

Great Western Highway East **Review of Environmental Factors**

FIGURE 6-4c: Heritage items within and near the proposal area

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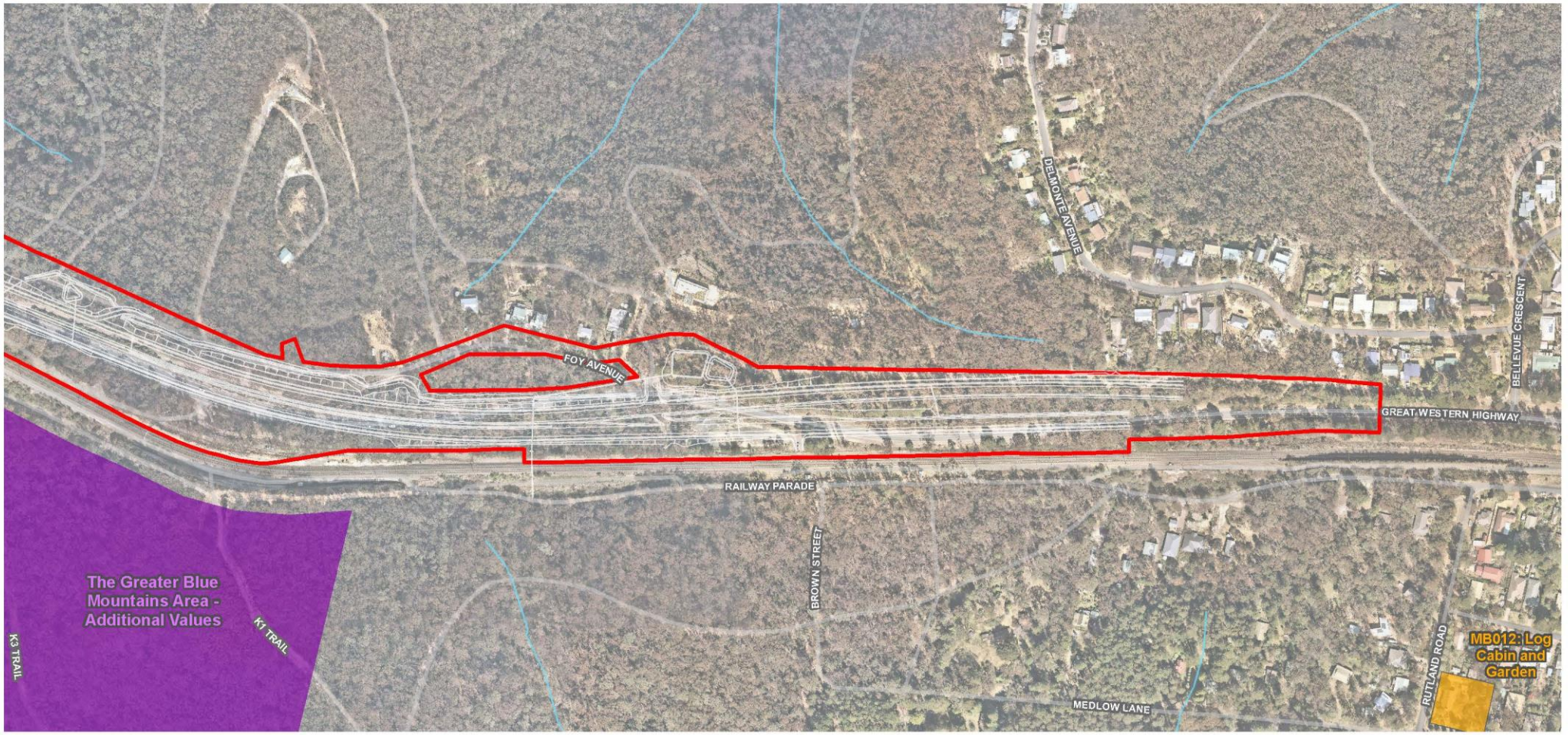

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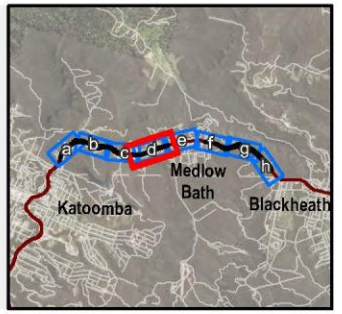
The design
Proposal area
Blue Mountains LEP 2015
National heritage register (nominated)



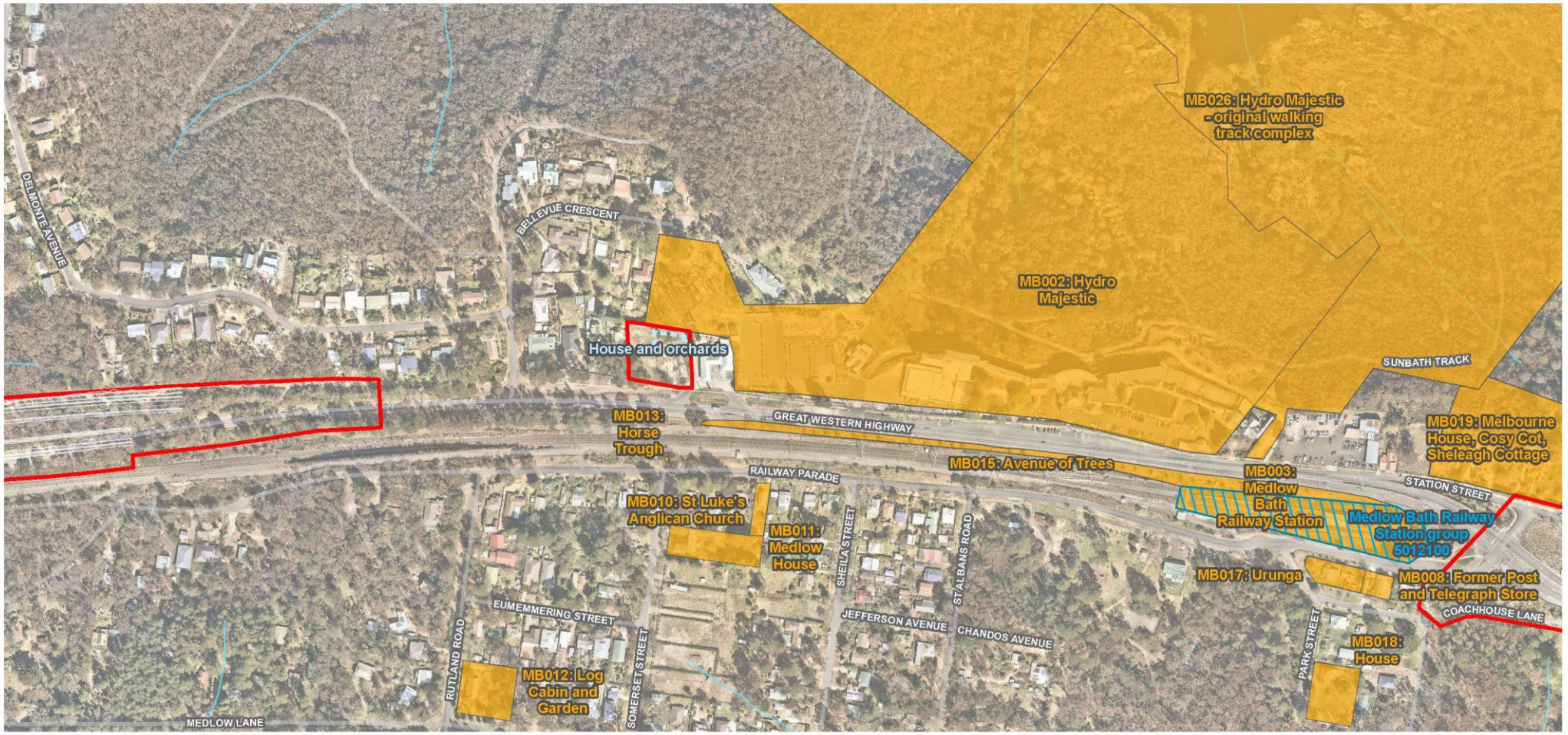
Source: Aurecon, Mott MacDonald, LPI, Nearmap, Niche

1:5,000@A4
0 50 100m

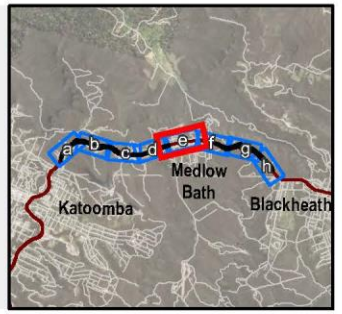
Projection: GDA2020 MGA Zone 56

Great Western Highway East **Review of Environmental Factors**

FIGURE 6-4d: Heritage items within and near the proposal area



The design
Proposal area
Potential heritage sites
State heritage register
Blue Mountains LEP 2015



Source: Aurecon, Mott MacDonald, LPI, Nearmap, Niche

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0 50 100m

Projection: GDA2020 MGA Zone 56

Great Western Highway East **Review of Environmental Factors**

FIGURE 6-4e: Heritage items within and near the proposal area

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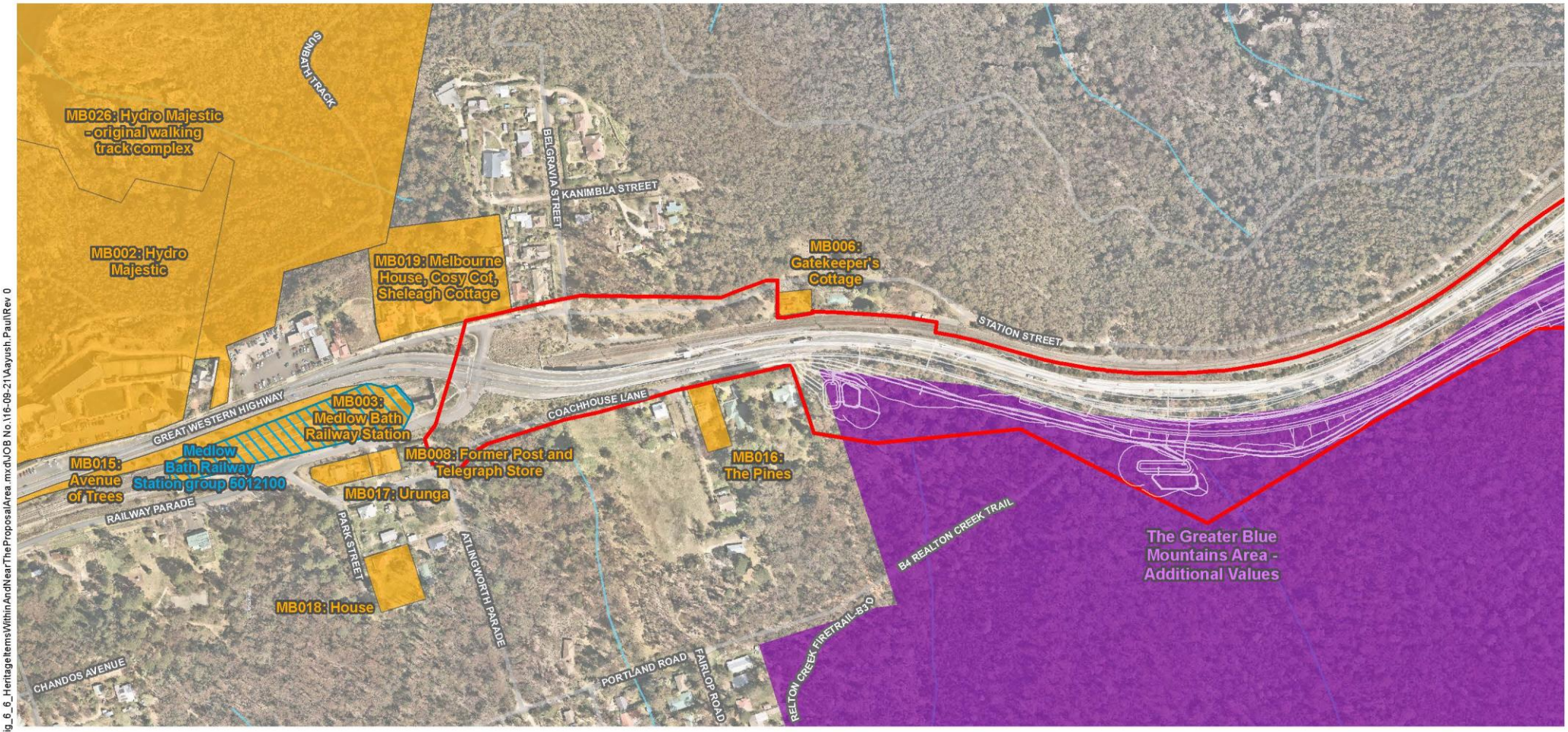

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Source: Aurecon, Mott MacDonald, LPI, Nearmap, Niche

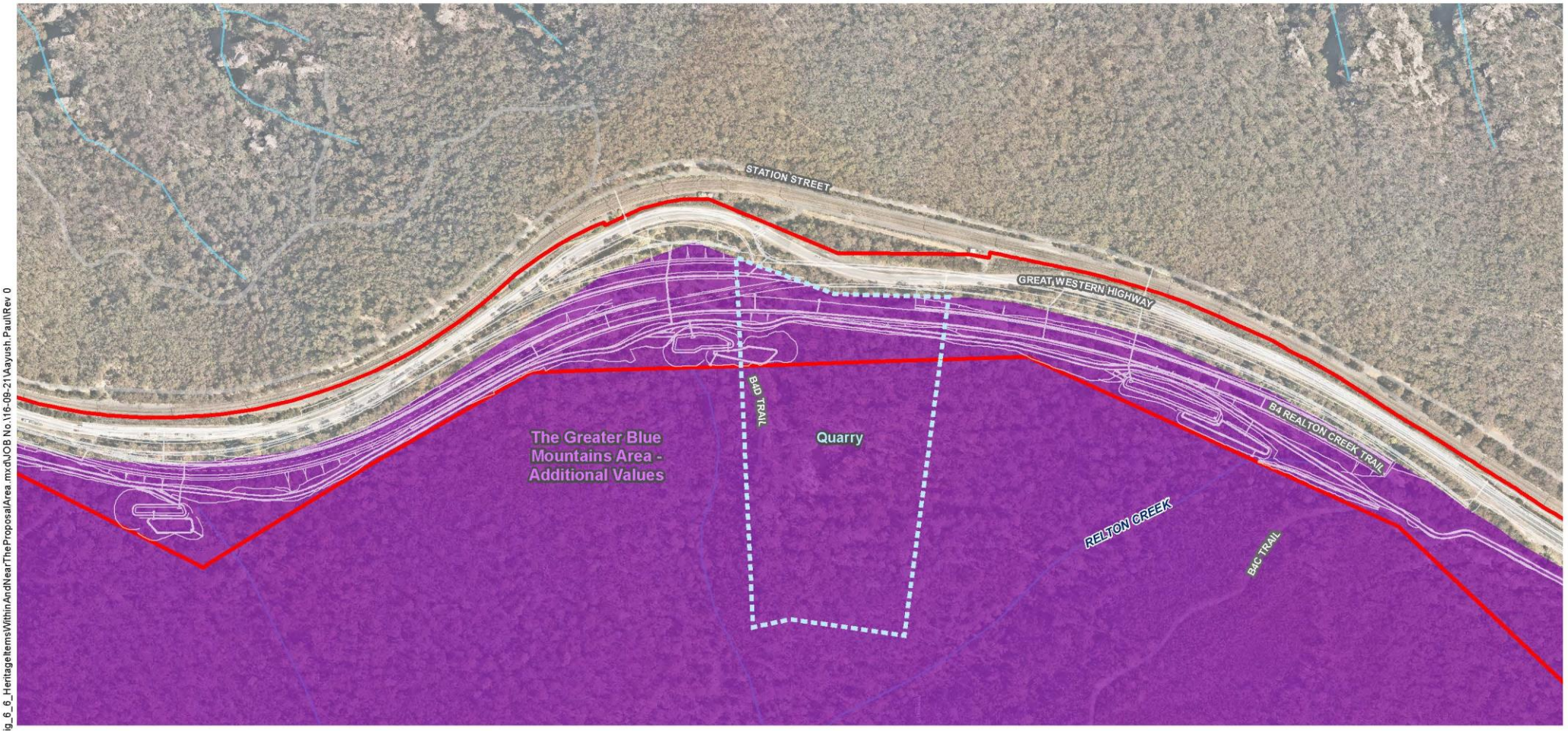
1:5,000@A4

0 50 100m

Projection: GDA2020 MGA Zone 56

Great Western Highway East **Review of Environmental Factors**

FIGURE 6-4f: Heritage items within and near the proposal area



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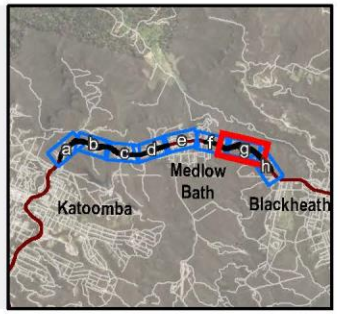
The design
Proposal area
Potential heritage sites
National heritage register (nominated)



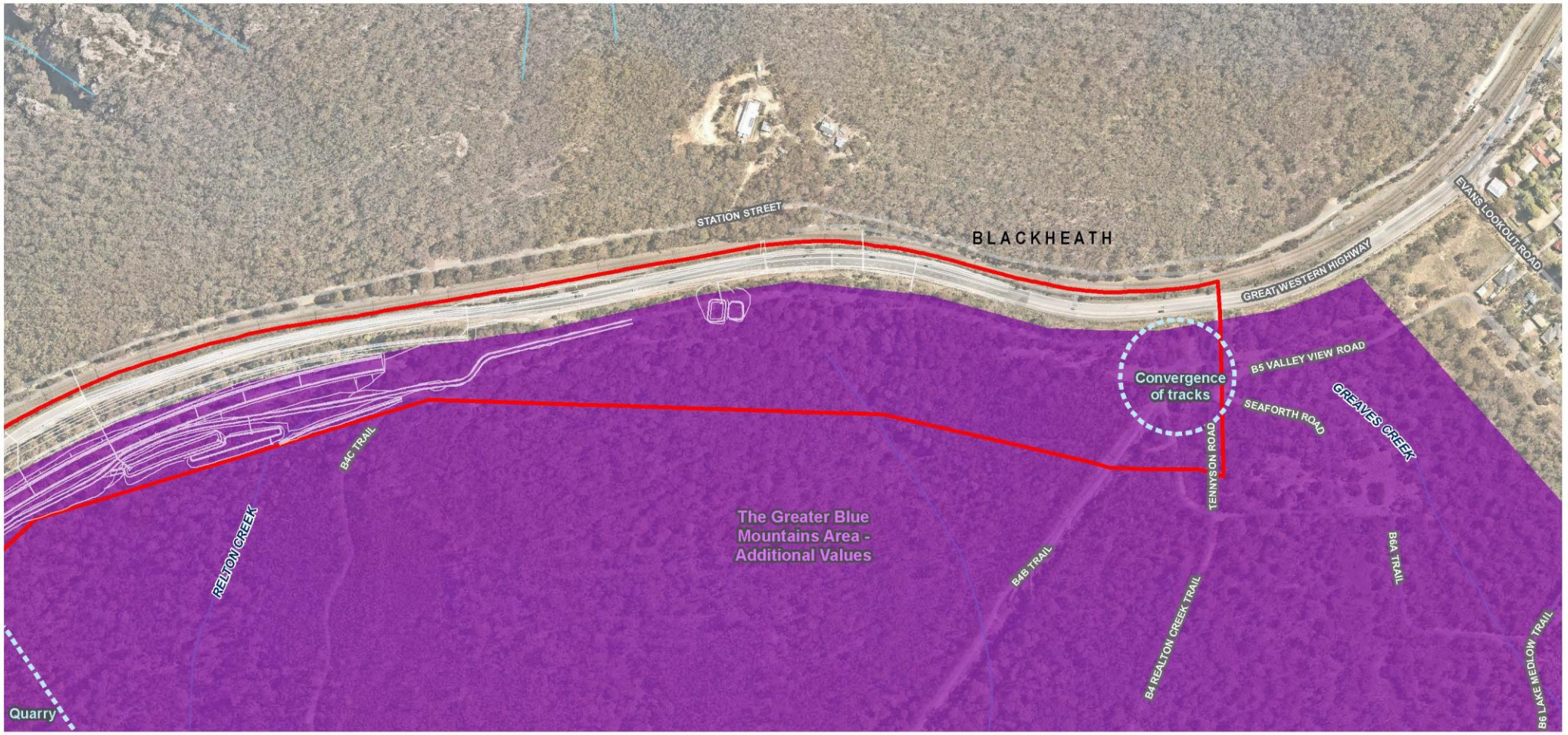
Source: Aurecon, Mott MacDonald, LPI, Nearmap, Niche

1:5,000@A4
0 50 100m

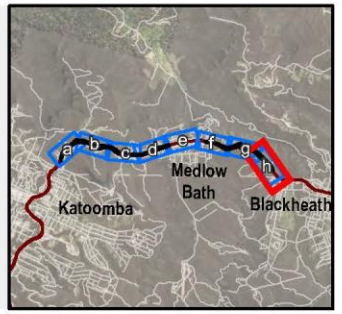
Projection: GDA2020 MGA Zone 56

Great Western Highway East **Review of Environmental Factors**

FIGURE 6-4g: Heritage items within and near the proposal area



The design
Proposal area
Potential heritage sites
National heritage register (nominated)



P:\GIS\Project-4\project\511168_GWH\GWHE_REF_Fig_6_6_HeritageItemsWithinAndNearTheProposalArea.mxd\JOB No.\16-09-21\Aayush.Paul\Rev 0

Source: Aurecon, Mott MacDonald, LPI, Nearmap, Niche

1:5,000@A4
0 50 100m

Projection: GDA2020 MGA Zone 56

Great Western Highway East **Review of Environmental Factors**

FIGURE 6-4h: Heritage items within and near the proposal area

Archaeological potential of the proposal area

The historical archaeological assessment found largely low potential for subsurface historical archaeological deposits across most of the proposal area. There were some areas with moderate to high levels of potential identified throughout the proposal area. Within or near the Katoomba to Medlow Bath proposal area, there is:

- moderate-high potential evidence of graves on Pulpit Hill
- moderate potential evidence of previous road alignments of the Great Western Highway
- moderate potential evidence of the construction and ongoing use of the railway, including culverts, embankments and workers camps
- moderate-high potential evidence of the Shepherd and His Flock Inn site and Lock-up site
- low-moderate potential evidence of tracks and occupation at Bonnie Doon Reserve
- low potential evidence of the stockyard as a stopping site along previous road alignments
- high potential evidence of settlements at the House at Pulpit Hill.

Within or near the Medlow Bath to Blackheath proposal area, there is high potential evidence of the cottage at the former quarry site.

There is also moderate potential evidence of settlement at the House and Orchards (former Glenara Cottage) site within the Great Western Highway, Medlow Bath ancillary facility.

6.4.3 Potential impacts

Construction

Construction of the proposal would directly and indirectly impact the identified heritage items near the proposed work. Table 6-21 outlines the predicted impacts of the construction of the proposal on these items.

During construction, there would be visual changes that may impact the setting of and views to heritage items, especially within the Katoomba to Medlow Bath section. These visual impacts would mainly be caused by the movement and operation of various machinery and light and heavy vehicles surrounding heritage items, affecting overall amenity and setting. Visual impacts of the proposal are discussed further in Section 6.5.3.

Construction work could also impact on the archaeological potential identified near Pulpit Hill. This would impact the Pulpit Hill and Environs heritage item however would not impact the potential grave sites within the Stone Arrangements curtilage. The proposed design would be further refined during detailed design to minimise heritage impacts on this item. However, it is noted that as part of the Katoomba to Medlow Bath section, the existing heritage interpretation area would be consolidated and improved to better integrate the heritage significance of the Pulpit Hill area and provide better accessibility to visitors.

Table 6-21: Potential impacts on the identified heritage items during construction of the proposal

Item	Listing number	Listing	Predicted impacts
Great Western Highway	N/A	N/A	**Minor partial physical impacts – Katoomba to Medlow Bath and Medlow Bath to Blackheath sections** There would be direct impacts to the Great Western Highway due to the proposed road duplication and ancillary work impacting the existing road corridor. The existing Great Western Highway road alignment holds heritage significance as the crossing of the Blue Mountains and so, in areas that are no longer used, would affect the significance of those areas. Changing the alignment would result in minor impacts to the overall significance of the item.
Greater Blue Mountains Area – Additional Values (Nominated)	105696	National	**No direct or indirect impacts – Katoomba to Medlow Bath section** **Minor partial physical impacts – Medlow Bath to Blackheath section** There would be direct impacts due to vegetation clearance, road widening and construction of associated drainage basins along the western periphery of the Greater Blue Mountains Area - Additional Values area. It would involve the removal of established native trees that contribute to the overall significance of the heritage item however the loss of these elements would not reduce the overall significance of the item.
Bonnie Doon Reserve	K079	Local	**Minor partial physical impacts – Katoomba to Medlow Bath section** There would be direct impact to the northern section of the Bonnie Doon curtilage, along the existing road shoulder. Construction work would involve vegetation clearance, road widening, cut and fills and the construction of a drainage basin in this area. While established native trees that contribute to the overall significance of the heritage item would be removed, their removal would not reduce the overall significance of the item.
Pulpit Hill and Environs including: **Lock-up** **Stockyard** **Elements of Cox's Road**	K166	Local (Recommended for State listing)	**High partial physical impacts – Katoomba to Medlow Bath section** There would be direct physical impacts to the eastern curtilage of this item. This would occur through road widening, earthworks, bridge construction, intersection upgrade and carpark construction. While the heritage interpretation of Pulpit Hill would be partially removed, the existing Blue Mountains City Council heritage interpretation area would be retained. An expanded and cohesive heritage interpretation area would be developed to reinterpret and display the Aboriginal and non-Aboriginal heritage of the area (refer to Section 3.2.3). Whilst there would be no potential heritage impacts to some components of Pulpit Hill and Environs, the cumulative impacts to the greater Pulpit Hill environs would impact the significance of these elements.
Stone Arrangements (within Pulpit Hill curtilage)	K039	Local (Recommended for State listing)	**High partial physical impacts – Katoomba to Medlow Bath section** There would be high direct impacts to this site due to major earthworks and road widening along the eastern curtilage of the Stone Arrangements site, directly adjacent to the recorded locations of stone arrangements. However, there would not be impacts to the potential grave sites within the Stone Arrangements curtilage
Shepherd and His Flock Inn site	K082	Local	**No direct or indirect impacts – Katoomba to Medlow Bath section** While there would be no impacts to this item, due to its location within Pulpit Hill and Environs, there would be high cumulative impacts on the significance of the entire curtilage.

Item	Listing number	Listing	Predicted impacts
Explorer's Tree and Environs	K031	Local	**Minor-moderate partial physical impacts – Katoomba to Medlow Bath section** There would be direct impacts due to earthworks and the construction of the upgraded heritage interpretation area and carpark in the former location of the Explorer's Tree. While the Explorer's Tree has been previously removed, the site is still a heritage listed site and the proposal would have a partial impact on the site. The upgrade of the heritage interpretation area would help to enhance the location in the landscape.
Alignment change	N/A	N/A	**Minor partial physical impacts – Katoomba to Medlow Bath section** There would be direct impacts due to earthworks and road widening at the northern and southern sections of the alignment change. These locations are likely to be heavily disturbed through the previous construction of the Great Western Highway and is unlikely to retain in situ remains in the location of the proposed design.
Old alignment	N/A	N/A	**Minor partial physical impacts – Katoomba to Medlow Bath section** There would be direct impacts due to earthworks and road widening at the western sections of the old alignment. These locations are likely to be heavily disturbed through the previous construction of the Great Western Highway and is unlikely to retain in situ remains in the location of the proposed design.
Culvert XA6	N/A	Local (recommended)	**Minor indirect (vibration) impacts – Katoomba to Medlow Bath section** This culvert would be located directly adjacent to proposed work, but not directly affected. The potential vibration impacts on this item are assessed in Section 6.6.4.
Culvert XA7	N/A	Local (recommended)	**Minor indirect (vibration) impacts – Katoomba to Medlow Bath section** This culvert would be located directly adjacent to proposed work, but not directly affected. The potential vibration impacts on this item are assessed in Section 6.6.4.
Culvert XA7a	N/A	Local (recommended)	**Minor indirect (vibration) impacts – Katoomba to Medlow Bath section** This culvert would be located directly adjacent to proposed work, but not directly affected. The potential vibration impacts on this item are assessed in Section 6.6.4.
The Pines	MB016	Local	**Minor indirect (vibration) impacts – Katoomba to Medlow Bath section** The widened existing road corridor in front of the item would have no direct impact on the item's significance. The potential vibration impacts on this item are assessed in Section 6.6.4.
Gatekeeper's Cottage	MB006	Local	**Minor indirect (vibration) impacts – Katoomba to Medlow Bath section** The Katoomba to Medlow Bath section would widen the existing road in front of the item and would have no direct impact on the item's significance. The potential vibration impacts on this item are assessed in Section 6.6.4.
House and Orchards (former Glenara Cottage)	N/A	N/A	**Moderate temporary partial physical impacts – Medlow Bath ancillary facility** There would be direct impacts to this item during its use as an ancillary facility during construction, including as a temporary site laydown area. An Historic (non-Aboriginal) Archaeological Assessment would be carried out to identify the extent of archaeological resources prior to construction work occurring.

Item	Listing number	Listing	Predicted impacts
Quarry	N/A	N/A	**Minor partial physical impacts – Medlow Bath to Blackheath section** There would be direct impacts to this site due to road widening and earthworks within the western half of this identified area. It may impact the area of an early 20th century cottage associated with the quarry use, however, this cottage does not meet the threshold for local heritage significance.

Operation

Generally, the proposal would be contained within the existing corridor and so would not visually dominate any heritage items more than the current alignment. The proposal would have a low visual impact on the context and views of The Pines and the Gatekeeper's Cottage heritage items. The character of the area around these items would remain similar as the Medlow Bath to Blackheath section would tie into the existing highway at this location. Visual impacts of the proposal are discussed further in Section 6.5.3.

The proposal has been designed to complement the heritage significance of the proposal area by following the original alignment and creating spaces for interpretation and community access. These design features include the consolidation and improvement of the heritage interpretation area near Nellies Glen Road and the provision of improved active transport trails. Further details are available in Section 3.2.3

Transport is currently engaging with specialist heritage consultants GML Heritage and Balarinji Indigenous Design and Strategy to engage stakeholders in developing a cultural interpretation strategy across the Great Western Highway Upgrade Program – Katoomba to Lithgow. This cultural interpretation strategy would look to interpret both Aboriginal and non-Aboriginal heritage along the highway alignment. The Pulpit Hill heritage interpretation area would be further developed as part of the Great Western Highway Upgrade Program cultural interpretation strategy, in consultation with the Blue Mountains City Council, Heritage NSW, Aboriginal knowledge holders and the local community.

As such, the operation of the proposal is not expected to result in any other direct or indirect impacts on the identified heritage items.

6.4.4 Safeguards and management measures

Safeguards and management measures for non-Aboriginal heritage are outlined in Table 6-22.

Table 6-22: Safeguards and management measures – non-Aboriginal heritage

Impact	Environmental safeguards	Responsibility	Timing	Reference
Non-Aboriginal heritage	A Non-Aboriginal Heritage Management Plan (NAHMP) will be prepared and implemented as part of the CEMP. It will provide specific guidance on measures and controls to be implemented to avoid and mitigate impacts to Non-Aboriginal heritage.	Transport / Contractor	Detailed design / pre-construction	Section 4.10 of QA *G36 Environment Protection*
Non-Aboriginal heritage	The *Standard Management Procedure - Unexpected Heritage Items* (Transport, 2015d) will be followed in the event that any unexpected heritage items, archaeological remains or potential relics of Non-Aboriginal origin are encountered. Work will only re-commence once the requirements of that Procedure have been satisfied.	Transport / Contractor	Detailed design / pre-construction	Section 4.10 of QA *G36 Environment Protection*
Non-Aboriginal heritage	The proposed design will be further refined during detailed design to avoid and/or minimise non-Aboriginal heritage impact. Should detailed design result in changes to non-Aboriginal heritage impacts, this will be re-evaluated at that stage.	Transport	Detailed design	Additional safeguard
Non-Aboriginal heritage	A Photographic Archival Record of the current state of the Great Western Highway will be prepared prior to the commencement of construction. The archival recording will be submitted to Transport, local historical societies and Blue Mountains City Council.	Contractor	Pre-construction	Additional safeguard
Greater Blue Mountains Area – Additional Values	Removal of vegetation within the Greater Blue Mountains Area – Additional Values areas will be minimised as much as possible.	Transport	Detailed design	Additional safeguard
Pulpit Hill and Environs	• A Conservation Management Plan (CMP) will be prepared for Pulpit Hill and Environs to manage the heritage significance of the site and provide for ongoing management. • The proposed concept design will be further refined during detailed design to minimise adverse heritage impact on the Pulpit Hill and Environs curtilage (including Stone Arrangements site) and interpret the heritage significance of this site, including the role the Explorers Tree played as a waypoint. • If it is not possible to completely avoid the Stone Arrangements, then further information will be required to better understand the constraints and significance of the heritage site. This further study will include: – An Historical Archaeology Assessment including a Historical Research Study	Transport / Contractor	Detailed design / pre-construction / Construction	Additional safeguard

Impact	Environmental safeguards	Responsibility	Timing	Reference
	– An Archaeological Research Design (ARD) for archaeological work – An archaeological test excavation targeting a portion of the Stone Arrangements and a soil analysis of excavated soil to confirm the presence of graves – Further remote sensing studies to verify previous study results. • The archaeological test excavation will be carried out to confirm whether a permit under Section 140 of the *Heritage Act 1977* will be required for the proposal. • A heritage interpretation strategy for the Pulpit Hill area will be developed to reinterpret the existing heritage interpretation area and communicate the heritage significance of the Pulpit Hill area. This will be integrated with the cultural interpretation strategy for the Great Western Highway Upgrade Program. The existing interpretation area will be retained as much as possible.			
Bonnie Doon Reserve	Vegetation removal within the Bonnie Doon Reserve curtilage will be limited to as little as needed and unobtrusive as possible.	Transport	Detailed design	Additional safeguard
Culvert XA6, XA7 and XA7a	A further vibration assessment will be prepared to assess the indirect impacts of the proposal near Culvert XA6, XA7 and XA7a.	Transport	Detailed design	Additional safeguard
House and Orchards (former Glenara Cottage)	An Historic (non-Aboriginal) Archaeological Assessment (HAA) will be carried out to the determine the nature, extent and significance of any archaeological resources associated with the House and Orchards (former Glenara Cottage) in this area and identify appropriate management measures.	Contractor	Pre-construction	Additional safeguard
The Pines and The Gatekeeper's Cottage	• A further vibration assessment will be prepared to assess the indirect impacts of the proposal near The Pines and The Gatekeeper's Cottage. • Should detailed design result in changes to the proposal near The Pines and The Gatekeeper's Cottage, visual impacts will be revaluated upon completion of detailed design.	Transport	Detailed design	Additional safeguard

Other safeguards and management measures that would address non-Aboriginal heritage impacts are identified in Section 6.6.4.

6.5 Landscape character and visual impacts

The potential landscape character and visual impacts during construction and operation of the proposal have been assessed as part of the *Urban Design, Landscape Character and Visual Impact Assessment* (Spackman Mossop Michaels, 2022), provided in Appendix G.

6.5.1 Methodology

The landscape character and visual impact assessment (LCVIA) was carried out in accordance with the *Practice Note: Guideline for landscape character and visual impact assessment* (EIA-N04).

The assessment included:

- a landscape character assessment, which assessed the overall impact of a project on an area's character and sense of place
- a visual impact assessment, which assessed the proposal's impacts on views.

The assessment of landscape character involved identifying landscape character zones (LCZ) near the proposal area and assessing the sensitivity and magnitude of the proposal for each zone. This involved analysing aerial imagery to distinguish distinct vegetation communities and growth patterns as well as topography, geology, water and infrastructure. A site visit confirmed the boundary of each zone by experiencing the landscape on foot and in a car.

The assessment of visual impact required the selection of viewpoints overlooking the proposal area. A collection of viewpoints was selected from different locations, distances and directions within the visual catchment of the proposal area. This involved a desktop assessment of the Visual Envelope Map for the proposal and adjustment of each viewpoint to fall within a likely area of observation, including roadways, residential housing, a walking track or lookouts. These viewpoints were verified during the site visit.

The LCVIA identified the sensitivity of individual LCZ and viewpoints and the magnitude of change at each associated with the proposal. Sensitivity refers to how susceptible the environment is to the proposed change. Magnitude refers to the type of proposal and its compatibility with existing landscape character, including scale, form and material composition of elements, as well as their location or setting. Impacts were determined by assessing sensitivity and magnitude using the matrix shown in Table 6-23.

Table 6-23: Landscape character and visual impact rating matrix

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

6.5.2 Existing environment

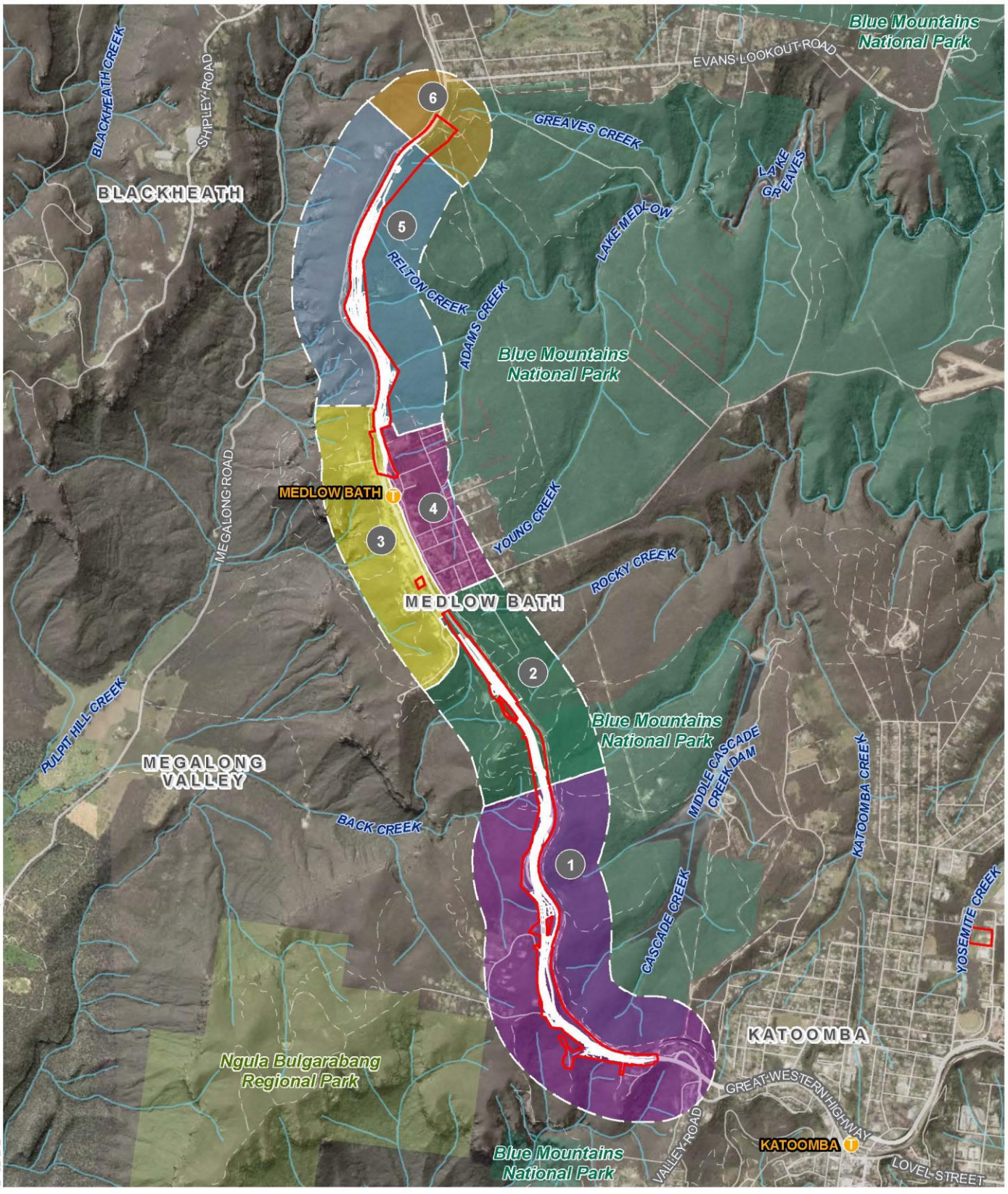
The proposal area contains mostly environmental landscapes. The Katoomba to Medlow Bath section follows undulating topography and is dominated by dense vegetation along the road corridor. As such, most of the Great Western Highway in this section does not have views over the adjoining rail corridor. However, the rail corridor is more visible within the Medlow Bath to Blackheath section. This section is relatively flat, with the Blue Mountains National Park directly to the east of the road corridor in this section.

There are six distinct LCZ for the proposal that are outlined in Table 6-24 and are shown in Figure 6-5. Due to their location, LCZ 3 and 4 are considered across both sections of the proposal. This assessment included the town of Medlow Bath due to its proximity to the two sections of the proposal. The proposal area has been shaped by natural and cultural elements over time. Landscape character has been shaped by landforms, vegetation, views, settlement patterns, and built structures within and adjacent to the proposal area.

Table 6-24: Landscape character zone description

Zone	Description	Landscape view
LCZ 1 – Pulpit Hill (Katoomba to Medlow Bath section)	High landform with densely established indigenous open forest bushland vegetation, dissected by the Great Western Highway.	
LCZ 2 – Enclosed Bushland (Katoomba to Medlow Bath section)	High quality plant communities, densely vegetated enclosed bushland with prominent rock cuttings, edged by roadside vegetation.	
LCZ 3 – Medlow Bath Western Plateau (Katoomba to Medlow Bath and Medlow Bath to Blackheath sections)	Plateau adjacent to the Megalong Valley escarpment, rich in high visual and scenic qualities.	

Zone	Description	Landscape view
LCZ 4 – Medlow Bath East Village (Katoomba to Medlow Bath and Medlow Bath to Blackheath sections)	Flat to gently undulating topography, predominantly low-density housing surrounded by remnant stands of woodland vegetation and mature planted exotics.	
LCZ 5 – Ridgeline Transition (Medlow Bath to Blackheath section)	Native forest, natural bushland sitting high atop the ridgeline. Man-made elements including powerlines detract from the natural landscape in the east, whilst open views over the Megalong Valley exist in the west.	
LCZ 6 – Blackheath Approach (Medlow Bath to Blackheath section)	A mix of natural bushland to the west with steep slopes toward the Megalong Valley and single storey dwellings in the east with planted exotics.	



The design
Proposal area
Blue Mountains National Park
Ngula Bulgarabang Regional Park
Watercourses

Landscape character zone

1 - Pulpit Hill
2 - Enclosed Bushland
3 - Medlow Bath Western Plateau
4 - Medlow Bath East Village
5 - Ridgeline Transition
6 - Blackheath Approach

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Source: Aurecon, LPI, DPIE, BoM, Niche

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Great Western Highway East **Review of Environmental Factors**

Projection: GDA2020 MGA Zone 56

FIGURE 6-5: Landscape Character Zones

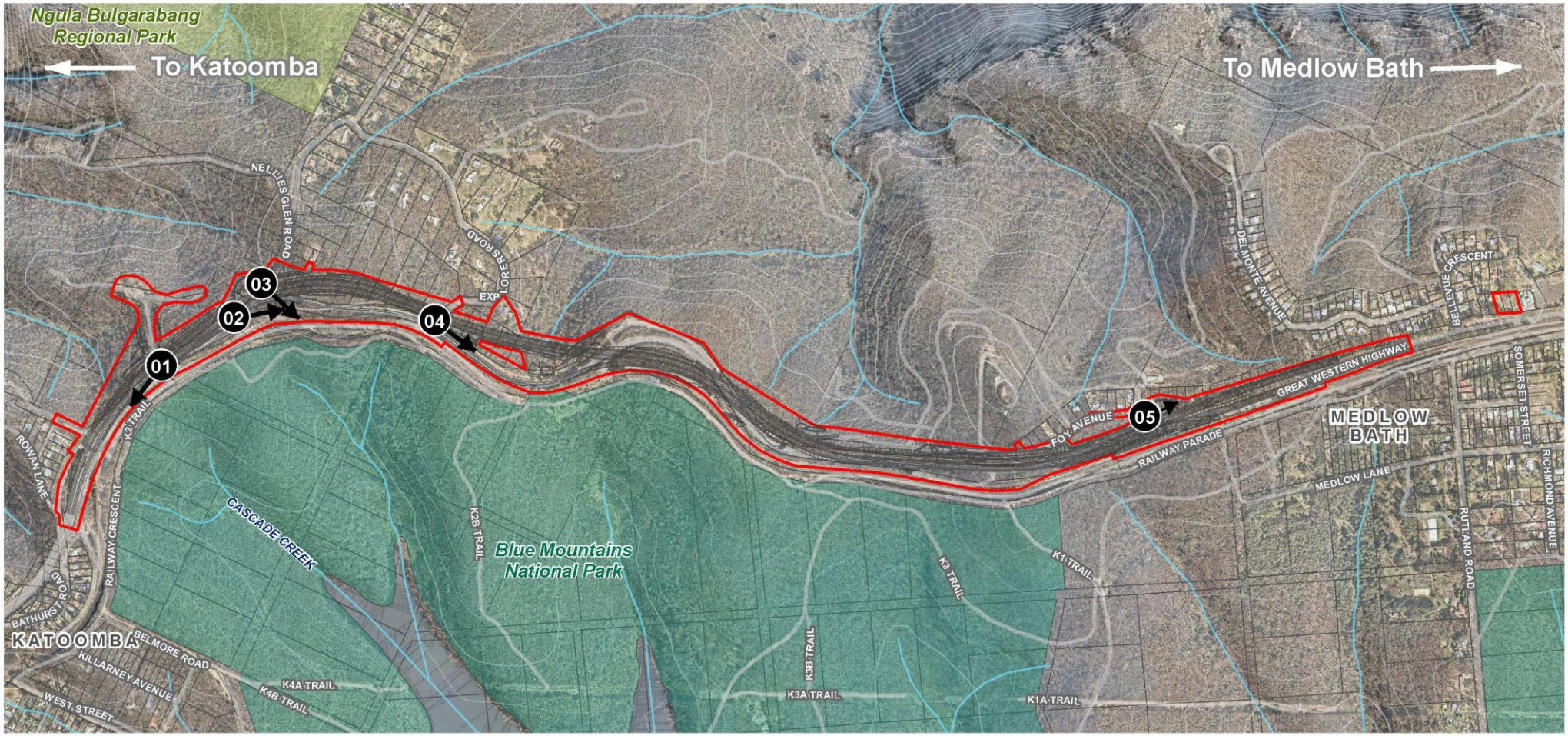
Eight viewpoints were selected to represent receivers or sites that have potential to be visually impacted by the proposal. There are five viewpoints (VP 1, VP 3, VP 4 and VP 5) within the Katoomba to Medlow Bath section and three viewpoints (VP 6, VP 7 and VP 8) within the Medlow Bath to Blackheath section. The receivers in these viewpoints include residents, tourists, recreational and park users, pedestrians, cyclists and motorists. The eight viewpoints are shown in Table 6-25 and Figure 6-6a-b.

Table 6-25: Summary description associated with viewpoints

Viewpoint	Description
 **VP 1: Entry into Bonnie Doon Reserve along the Great Blue Mountains Trail, looking south east.**	The existing road infrastructure makes up an even proportion of the existing view for motorists and recreational users of the adjacent trail.
 **VP 2: Heritage Interpretation Area along Nellies Glen Road, looking north toward the Great Western Highway.**	The existing vegetation and exposed rock makes up a large proportion of the existing view for motorists travelling along the Great Western Highway.
 **VP 3: Heritage Interpretation Area along Nellies Glen Road, looking north toward the Great Western Highway.**	The existing road infrastructure is in the background of this view, with Nellies Glen Road in the mid-ground. The existing view is dominated by vegetation along the fringes of the existing Heritage Interpretation Area, Nellies Glen Road and the existing Great Western Highway. This view is typical for motorists travelling along Nellies Glen Road, pedestrians and cyclists using the Great Blue Mountains Trail or Six Foot Track, and visitors to the Pulpit Hill heritage interpretation area and adjoining informal carpark.

Viewpoint	Description
 **VP 4: Multi use access track on the corner of Explorers Road and the Great Western Highway, looking north.**	An even proportion of the view comprises of the existing road corridor and existing vegetation for pedestrians and cyclists using the Great Blue Mountains Trail and motorists travelling along Explorers Road.
 **VP 5: The corner of Foy Avenue and the Great Western Highway looking north toward the proposal. The viewpoint is representative of a number of views from residences along this portion of Foy Avenue.**	The existing road infrastructure makes up an even proportion of the existing view for residents, motorists and recreational users of the adjacent trail. The existing Great Blue Mountains Trail is buffered by existing vegetation between the roadway.
 **VP 6: Existing Great Blue Mountains Trail along Station Street, looking east toward the proposal.**	The existing road and rail corridors are seen in the background of this viewpoint by motorists travelling along Station Street and pedestrians and cyclists using the Great Blue Mountains Trail. This existing infrastructure is partially screened by existing established vegetation.

Viewpoint	Description
 **VP 7: The Gatekeepers Cottage along Station Street, looking Southeast across the Main Western Railway Line toward the Great Western Highway.**	The viewpoint is representative of a number of views experienced by residents on Station Street, rail commuters and pedestrians and cyclists. The existing road and rail infrastructure are dominant features within this view.
 **VP 8: Coachhouse Lane looking north toward the proposal and rail corridor in the background.**	The view is made up of both transport infrastructure and mature tree and larger shrub vegetation along the road verge and the background. This is representative of the views of residents of Coachhouse Lane and pedestrians.



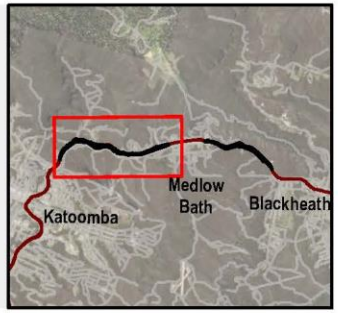
The design

Proposal area

Blue Mountains National Park

Ngula Bulgarabang Regional Park

01 Viewpoints



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Source: Aurecon, Mott MacDonald, LPI, Nearmap

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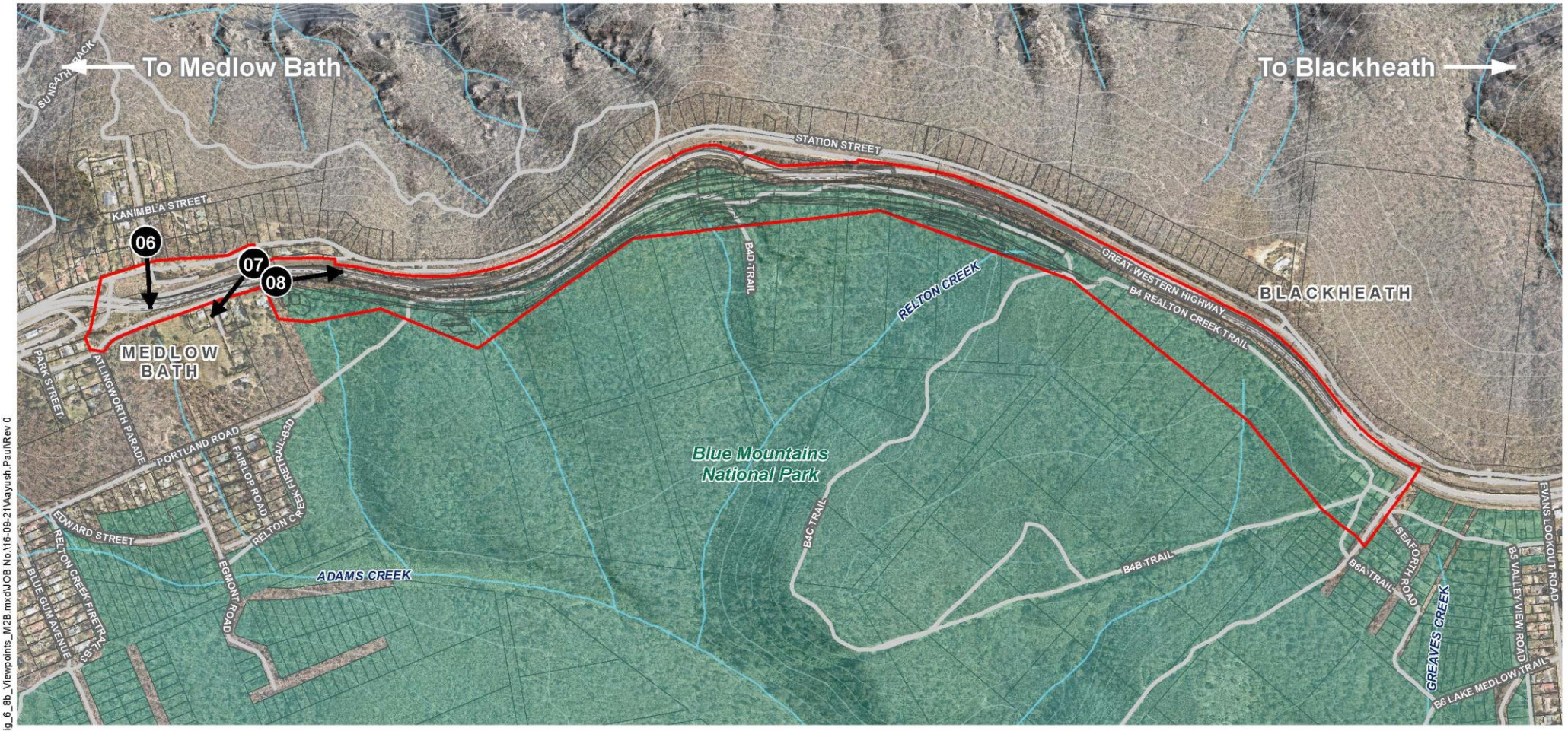
Projection: GDA2020 MGA Zone 56

Great Western Highway East **Review of Environmental Factors**

FIGURE 6-6a: Viewpoints

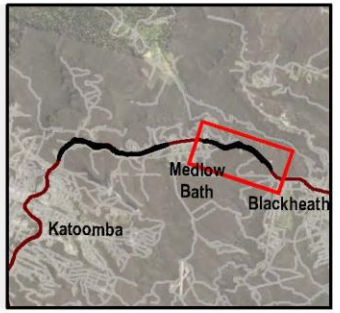


The design

Proposal area

Blue Mountains National Park

01 Viewpoints



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Source: Aurecon, Mott MacDonald, LPI, Nearmap, RFS

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Projection: GDA2020 MGA Zone 56

Great Western Highway East **Review of Environmental Factors**

FIGURE 6-6b: Viewpoints

6.5.3 Potential impacts

Construction

General construction activities would result in temporary visual impacts on views near the work for the duration of construction. These include the movement and operation of machinery, light and heavy vehicles, and the erection of temporary structures such as fencing, lighting and construction ancillary facilities. Visual impacts would be experienced due to clearance of vegetation, excavations and earthworks and the presence of construction areas including ancillary facilities and plant and equipment. The visual impacts would be seen by motorists, recreational walkers and cyclists.

However, the greatest visual impacts would be experienced by residents that overlook the construction sites due to their proximity to the proposed work sites. Within the Katoomba to Medlow Bath section, this would include residents on Rowan Lane, Katoomba; Foy Avenue and Delmonte Avenue, Medlow Bath. There would be major visual impacts experienced at residences on Explorers Road, especially those down the valley due to their proximity to the construction of the twin bridges. The incremental construction of the twin bridges would involve construction work at a greater elevation than the current Great Western Highway. Within the Medlow Bath to Blackheath section, visual impacts experienced by residents would be limited to those who live on Coachhouse Lane and Station Street, Medlow Bath near the southern end of the section.

There are no anticipated residual landscape or visual impacts resulting from the construction phase of the proposal. Contractors would be required to rehabilitate all work sites prior to and at the end of the construction period. Landscape and visual impacts may arise from rehabilitation work and would be most evident during the first year of operation. Visual impacts may vary depending on final construction methods and staging identified in detailed design.

Operation

Landscape character impacts

The six landscape character zones have been assessed as part of the landscape character study and consider areas both within and beyond the proposal area. A summary of the landscape character impact assessment is presented in Table 6-26.

Table 6-26: Landscape character impacts during operation of the proposal

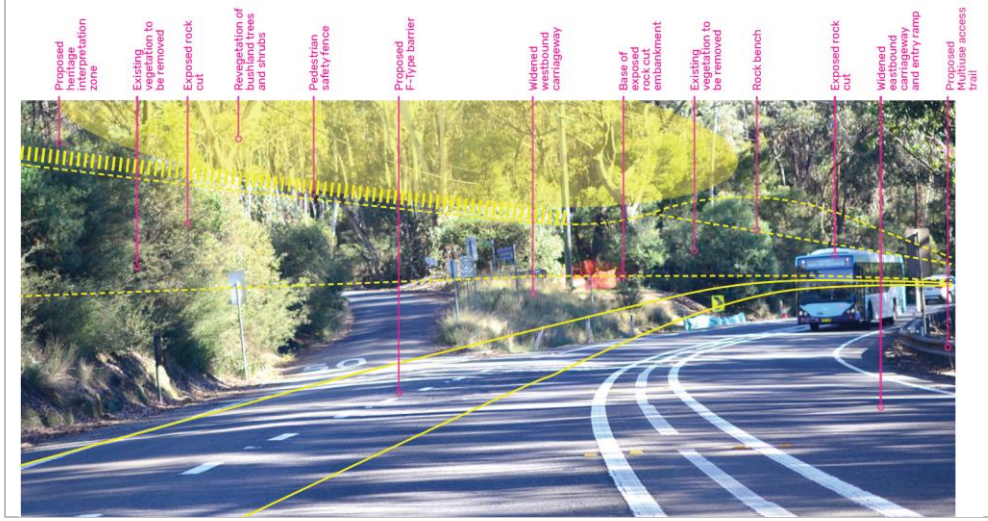
Zone	Sensitivity	Magnitude	Impact
LCZ 1 – Pulpit Hill	**High** • Well established indigenous open forest bushland. • Bushland plays an important role as a visual backdrop. • This LCZ is highly sensitive to change and would not be easily able to absorb changes.	**High** • The proposal would increase the amount of the road-related infrastructure in this LCZ. • It would require clearing of mature bushland vegetation. • Changes to the natural landform.	**High**
LCZ 2 – Enclosed Bushland	**High** • Densely vegetated LCZ has a strong relationship with the surrounding National Park, road and rail corridor. • Undulating topography and windy nature of the Great Western Highway contributes to the character. • Bushland is important as a visual backdrop to the Great Western Highway. • This LCZ is highly sensitive to change and would not be easily able to absorb changes.	**Moderate** • The proposal would increase the amount of the road-related infrastructure in this LCZ. • It would require clearing of mature bushland vegetation and changes to the natural landform.	**High – Moderate**
LCZ 3 – Medlow Bath Western Plateau	**Moderate** • Nature of the Western Plateau is one of both high visual amenity, overlooking the Megalong Valley and also contributing to the neighbourhood feel of Medlow Bath. • Existing proximity to the road and rail corridor allows for this LCZ to absorb change more successfully.	**Low** • The proposal would increase road related infrastructure in the northern portion of the Medlow Bath Western Plateau LCZ. • The majority of work within this LCZ would be within the existing road corridor. • At the tie-in with the Medlow Bath Upgrade, spatial character of the LCZ would be maintained, with the proposal following the existing alignment of the Great Western Highway.	**Moderate – Low**
LCZ 4 – Medlow Bath East Village	**Moderate** • Medlow Bath East Village LCZ predominantly consists of low-density residential housing. • This LCZ has a reasonable ability to absorb change near Coachhouse Lane due to an existing retaining wall between the proposal and residences along Coachhouse Lane and the existing proximity of these residences to the road and rail corridor.	**Low** • The proposal would increase pedestrian and cyclist access along Coachhouse Lane. • Existing bushland along the north-eastern fringe of this LCZ within the proposal area is likely to be cleared.	**Moderate – Low**

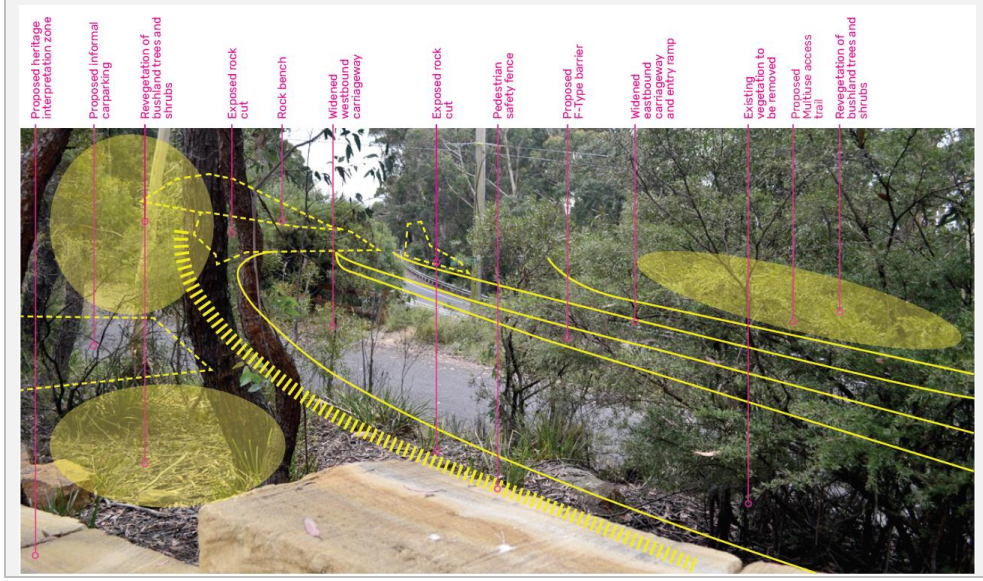
Zone	Sensitivity	Magnitude	Impact
LCZ 5 – Ridgeline Transition	**Moderate** • Well established natural bushland that sits high atop the ridgeline, overlooking the Megalong escarpment to the west. • Combination of mature bushland along the fringes of the road corridor to the east and the rail corridor and associated infrastructure to the west. • This LCZ would find it difficult to absorb changes.	**Moderate** • The proposal would increase the hard surface to the east of the existing Great Western Highway. • Existing vegetation removal to accommodate the expansion of the roadway and adjacent multi use access path. • The changes would only slightly impact the spatial character given the existing conditions along the Great Western Highway.	**Moderate**
LCZ 6 – Blackheath Approach	**Moderate** • Consists of a mix of natural bushland with steep slopes away from the transport corridor in the west and single-storey dwellings to the east. • This LCZ would find it difficult to absorb changes.	**Moderate** • The proposal would slightly increase the hard surface to the east of the existing Great Western Highway. • Existing vegetation removal to accommodate the expansion of the roadway and adjacent multi use access path. The changes would only slightly impact the spatial character given the existing conditions along the Great Western Highway.	**Moderate**

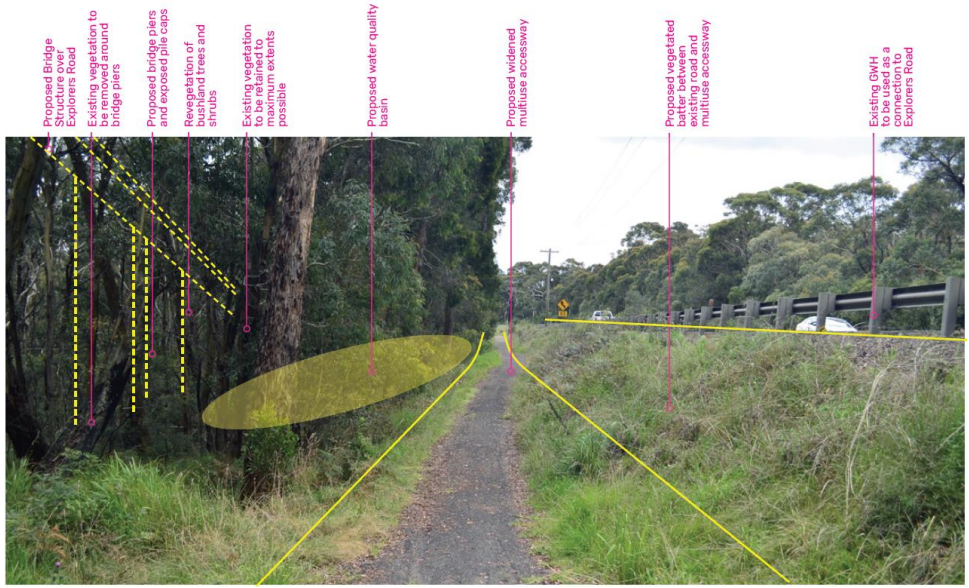
Visual impacts

Assessment of the visual impacts at eight viewpoints within or near the proposal area and are summarised in Table 6-27.

Table 6-27: Viewpoint impact assessment summary

Viewpoint	Sensitivity	Magnitude	Impact
VP 1 	**High** • Existing road infrastructure makes up an even proportion of the existing view. • The experiential quality of the meandering roadway enclosed by bushland is highly sensitive to change given any work that would remove vegetation and alter the perceived curvature of the roadway would affect the road user experience.	**Moderate** • Widening of pavement in the foreground of this viewpoint. • Vegetation along the southbound carriageway will require clearing. • Vegetation installed as part of the proposal landscape design would somewhat reduce the visual effect of change over time and mitigate increased light spill at night.	**High – Moderate**
VP 2 	**High** • Existing vegetation and exposed rock make up a large proportion of the existing view. • The experiential quality of the meandering roadway enclosed by bushland is highly sensitive to change and changes to this spatial quality via the removal of vegetation and increase in hardstand would substantially affect the road user experience.	**High** • Large benched cutting directly adjacent to the widened northbound carriageway. • Vegetation clearing and the widening of the roadway would result in a substantial change to the visual composition of this viewpoint. • Vegetation installed as part of the proposal landscape design would only provide minor mitigation over time.	**High**

Viewpoint	Sensitivity	Magnitude	Impact
VP 3 	**Moderate** • Existing view is dominated by vegetation along the fringes of the existing Heritage Interpretation Area • This viewpoint would be sensitive to change as changes to the vegetation would result in limited ability to absorb changes.	**Moderate** • The proposal would relocate the existing Nellies Glen Road behind the location of this viewpoint. • Introduction of a large rock cutting along the northbound carriageway to enable a realignment of the road corridor. • Vegetation clearing and the widening of the roadway will result in a substantial change to the visual composition of this viewpoint. • Vegetation installed as part of the Proposal landscape design would reduce the visual effect of change over time.	**Moderate**

Viewpoint	Sensitivity	Magnitude	Impact
VP 4 	**Moderate** • An even proportion of the view comprises of the existing road corridor and existing vegetation. • This viewpoint would be sensitive to change given alterations to dense vegetation would result in limited ability to absorb changes.	**High** • The proposal would provide a bridge crossing over Explorers Road, increasing light spill. • Removal of existing bushland vegetation. • Existing Highway would remain as an access way onto the Great Western Highway, from Explorers Road. • Substantial changes to the enclosed character of this portion of the proposal would result in a high magnitude of change. • Revegetation strategies installed as part of the proposal landscape design would reduce the visual effect of change over time and further mitigate light spill. • Given the required bridge infrastructure and setbacks the experience of users is unlikely to be regained	**High – Moderate**

Viewpoint	Sensitivity	Magnitude	Impact
VP 5 	**Moderate** • The existing road infrastructure makes up an even proportion of the existing view. • The existing Great Blue Mountains Trail is buffered by existing vegetation between the roadway. • The experiential quality of the roadway upon entering Medlow Bath is enclosed by mature vegetation and as such is sensitive to change given any work that would remove vegetation and alter road user experience	**Moderate** • The proposal would introduce the raising and widening of the. • Vegetation along the northbound carriageway will require clearing with fill batters proposed on either side of the carriageway. • Vegetation installed as part of the proposal landscape design would reduce the visual effect of change over time and light spill.	**Moderate**

Viewpoint	Sensitivity	Magnitude	Impact
VP 6 	**Low** • The existing road infrastructure is seen in the background of this view, partially screened by existing established vegetation. • The foreground of the existing view is dominated by vegetation along the fringes of the existing rail corridor, the highway and rail infrastructure are seen as dominant existing features in the background. • As a result, this viewpoint would be able to absorb changes given the existing screen planting, as well as existing built elements	**Low** • The proposal would relocate the existing retaining wall along the rail corridor and relocate the associated rail infrastructure. • As a result of this widening, there would not be a substantial change to the visual composition of this viewpoint. • Vegetation installed as part of the proposal landscape design would assist in further reducing the visual effect of change over time.	**Low**
VP 7 	**Low** • The existing road and rail infrastructure are dominant features within this view. • As a result of extensive infrastructure in the foreground, this viewpoint would be able to successfully absorb changes.	**Moderate** • The proposal would relocate the existing retaining wall along the rail corridor and relocate the associated rail infrastructure. • The proposal would not be a significant change to the visual composition of this viewpoint. • There would likely be increased traffic travelling past this viewpoint and light spill at night from the proposal.	**Moderate – Low**

Viewpoint	Sensitivity	Magnitude	Impact
VP 8 	**High** • The view is made up of an even ratio of transport infrastructure and mature tree and larger shrub plantings along the road verge and the background. • The sensitivity of this view to change is high given the limited ability of this view to absorb changes to the removal of existing established vegetation along the fringe of the road corridor. • The view is sensitive given the existing residential properties along Coachhouse Lane, which would be impacted by changes to this view, in the form of partial screening of incoming traffic from this viewpoint.	**Moderate** • The proposal would introduce the widening of pavement in the foreground of this viewpoint. • Introduction of a multi-use access trail, where previous access was restricted. • Vegetation along the southbound carriageway would require clearing with a retaining wall and batter proposed along the edge of the roadway and access path. • Vegetation installed as part of the proposal landscape design along the batter would somewhat reduce the visual effect of change over time and reduce increased light spill.	**High – Moderate**

6.5.4 Safeguards and management measures

Safeguards and management measures for landscape and visual impacts are presented in Table 6-28.

Table 6-28: Safeguard and management measures – landscape character and visual impact

Impact	Environmental safeguards	Responsibility	Timing	Reference
Landscape character and visual impact	An Urban Design Plan will be prepared to support the final detailed project design and implemented as part of the CEMP. The Urban Design Plan will present an integrated urban design for the project, providing practical detail on the application of design principles and objectives identified in the environmental assessment. The Plan will include design treatments for: • location and identification of existing vegetation and proposed landscaped areas, including species to be used • built elements including retaining walls, bridges and noise walls • pedestrian and cyclist elements including footpath location, paving types and pedestrian crossings • fixtures such as seating, lighting, fencing and signs • details of the staging of landscape work taking account of related environmental controls such as erosion and sedimentation controls and drainage • procedures for monitoring and maintaining landscaped or rehabilitated areas.	Contractor	Detailed design/pre-construction	Standard safeguard
Proposal design	• Rail infrastructure will be screened using shrubs and trees, where possible • Cut and fill batters will be rounded to help integrate into the existing landform and create a more naturalised appearance. • Opportunities to reduce the proposal footprint will be explored during detailed design • Connectivity and access to the existing and proposed heritage interpretation area will be enhanced. • Exposed rock faces will be retained in the rock cuttings	Transport	Detailed design	Additional safeguard
Bridges	• The bridge design and the design of peripheral elements will be refined to reduce its visual impact.	Transport	Detailed design	Additional safeguard
Bicycle and pedestrian	• Cyclist and pedestrian access will be improved through new and upgraded, multi-use access tracks • Visibility of proposed multi-use access tracks and adjoining residential properties will be improved.	Transport	Detailed design	Additional safeguard
Structures	• Design of new retaining walls will have finishes of a high standard and quality that is in keeping with the Great Western Highway character.	Transport	Detailed design	Additional safeguard
Landscape implementation	• Fill batters will be screened where possible using seeding, shrubs and trees, as well as bushland reconstruction techniques.	Transport	Detailed design	Additional safeguard

Impact	Environmental safeguards	Responsibility	Timing	Reference
	• Buffer planting will be introduced in front of the retaining wall at the southern entry into Medlow Bath to minimise visual impacts. • Bushland reconstruction and bushland seeding will be maximised where possible. • Native and endemic plantings will be used along the highway outside of the village. • Revegetation with appropriate species will be maximised along the highway to reduce perceived corridor width. • The selection of plant species will complement and integrate with the existing environment. • Opportunities for additional tree plantings along the proposal corridor will be investigated.			
Construction visual impact	The layout of ancillary facility sites will be designed to limit impact. The design will consider: • screening of boundaries facing sensitive receivers or views • careful placement of structures and buildings to maintain viewpoints or provide additional screening of site activities.	Contractor	Pre-construction / Construction	Additional safeguard
Construction visual impact	Ancillary facilities will be maintained, kept tidy and well-presented including sorting regular removal of excess materials to reduce visual impact.	Contractor	Construction	Additional safeguard
Construction visual impact	Ancillary facility sites and temporary construction areas will be progressively restored to at least their pre-construction conditions when no longer required.	Contractor	Construction	Additional safeguard

6.6 Noise and vibration

The potential noise and vibration impacts during construction and operation of the proposal have been assessed as part of the *Noise and Vibration Technical Paper* (Renzo Tonin, 2022), provided in Appendix H.

6.6.1 Methodology

The methodology for the noise and vibration assessment involved:

- identifying the noise and vibration assessment study area and associated sensitive receivers
- measuring the existing background noise levels at seven noise monitoring locations and carrying out concurrent traffic count surveys to calibrate the existing road traffic noise models
- grouping sensitive receivers that are located at similar distances from noise generating activities into seven noise catchment areas (NCA) and describing the existing noise environment for each NCA
- defining relevant assessment criteria to assess noise and vibration impacts
- identifying 'realistic worst-case' construction scenarios and representative plant and equipment for each scenario
- predicting and assessing construction noise levels for the construction scenarios using CadnaA software in accordance with the Interim Construction Noise Guideline (ICNG) (DECC, 2009) and Construction Noise and Vibration Guideline (CNVG) (Transport, 2016a)
- calculating and assessing construction vibration using source vibration levels and minimum working distances in accordance with relevant guidelines
- assessing the predicted operational road traffic noise levels using CadnaA software in accordance with the Road Noise Policy (RNP) (DECCW, 2011)
- recommending safeguards and management measures to be implemented to minimise noise and vibration impacts during construction and operation of the proposal, with reference to the CNVG and Noise Mitigation Guideline (NMG) (Transport, 2015c).

Noise monitoring

Noise monitoring was carried out near the proposal to determine the existing background noise environment. Unattended noise monitoring was completed during August 2021. The noise monitoring locations were chosen to be representative of the different NCAs surrounding the proposal. Five of the seven noise monitors were installed at residences with an unobstructed view of Great Western Highway, which were the most appropriate locations for calibration of the traffic noise model.

Additional noise monitoring was conducted at two locations (L5 and L7) to obtain background noise levels for setting construction noise goals.

The noise monitoring equipment continuously measured existing noise levels in 15-minute periods during the daytime, evening and night-time. Traffic count surveys were carried out alongside the long-term unattended noise monitoring surveys to calibrate the road traffic noise volumes.

While noise monitoring was conducted during a COVID-19 lockdown period, operational traffic noise predictions are based on previous traffic volumes monitored in March and April 2021 when there was no lockdown period. Future traffic volumes and growth estimates were also based on pre-pandemic conditions so that traffic volumes are not underestimated.

Construction noise and vibration assessment model and scenarios

Construction noise at sensitive receivers was modelled using CadnaA software.

The nine construction scenarios developed for construction noise modelling were:

- site preparation (SP)
- site establishment (SE)
- bulk earthworks (BE)
- drainage infrastructure (DI)
- paving / asphalting (including concrete sawing) (PA)
- finishing work (FW)
- bridge work – foundations (BWF)
- bridge work – launching (BWD)
- ancillary facility operational (AFO).

These scenarios provide 'realistic worst-case' activity sequences for different construction activities. They were attributed a unique assessment identification number for each section of the proposal. The bridge work scenarios were only modelled for the Katoomba to Medlow Bath section.

The scenarios represent one possible way that the proposal could be constructed and may not necessarily be the same methodology that the contractor engaged to construct the proposal would use. The final construction methodology (including the full plant and equipment list) and the expected construction noise levels would be confirmed during detailed design.

The assessment has considered potential noise impacts from work during standard working hours as well as out-of-hours periods for all scenarios. Refer to Section 3.3.4 for more information on the proposed construction hours.

Operational noise assessment model and scenarios

A noise model of the 'operational study area' has been used to predict noise levels from the operation of the proposal to surrounding receivers using CadnaA software. Various inputs and parameters were applied to the model including local terrain, surrounding buildings, typical vehicle speeds, traffic volumes, vehicle types and road surfaces.

The operational study area has been defined as 600 metres from the centre of the outside lanes of the project roads, as required by the Noise Criteria Guideline (NCG) (Transport, 2015b).

With exception of the new twin bridges over the valley from Pulpit Hill near Explorers Road, all 'project' roads are considered to be 'redeveloped' as per the NCG. The twin bridges are assessed as a 'new' road due to change in alignment and elevation compared to the existing Great Western Highway in this area.

There is a 'type 1 transition zone' at the new bridges where residences are impacted by road noise from both the new bridges and the redeveloped roads at the northern and southern ends of the bridges. Receivers located within the type one transition zone have been assigned transition zone criteria (refer to Section 6.6.3) based on the level of exposure to the new and redeveloped roads.

There are 'type 2 transition zones' at the western end of the proposal in Blackheath and at the eastern end of the proposal in Katoomba where the proposal ties in with the existing Great Western Highway. For receivers in these zones, the contribution of road traffic noise from all roads is calculated to determine if the receiver should be considered for additional noise mitigation (as per the NMG).

Operational traffic noise levels were modelled for the 14 scenarios outlined in Table 6-29. The assessment considered both the 'build' (with the proposal) and 'no build' (without the proposal) scenarios.

Table 6-29: Noise modelling scenarios

Label	Description
2021 Existing – day	Daytime, based on existing measured 2021 traffic and road alignment for model validation purposes
2021 Existing – night	Night-time, based on existing measured 2021 traffic and road alignment for model validation purposes
2026 No build – day	Daytime based on 2026 ‘No build’ scenario
2026 No build – night	Night-time based on 2026 ‘No build’ scenario
2036 No build – day	Daytime based on 2036 ‘No build’ scenario
2036 No build – night	Night-time based on 2036 ‘No build’ scenario
2026 Build – day	Daytime based on 2026 with 'Build’ scenario (with and without low noise pavement)
2026 Build – night	Night-time based on 2026 with 'Build’ scenario (with and without low noise pavement)
2036 Build – day	Daytime based on 2036 with 'Build’ scenario (with and without low noise pavement)
2036 Build – night	Night-time based on 2036 with 'Build’ scenario (with and without low noise pavement)

6.6.2 Existing environment

Noise catchment areas and sensitive receivers

The nearest sensitive receivers to the proposal are residential properties near:

- Rowan Lane, Katoomba (Katoomba to Medlow Bath section)
- Explorers Road, Katoomba (Katoomba to Medlow Bath section)
- Foy Avenue, Medlow Bath (Katoomba to Medlow Bath section)
- Delmonte Avenue, Medlow Bath (Katoomba to Medlow Bath section)
- Coachhouse Lane, Medlow Bath (Medlow Bath to Blackheath section).

There are other sensitive receivers, especially in the town of Medlow Bath, between the two sections of the proposal. A comprehensive list of ‘other sensitive’ receivers (non-residential) identified within the study area is provided in Section 3.2 of Appendix H to the REF.

Seven NCAs have been identified surrounding the proposal, which each represent an area that contains a group of receivers that may be similarly affected by road traffic noise from the proposal. This may reflect the different land uses and existing background noise levels within and surrounding the proposal area. The NCAs, sensitive receivers and noise monitoring locations for the proposal are shown in Figure 6-7a-b.

Background noise levels

Existing noise levels in the proposal area are generally dominated by road traffic noise from the Great Western Highway as well as noise from the rail corridor when trains pass by. The noise monitoring results of the existing noise levels are summarised in Table 6-30.

Table 6-30: Background noise levels

ID	Address	L_{A90} Rating Background Noise (RBL)				
		Day[1]	Shoulder 1[4]	Evening[2]	Night[3]	Shoulder 2[5]
L1	60-81 Station Street, Blackheath	48	39	33	30[6] (28)	32
L2	16 Coachhouse Lane, Medlow Bath	45	38	31	30[6] (26)	34
L3	136 Great Western Highway, Medlow Bath	47	40	33	30[6] (28)	35
L4	43 Foy Avenue, Medlow Bath	45	40	33	30[6] (27)	32
L5	26 Explorers Road, Katoomba	44	38	32	30[6] (23)	32
L6	313 Bathurst Road, Katoomba	47	40	38	30[6] (28)	34
L7	46-56 Woodlands Road, Katoomba	36	35	30	30[6] (28)	33

Notes:
1. Day is 7:00am to 6:00pm on all days except Sundays and Public Holidays when it is 8:00am to 6:00pm
2. Evening is 6:00pm to 10:00pm
3. Night is the remaining periods
4. Shoulder period 1 of 6pm to 7pm, Monday to Friday
5. Shoulder period 2 of 6am to 7am, Monday to Friday
6. Number in brackets represents the measured (actual) RBL value, which is below the minimum policy value of 30 dB(A) during the evening or night period or 35 dB(A) during the day period.

6.6.3 Criteria

Construction

Construction noise assessment periods

The assessment time periods adopted in the assessment are outlined in Table 6-31. As noted in Section 3.3.4, Transport is seeking approval for 'extended construction hours' for this proposal beyond the standard hours derived from the ICNG.

Table 6-31: Construction hours

Construction hours	Monday to Friday	Saturday	Sunday / Public holiday
Recommended standard construction hours			
Standard hours	7am to 6pm	8am to 5pm	No work
Outside recommended standard construction hours			
Extended construction hours	6am to 7am 6pm to 7pm	N/A	N/A
Out-of-Hours Work (Day)	N/A	5pm to 6pm	8am to 6pm
Out-of-Hours Work (Evening)	7pm to 10pm	6pm to 10pm	6pm to 10pm
Out-of-Hours Work (Night)	10pm to 6am	10pm to 8am	10pm to 8am

Construction noise criteria

Project-specific noise management levels (NMLs) were established for noise-affected receivers. The residential NMLs for the proposal have been determined based on the RBLs and are presented in Table 6-32. The only non-residential NML relevant to this assessment was the internal noise level objective for hospital wards and operating theatres NML of 45dB(A).

The ICNG also states that where construction noise levels are above 75 dBA at residential receivers during standard hours, they are considered 'highly noise affected' and require additional consideration in terms of noise mitigation and management measures.

Table 6-32: Construction noise management levels at residential receivers

NCA	Logger ID	Noise management level (NML) LAeq(15min)						Sleep disturbance screening criterion LAmax dB(A)
		Standard hours (RBL+10dB)	Extended/out-of-hours work (OOHW) (RBL+5dB)					
		Day	Day	Shoulder 1	Evening	Night	Shoulder 2	
NCA01	L1	58	53	44	38	35	37	55
NCA02	L2	55	50	43	36	35	39	55
NCA03	L3	57	52	45	38	35	40	55
NCA04	L4	55	50	45	38	35	37	55
NCA05	L5	54	49	43	37	35	37	55
NCA06	L6	57	52	45	43	35	39	55

Construction traffic

The potential impacts from construction traffic associated with the proposal when travelling on public roads are assessed under the NSW EPA RNP (DECCW, 2011) and CNVG. An initial screening test was first applied to evaluate whether existing road traffic noise levels were expected to increase by more than 2.0 dB because of construction traffic. Where this was considered likely, further assessment was required using the RNP and NCG.

Construction vibration

Construction vibration impacts have been assessed using the CNVG minimum working distances for human comfort, building contents and structural/cosmetic damage.

Human comfort vibration

People can sometimes perceive vibration impacts when vibration generating construction work is located close to occupied areas and buildings. The EPA's *Assessing Vibration: a technical guideline* (DECC, 2006) was used to determine the criteria for intermittent vibration based on the Vibration Dose Value (VDV).

Structural damage criteria

If vibration from construction works is sufficiently high, it can cause cosmetic damage to structural elements of affected buildings. Industry standard cosmetic damage vibration limits are specified in British Standard *BS 7385 Part 2-1993 Evaluation and measurement for vibration in buildings Part 2* (BS 7385; British Standards Institute, 1993) and German Standard *DIN 4150: Part 3-2016 Structural vibration – Effects of vibration on structures* (DIN 4150; Deutsches Institute fur Normung, 1999).

Heritage listed buildings and structures should be considered on a case-by-case basis but as noted in BS 7385 should not be assumed to be more sensitive to vibration, unless structurally unsound. Where a heritage building is deemed to be sensitive, the more stringent DIN 4150 Group 3 guideline values of 2.5 millimetres per second can be applied.

Minimum working distances for vibration intensive work

Minimum working distances for typical vibration intensive construction equipment are provided in the CNVG and are outlined in Section 12.1 of Appendix H to this REF. They suggest that where work is further from receivers than the quoted minimum distances then impacts are not considered likely.

Operation

Operational noise

The NCG criteria for residential receivers relevant to this proposal are shown in Table 6-33. For these receivers, the criteria shown have been applied to the receiver based off the type of road at the relevant part of the proposal. The NCG criteria for relevant 'other sensitive' receivers are shown in Table 6-34. The NCG does not consider commercial and industrial receivers as being sensitive to operational road traffic noise impacts.

Table 6-33: NCG criteria for residential receivers

Road category	Type of project/land use	Assessment criteria (dB)	
		Daytime (7am to 10pm)	Night-time (10pm to 7am)
Freeway/ arterial/ sub-arterial roads **roads**	1. Existing residences affected by noise from new freeway/arterial/sub-arterial road corridors	$L_{Aeq(15hr)}$ 55 (external)	$L_{Aeq(9hr)}$ 50 (external)
	2. Existing residences affected by noise from redevelopment of existing freeway/arterial/sub-arterial roads 3. Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments	$L_{Aeq(15hr)}$ 60 (external)	$L_{Aeq(9hr)}$ 55 (external)
	4. Existing residences affected by both new roads and the redevelopment of existing freeway/arterial/sub-arterial roads in a Transition Zone[1]	Between $L_{Aeq(15hr)}$ 55-60 (external)	Between $L_{Aeq(9hr)}$ 50-55 (external)

Notes
1. The criteria assigned to the entire residence depend on the proportion of noise from the new and redeveloped road. See the NCG for further information.
2. The criteria at each facade are determined from the existing traffic noise level plus 12dB(A).

Table 6-34: NCG criteria for other sensitive receivers

Existing sensitive land use	Assessment criteria (dB)	
	Daytime (7am – 10pm)	Daytime (7am – 10pm)
Hospital wards	$L_{Aeq(1\ hour)}$ 35 (internal)	$L_{Aeq(1\ hour)}$ 35 (internal)

The NMG provides guidance to control road traffic noise and describes the principles to be applied when reviewing noise mitigation for predicted exceedances of the adopted NCG criteria. The NMG provides three triggers where receivers may qualify for considerations of 'additional noise mitigation':

- Trigger 1 – the predicted noise level with the proposal exceeds the NCG controlling criterion and the noise level increase due to the proposal (i.e. the noise predictions for with the proposal minus without the proposal) is greater than 2.0 dB
- Trigger 2 – the predicted noise level with the proposal is 5 dB or more above the NCG controlling criterion (i.e. exceeds the cumulative limit) and the receiver is significantly influenced by project road noise, regardless of the incremental impact of the proposal
- Trigger 3 – the noise level contribution from the road project is acute (daytime LAeq(15hour) 65 dBA or higher, or night-time LAeq(9hour) 60 dBA or higher) even if noise levels are controlled by a non-project road.

Feasible and reasonable noise mitigation measures would be considered for sensitive receives that would exceed the noise criteria.

A maximum noise level assessment has also been carried out for the proposal to inform assessment of noise impacts in areas where traffic is slow moving, accelerating and decelerating. Changes to maximum noise levels have been calculated by modelling the existing and future road alignments using a source height of about 3.6 metres above the road (about the height of a truck exhaust). This is because maximum noise level events would typically be during compression braking events from heavy vehicles.

6.6.4 Potential impacts

Construction

The construction noise impact assessment is conservative in nature as it assumes:

- several items of construction equipment are in use simultaneously. In reality, there would frequently be periods when construction noise levels are much lower or where no noise- generating equipment would be in use.
- construction equipment is at the closest point to each receiver. For most work, the construction noise impacts would frequently be lower than predicted as the worst-case situation typically only occurs for a relatively short period.

Standard construction hours

During standard construction hours, there would be exceedances of the daytime NMLs where work is occurring near receivers. A summary of exceedances per scenario during standard construction hours is presented in Table 6-35 (Katoomba to Medlow Bath section) and Table 6-36 (Medlow Bath to Blackheath section). These tables reflect the expected exceedances due to work in each section of the proposal. Impacts would be greatest in NCA02 and NCA03 near Medlow Bath due to the close proximity of residential receivers to construction work near the village. High noise impacts during construction scenarios would occur during:

- the early site establishment construction scenarios
- the bulk earthworks phase
- the road construction work.

Figure 6-7a-b shows the worst-case noise impacts of the bulk earthworks construction scenario identified as ‘BE’ in Table 6-35 (Katoomba to Medlow Bath section) and Table 6-36 (Medlow Bath to Blackheath section). This scenario has the highest assumed construction activity noise level of any construction scenario. Further details on other construction scenarios are provided in Appendix H to this REF.

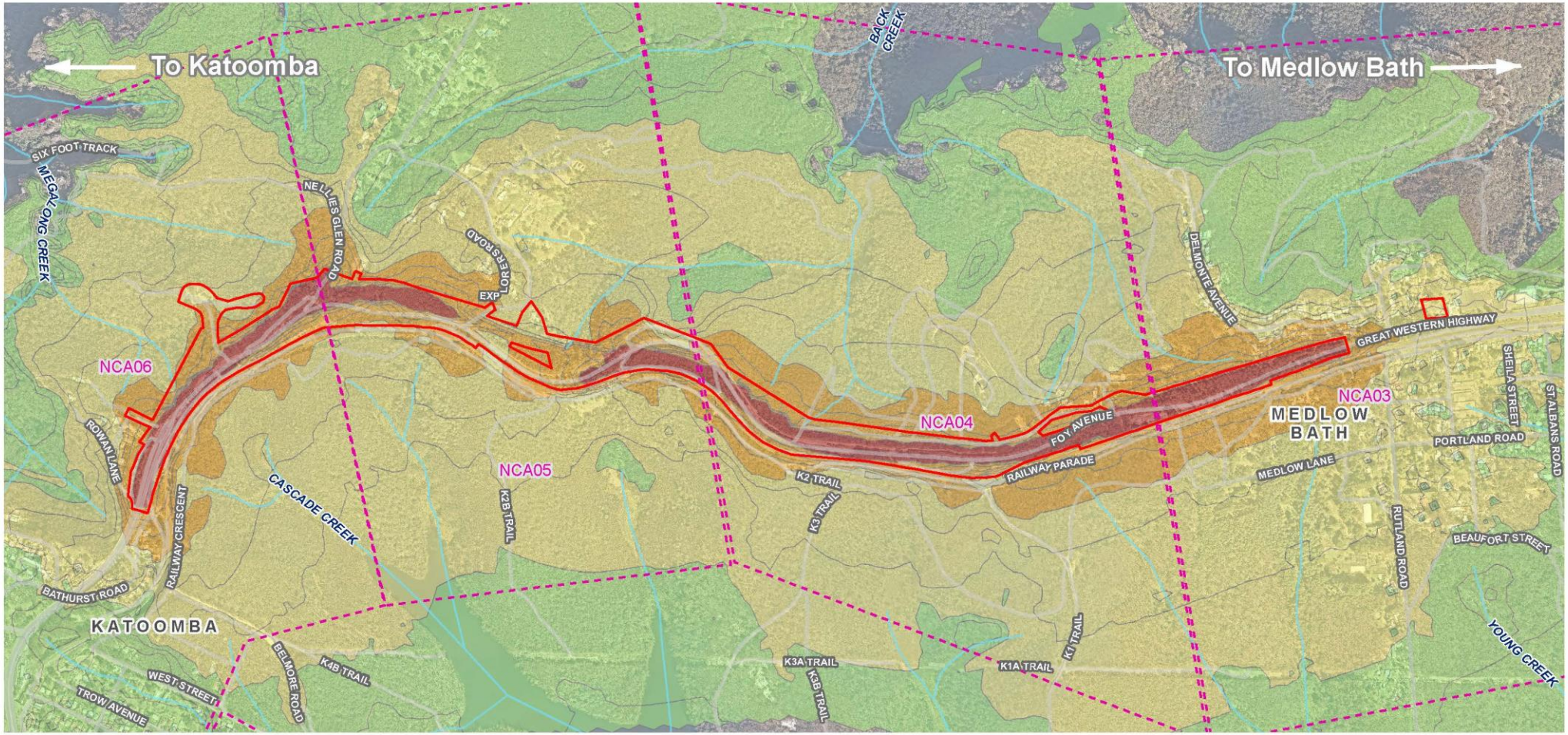
Up to six receivers are predicted to be highly noise affected at the western end of Medlow Bath due to site establishment, bulk earthworks, and road paving stages of work in the Medlow Bath to Blackheath section. Up to three receivers are predicted to be highly noise affected at the eastern end of Medlow Bath during the bulk earthworks phase in the Katoomba to Medlow Bath section.

Table 6-35: Summary of construction noise exceedances for all scenarios – Day standard hours, Katoomba to Medlow Bath section

NCA	dB(A) above NML ($L_{Aeq,15min}$)	Number of exceedances per scenario								
		SP	SE	BE	DI	PA	FW	BWF	BWD	AFO
01	-	Due to their location, receivers in NCA01 would not be subject to exceedances during construction of the Katoomba to Medlow Bath section								
02	-	Due to their location, receivers in NCA02 would not be subject to exceedances during construction of the Katoomba to Medlow Bath section								
03	0 to 10	30	76	76	16	41	9			
	>10	4	14	19		8				
	>75dBA		2	3						
04	0 to 10	2			7	3	4			
	>10	1	7	7		4				
	>75dBA	4								
05	0 to 10	5	13	15	2	9	6		11	1
	>10		2	2			1		3	
	>75dBA									
06	0 to 10	8	15	19	8	10	4			
	>10	2	8	8		4				
	>75dBA									
07	0 to 10		8	16						10
	>75dBA									

Table 6-36: Summary of construction noise exceedances for all scenarios – Day standard hours, Medlow Bath to Blackheath section

NCA	dB(A) above NML ($L_{Aeq,15min}$)	Number of exceedances per scenario					
		SP	SE	BE	DA	PA	FW
01	0 to 10	2	3	2		3	
	>10			1			
	>75dBA						
02	0 to 10	10	34	34	9	17	3
	>10	7	9	9	6	3	6
	>75dBA	1	6	6		6	
03	0 to 10	7	12	12	3	10	1
	>10		3	4			
	>75dBA						
04	-	Due to their location, receivers in NCA04 would not be subject to exceedances during construction of the Medlow Bath to Blackheath section					
05	-	Due to their location, receivers in NCA05 would not be subject to exceedances during construction of the Medlow Bath to Blackheath section					
06	-	Due to their location, receivers in NCA06 would not be subject to exceedances during construction of the Medlow Bath to Blackheath section					
07	-	Due to their location, receivers in NCA07 would not be subject to exceedances during construction of the Medlow Bath to Blackheath section					

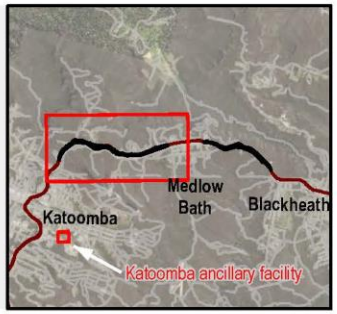


Proposal area

Noise catchment areas (NCA)

Predicted noise levels (dB)

- 40 - 50
- 50 - 65
- 65 - 85
- >85



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Source: Aurecon, Mott MacDonald, LPI, Nearmap, Renzo Tonin

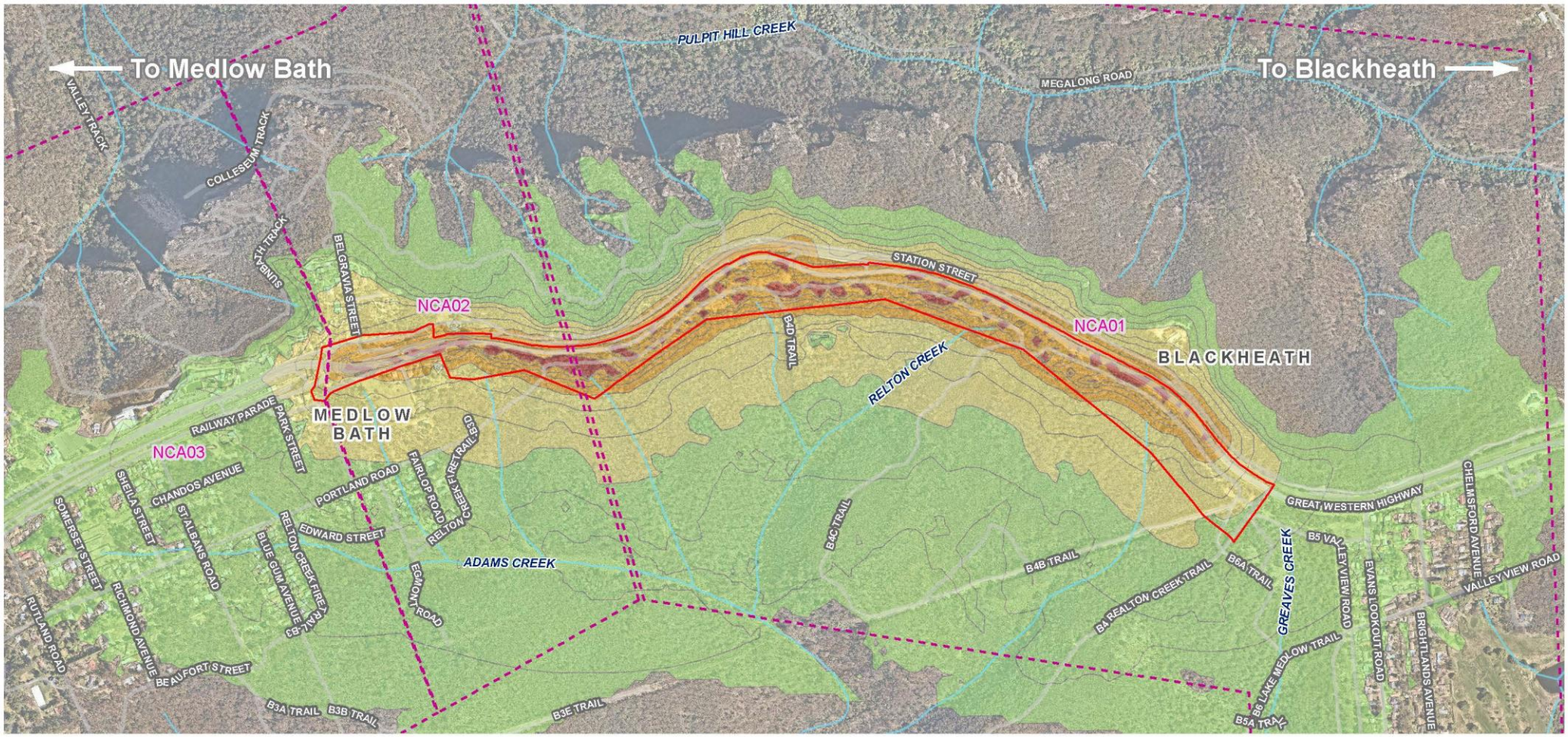
1:15,000@A4

0 150 300m

Projection: GDA2020 MGA Zone 56

Great Western Highway East **Review of Environmental Factors**

FIGURE 6-7a: Indicative worst-case noise impacts - bulk earthworks construction scenario

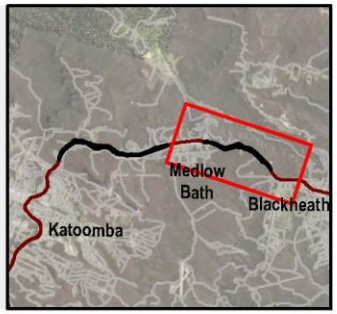


Proposal area

Noise catchment areas (NCA)

Predicted noise levels (dB)

- 40 - 50
- 50 - 65
- 65 - 85
- >85



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Source: Aurecon, Mott MacDonald, LPI, Nearmap, Renzo Tonin

1:14,000@A4

0 150 300m

Projection: GDA2020 MGA Zone 56

Great Western Highway East **Review of Environmental Factors**

FIGURE 6-7b: Indicative worst-case noise impacts - bulk earthworks construction scenario

Out of hours

During out of hours construction periods, there would be exceedances of the Shoulder 1, Evening, Night and Shoulder 2 NMLs (refer to Table 6-32) when construction work is occurring near receivers in all scenarios. Given the existing low background noise levels throughout the study area, exceedances are predicted for residential receivers in all NCAs. A summary of the number of exceedances per construction scenario during out of hours work periods is presented in Table 6-37 and Table 6-38.

Due to there being stricter NML criteria for these construction periods, greater noise impacts are expected than during standard construction hours. The highest noise impacts are expected for the Night construction period which has the strictest NML criteria for each NCA of any out of hours construction period (refer to Section 6.6.3).

Where work is occurring between the towns of Katoomba, Medlow Bath and Blackheath with no residences nearby, there may be an opportunity to work outside standard construction hours and comply with the relevant NMLs. However, justification would be required for any out of hours work. This may include areas where the proposal ties into the existing Great Western Highway.

Use of the batch plant within the Woodlands Road ancillary facility during out of hours is predicted to cause exceedances of the out of hours work NMLs at nearby residences and sensitive receivers. Batching of concrete would be limited to standard hours where feasible.

Table 6-37: Summary of construction noise exceedances – Katoomba to Medlow Bath section

NCA	Scenario	Number of exceedances per scenario (L_{Amax})								
		SP	SE	BE	DI	PA	FW	BWF	BWD	AFO
01	Sleep disturbance	0	1	1	0	0	0	0	0	Refer to Table 6-38
02	Shoulder 1	0	2	7	0	0	0	0		
	Evening	7	49	49	0	45	0	0	0	
	Night	33	49	49	0	49	0	0	0	
	Shoulder 2	0	49	49	0	2	0	0	0	
	Sleep disturbance	49	49	49	49	49	49	0	0	
03	Day OOHW	81	170	193	40	98	25	0	0	1
	Shoulder 1	193	276	284	112	218	81	0	0	6
	Evening	284	290	290	231	289	193	0	7	30
	Night	289	290	290	276	290	231	0	25	44
	Shoulder 2	264	290	290	210	284	141	0	0	18
	Sleep disturbance	290	290	290	290	290	290	28	49	290
04	Day OOHW	7	7	7	7	7	7	0	0	0
	Shoulder 1	7	7	7	7	7	7	0	0	0
	Evening	7	7	7	7	7	7	0	1	0
	Night	7	7	7	7	7	7	0	5	0
	Shoulder 2	7	7	7	7	7	7	0	1	0
	Sleep disturbance	7	7	7	7	7	7	7	7	7
05	Day OOHW	15	33	35	7	17	4	1	21	1
	Shoulder 1	33	44	44	17	39	14	29	35	4
	Evening	44	44	44	39	44	26	41	42	13

NCA	Scenario	Number of exceedances per scenario (L_{Amax})								
		SP	SE	BE	DI	PA	FW	BWF	BWD	AFO
	Night	44	44	44	43	44	35	41	42	16
	Shoulder 2	44	44	44	39	44	26	41	42	13
	Sleep disturbance	44	44	44	44	44	44	43	44	44
06	Day OOHW	22	43	47	12	27	8	16	0	0
	Shoulder 1	47	127	179	33	57	22	0	0	0
	Evening	57	208	245	38	73	27	0	14	0
	Night	271	349	352	127	312	61	3	142	8
	Shoulder 2	127	312	324	57	208	43	0	30	6
	Sleep disturbance	349	359	360	324	349	324	220	306	361
07	Day OOHW	2	101	141	0	16	0	0	0	57
	Shoulder 1	8	141	169	0	27	0	0	0	89
	Evening	101	544	650	16	169	0	0	28	352
	Night	101	544	650	16	169	0	0	28	352
	Shoulder 2	27	215	321	0	66	0	0	0	175
	Sleep disturbance	544	910	1038	215	544	215	0	216	1044

Table 6-38: Summary of construction noise results – Medlow Bath to Blackheath section

NCA	Scenario	Number of exceedances per scenario (L_{Amax})						
		SP	SE	BE	DI	PA	FW	AFO
01	Day OOHW	3	3	3	3	3	1	0
	Shoulder 1	13	118	136	3	37	3	0
	Evening	118	220	221	37	155	5	0
	Night	176	223	223	100	209	37	40
	Shoulder 2	136	221	222	53	176	13	22
	Sleep disturbance	223	223	223	220	223	220	223
02	Day OOHW	46	49	49	22	49	16	0
	Shoulder 1	49	49	49	49	49	46	0
	Evening	49	49	49	49	49	49	0
	Night	49	49	49	49	49	49	0
	Shoulder 2	49	49	49	49	49	49	0
	Sleep disturbance	49	49	49	49	49	49	49
03	Day OOHW	12	43	59	9	16	5	Refer to Table 6-33
	Shoulder 1	59	174	189	18	91	12	
	Evening	189	286	290	110	217	59	
	Night	228	290	290	174	270	110	
	Shoulder 2	153	244	270	76	189	23	
	Sleep disturbance	290	290	290	286	290	286	
04	Evening	0	0	2	0	0	0	
	Night	0	7	7	0	0	0	
	Shoulder 2	0	2	5	0	0	0	
	Sleep disturbance	7	7	7	0	7	0	

NCA	Scenario	Number of exceedances per scenario (L_{Amax})						
		SP	SE	BE	DI	PA	FW	AFO
05	Sleep disturbance	0	0	2	0	0	0	
06	-	No exceedances						
07	-	No exceedances						

Construction traffic

Construction of the proposal would generate additional road traffic noise from construction vehicles. The vehicle movements expected during construction would be as follows:

- Katoomba to Medlow Bath section – an average of 275 vehicle movements per day and 550 during peak construction periods
- Medlow Bath to Blackheath section – an average of 255 vehicle movements per day and 450 during peak construction periods.

When compared with existing traffic volumes, the predicted increase in road traffic noise as a result of construction traffic would be less than 1dB(A) on the Great Western Highway. This would not be audible and noise impacts from construction traffic on the Great Western Highway are considered negligible.

For the use of the Woodlands Road ancillary facility, as it is unknown the number of heavy vehicles that would be accessing the site, a conservative approach was taken to assess the construction noise impacts. The most sensitive receiver near the facility is the Blue Mountains District ANZAC Memorial Hospital on Woodland Road. The RNP noise criteria for hospital wards of $35dB_{Aeq\ 1\ hour}$ (internal noise level) was used to determine the number of heavy vehicles that could pass the hospital without triggering the noise level. This equates to four heavy vehicles per hour. During detailed design, further investigation would be carried out to confirm the use of the Woodland Road ancillary facility as well as traffic movements. This would then be considered in further noise assessment to appropriately assess the construction noise impacts.

Construction vibration

The worst-case item of vibration intensive equipment during construction would be high vibration 11-tonne padfoot rollers. While other items of vibration generating equipment would be required at times during construction, they are expected to be less vibration intensive.

Vibration offset distances have been determined from the CNVG minimum working distances for cosmetic damage (20 metres for padfoot rollers) and human annoyance (120 metres for padfoot rollers). Two heritage structures (Culvert XA6 and Culvert XA7a) have been identified as being within the minimum working distances for cosmetic damage of 20 metres using padfoot rollers. These items are about 10 metres away from proposed work and would experience indirect vibration impacts due to the proposal. No other heritage structures identified in the proposal area are within the cosmetic damage minimum working distance.

A number of residential receivers have been identified within the minimum working distances for human annoyance in NCA01 – NCA06 (refer to Table 6-39). Occupants of affected buildings may be able to perceive vibration impacts at times when vibration intensive equipment is in use.

Table 6-39: Number of affected receivers within the minimum working distance for human annoyance

NCA	Number of affected receivers (day-time)	Number of affected receivers (night-time)
01	0	1
02	8	8
03	18	28
04	4	7
05	0	1
06	6	7
07	0	0

Operation

Table 6-40 assesses the expected operational noise impacts of the proposal in each NCA without consideration of any mitigation measures. These impacts are for the 2026 and 2036 operational scenarios during the daytime and night-time.

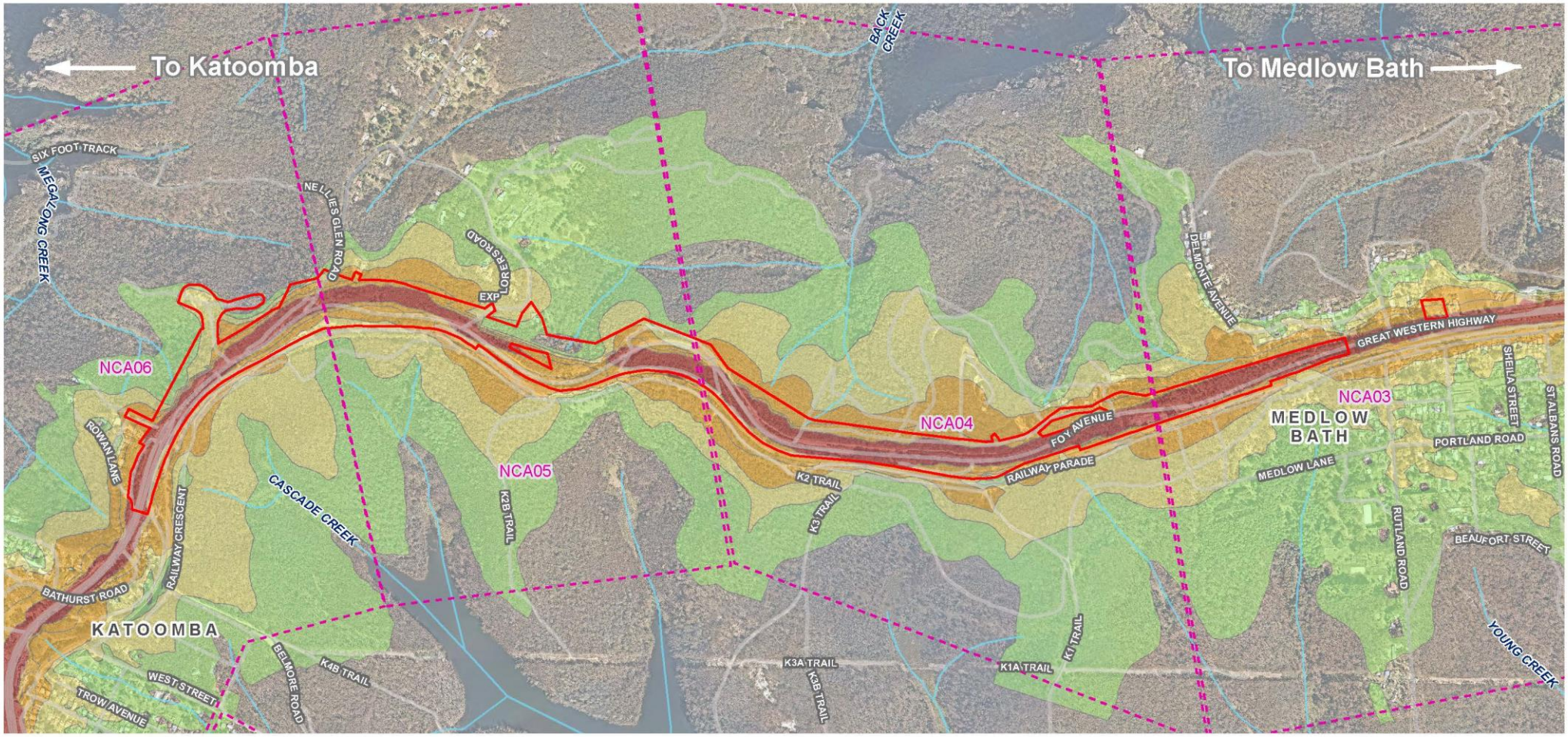
The greatest predicted noise levels are adjacent to the new road corridor. Changes in noise impacts due to the proposal would be highest where the proposal is located away from the current alignment and where topographic and other environmental features impact road noise levels. Operational noise impacts are displayed for:

- the day-time scenario during operation of the proposal in 2036 in Figure 6-8a-b
- the day-time scenario without the proposal in 2036 in Figure 6-9a-b
- the night-time scenario during operation of the proposal in 2036 in Figure 6-10a-b
- the night-time scenario without the proposal in 2036 in Figure 6-11a-b.

Table 6-40: Operational noise impacts (without mitigation)

NCA	Proposal description	Potential impacts due to the proposal
01	The proposal would widen the Great Western Highway to the east by up to 100 m in parts of this NCA. However, the highway would remain mostly on the existing road corridor near the residences on the western end of Station Street, near Blackheath.	• Receivers in Blackheath are not expected to experience a noticeable increase of more than 2dB(A) due to the proposal. • The 3 residences on Station Street within the proposal area would experience a decrease of up to 1dB(A) due to the proposal shifting the highway away. These decreases would be realised in the day and night scenarios in 2026 and 2036.
02	The proposal would widen the Great Western Highway to the east by up to 30 m in this NCA and by up to 5 m towards residences on Coachhouse Lane.	• Receivers are not expected to experience a noticeable increase (more than 2dB(A)) in traffic noise in any operational scenario. • However, residential receivers in this NCA along Coachhouse Lane and Station Street are exposed to existing traffic noise and future traffic noise which would exceed the NCG criteria by 5dB(A). This includes two heritage structures (The Pines and Gatekeeper's Cottage).
03	The proposal would widen the Great Western Highway to the west by between about 15 and 25 m in this NCA.	• There would be a decrease in traffic noise by about 2 to 3dB(A) for receivers on Railway Parade in all operational scenarios. • An increase in traffic noise of up to 3dB(A) for receivers along Delmonte Avenue and an exceedance of the NCG criteria by more than 5dB(A) is expected. Four receivers on Delmonte Avenue would experience an increase more than 2dB(A) in all scenarios.

NCA	Proposal description	Potential impacts due to the proposal
04	The proposal would realign the road corridor to be about 5 to 10 m away from residences on the western end of Foy Avenue, however, would mostly remain on the existing road corridor. Further east, the road corridor would be widened to be about 10 to 15 m closer to the residences at the eastern end of Foy Avenue.	• Traffic noise levels are expected to increase for receivers in this NCA along Foy Avenue. At three residences along Foy Avenue are predicted to exceed the NCG criteria by more than 5dB(A). One residence is predicted to experience an increase in traffic noise of up to 2.1dB(A) in the 2026 night-time scenario.
05	The construction of the twin bridges would result in the road corridor being about 100 m closer to the most impacted receivers on Explorers Road than the existing scenario.	• For three residences within about 200 m of the proposed alignment, noise levels are predicted to be above the NCG criteria and are predicted to increase as a result of the road corridor being moved closer. • While the road corridor is being realigned closer to residences, residences on Explorers Road are predicted to experience a decrease in noise levels during all operational scenarios as the bridge deck shields the traffic. For example: – four residences on Explorers Road, Pulpit Hill Road and Saywell Road, noise levels are predicted to decrease, typically by up to 1dB(A) – at 11 Explorers Road, noise levels are predicted to decrease by up to 6dB(A) due to the twin bridges bridge being elevated higher than the existing road corridor, resulting in residences having a more obstructed view of the road.
06	There would be minimal realignment of the road corridor on the eastern end of this NCA near the tie-in with the existing Great Western Highway at Katoomba. Further west, the road corridor would be realigned by about 30 m to the south-west.	• Receivers are not expected to experience a noticeable increase (more than 2dB(A)) in traffic noise in any operational scenario. • However, six residential receivers in this NCA near Rowan Lane are exposed to existing traffic noise and future traffic noise which would exceed the NCG criteria by 5dB(A).
07	N/A – NCA07 is outside of the operational study area being far enough away from the proposal to not be affected.	

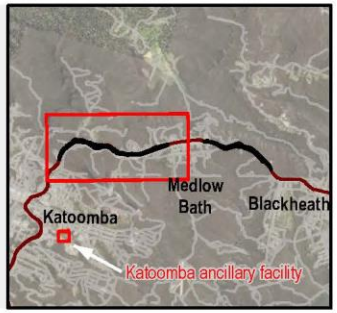


Proposal area

Noise catchment areas (NCA)

Predicted noise levels (dB)

- 50 - 55
- 55 - 60
- 60 - 70
- >70



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Source: Aurecon, Mott MacDonald, LPI, Nearmap, Renzo Tonin

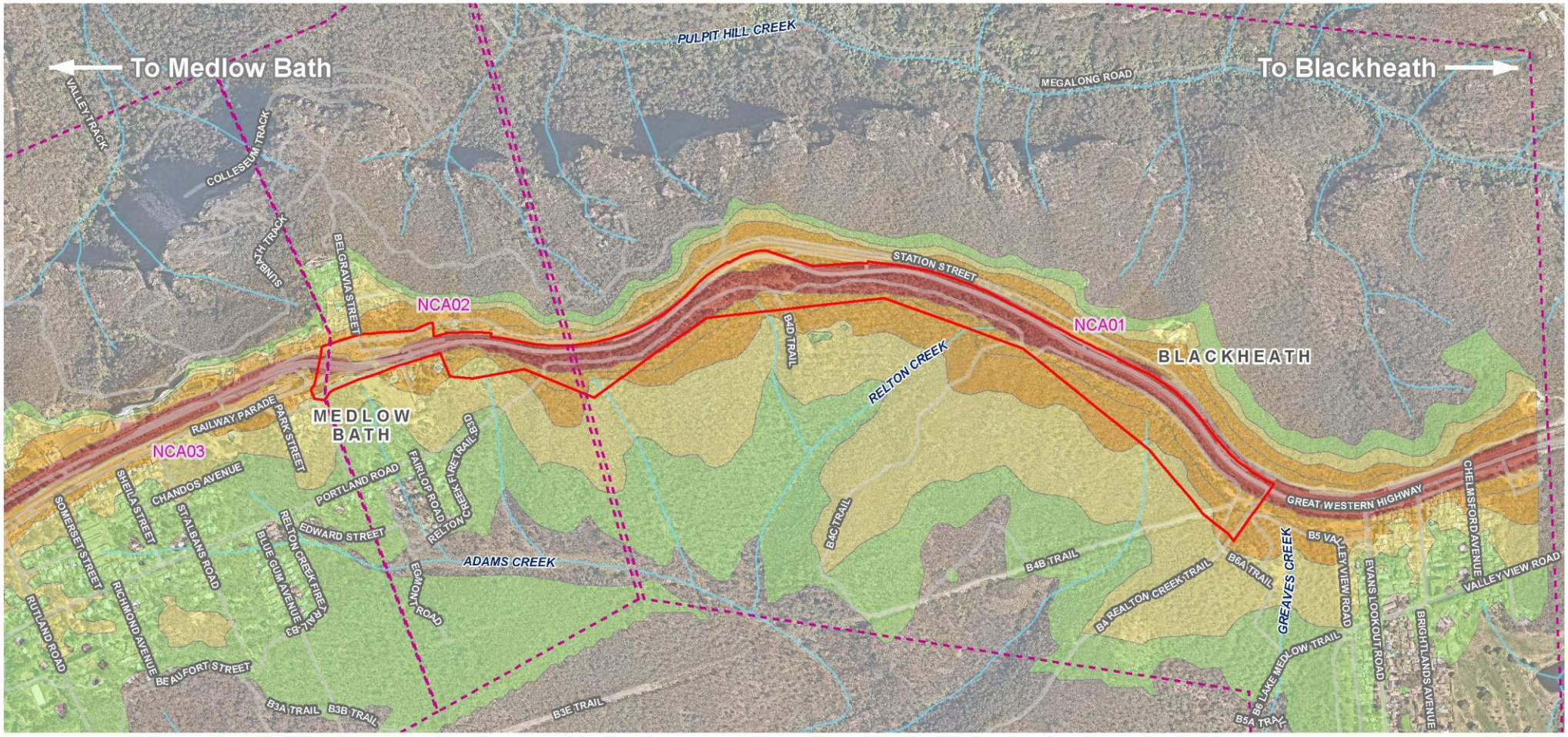
1:15,000@A4

0 150 300m

Projection: GDA2020 MGA Zone 56

Great Western Highway East **Review of Environmental Factors**

FIGURE 6-8a: Predicted noise levels during operation of the proposal (day-time scenario, 2036)

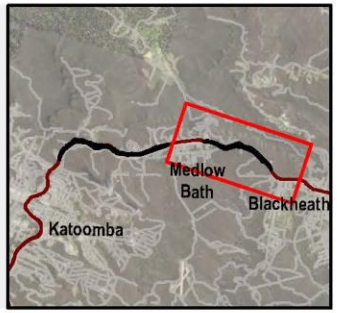


Proposal area

Noise catchment areas (NCA)

Predicted noise levels (dB)

- 50 - 55
- 55 - 60
- 60 - 70
- >70



Source: Aurecon, Mott MacDonald, LPI, Nearmap, Renzo Tonin

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0 150 300m

Projection: GDA2020 MGA Zone 56

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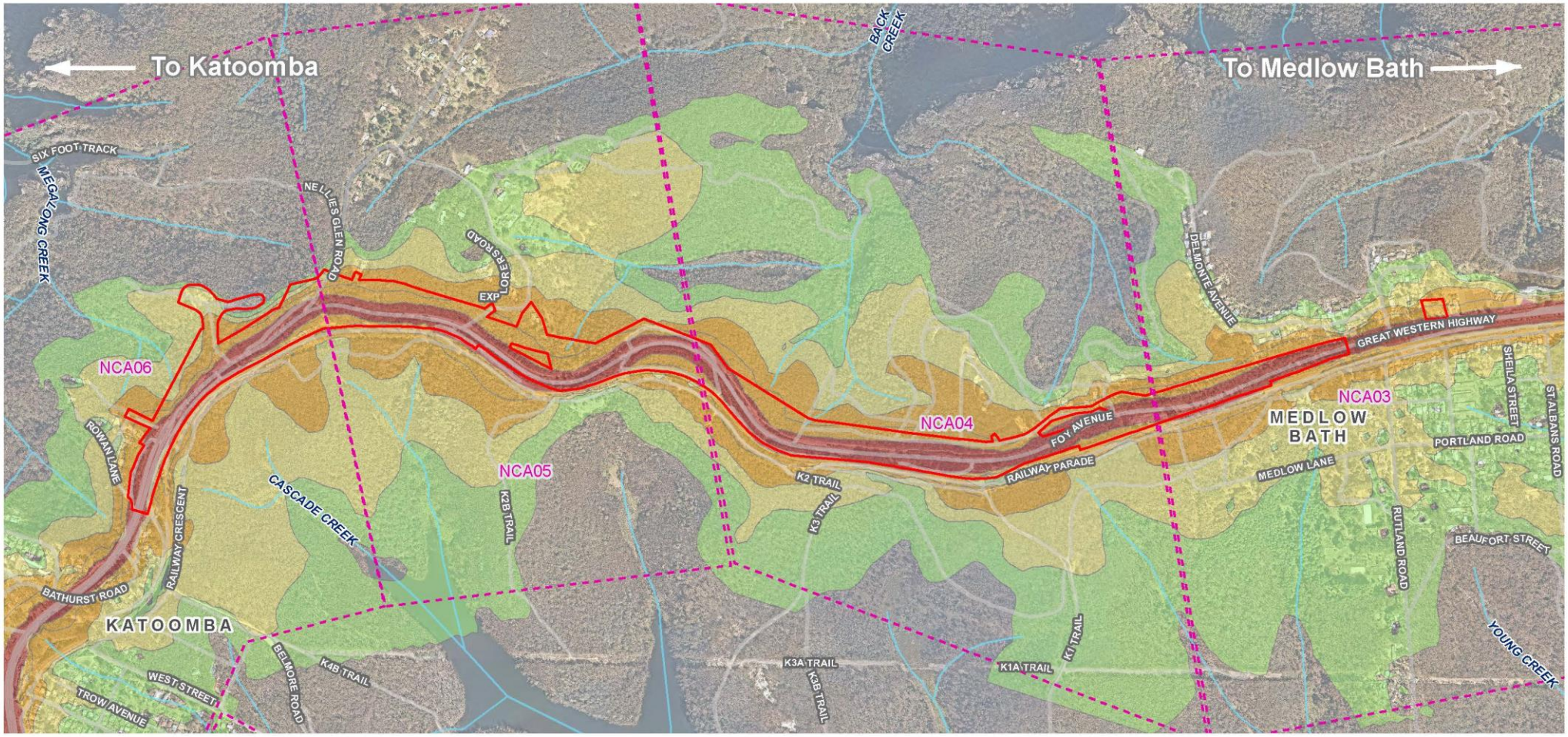
Great Western Highway East **Review of Environmental Factors**

FIGURE 6-8b: Predicted noise levels during operation of the proposal (day-time scenario, 2036)

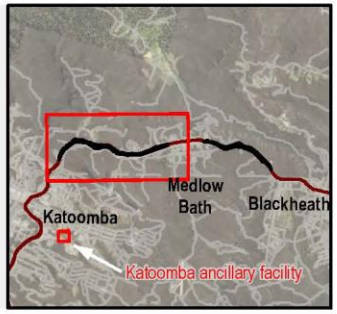


Proposal area

Noise catchment areas (NCA)

Predicted noise levels (dB)

- 50 - 55
- 55 - 60
- 60 - 70
- >70



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Source: Aurecon, Mott MacDonald, LPI, Nearmap, Renzo Tonin

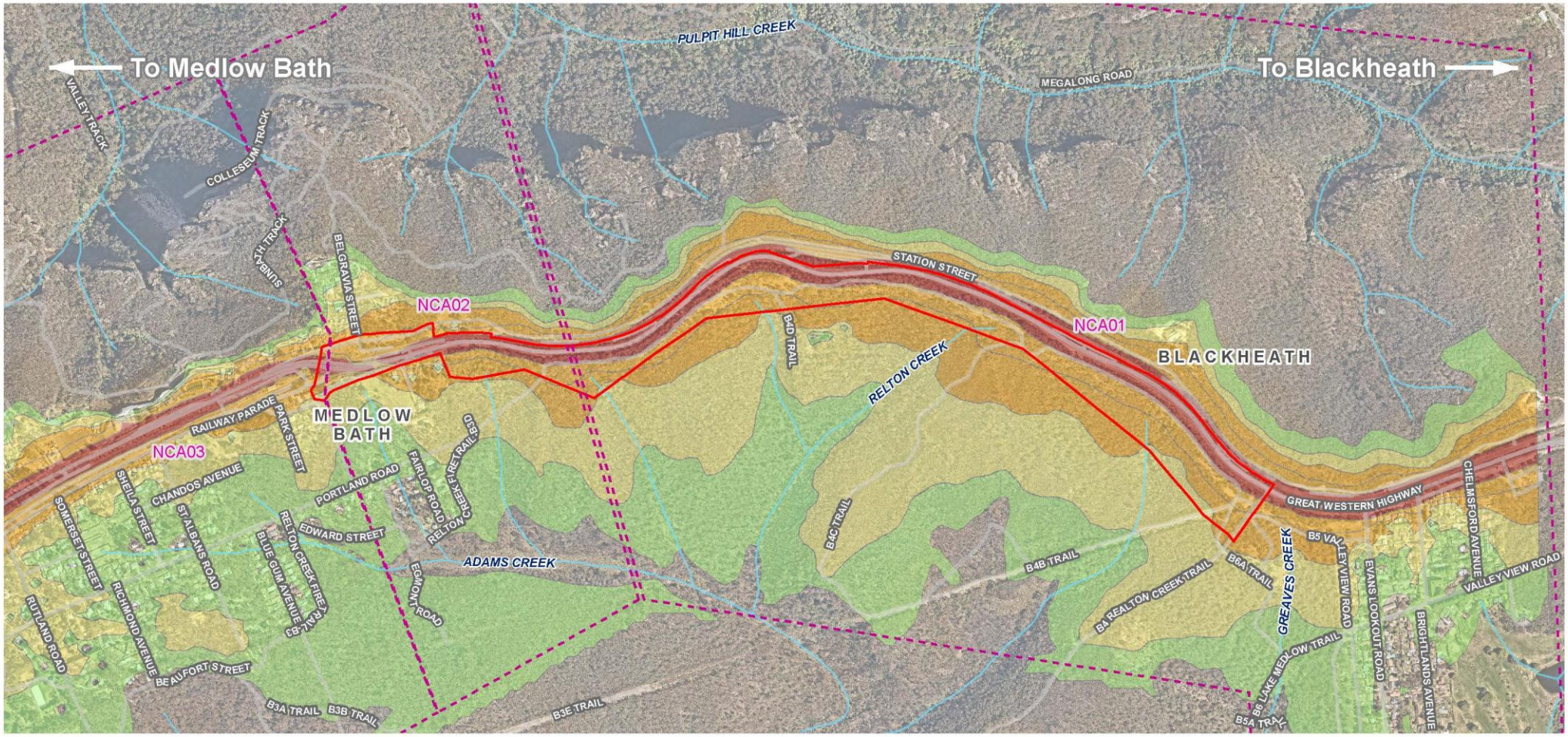
1:15,000@A4

0 150 300m

Projection: GDA2020 MGA Zone 56

Great Western Highway East **Review of Environmental Factors**

FIGURE 6-9a: Predicted noise levels without the proposal (day-time scenario, 2036)

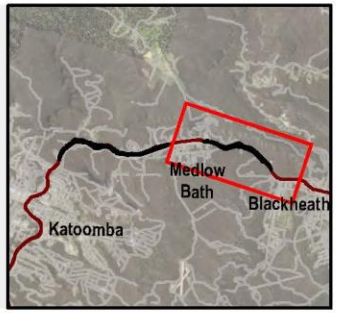


Proposal area

Noise catchment areas (NCA)

Predicted noise levels (dB)

- 50 - 55
- 55 - 60
- 60 - 70
- >70



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Source: Aurecon, Mott MacDonald, LPI, Nearmap, Renzo Tonin

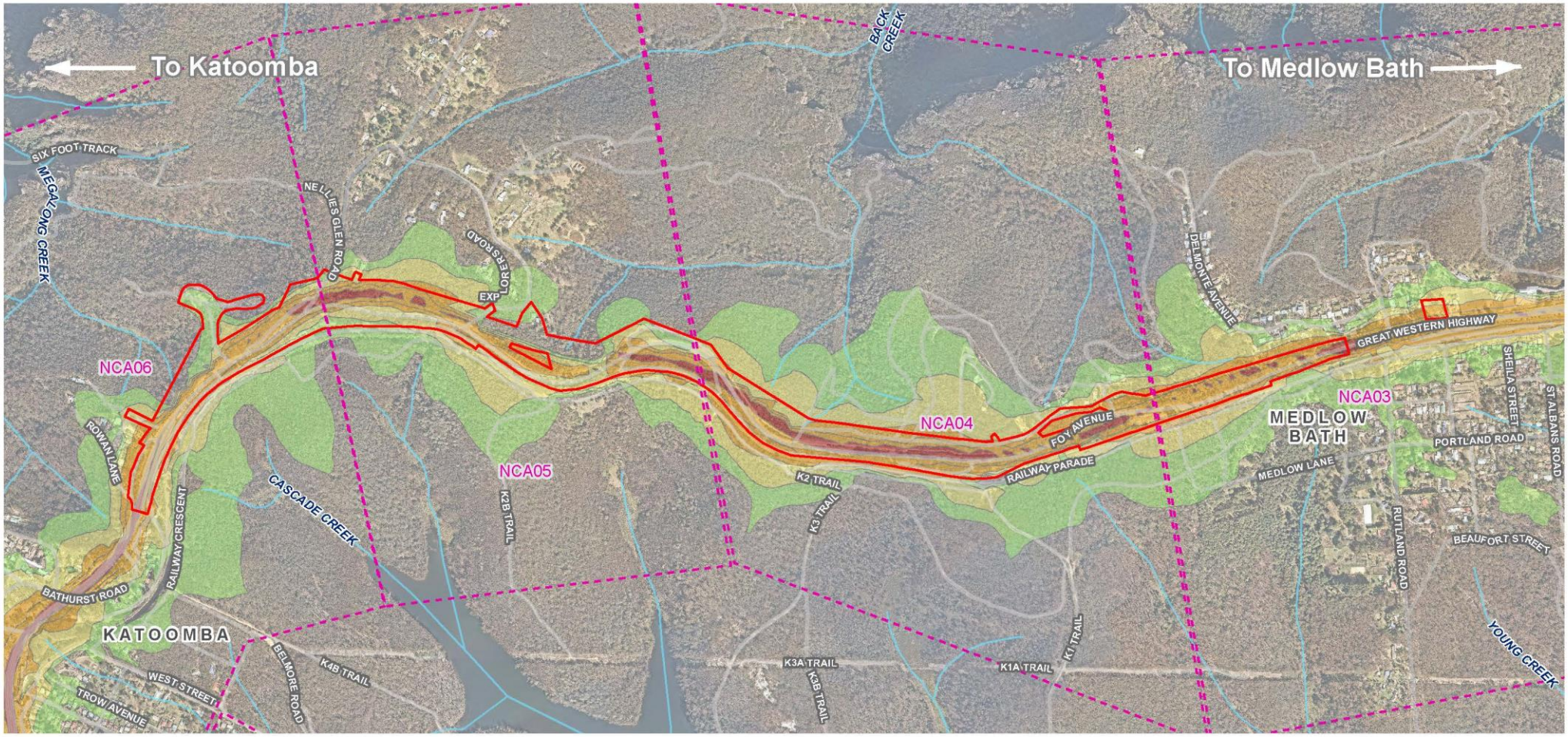
1:14,000@A4

0 150 300m

Projection: GDA2020 MGA Zone 56

Great Western Highway East **Review of Environmental Factors**

FIGURE 6-9b: Predicted noise levels without the proposal (day-time scenario, 2036)

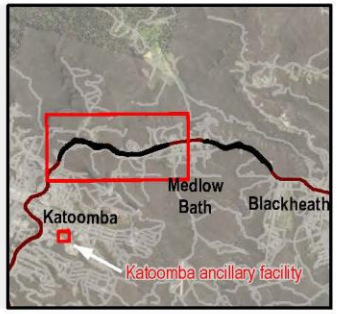


Proposal area

Noise catchment areas (NCA)

Predicted noise levels (dB)

- 50 - 55
- 55 - 60
- 60 - 70
- >70



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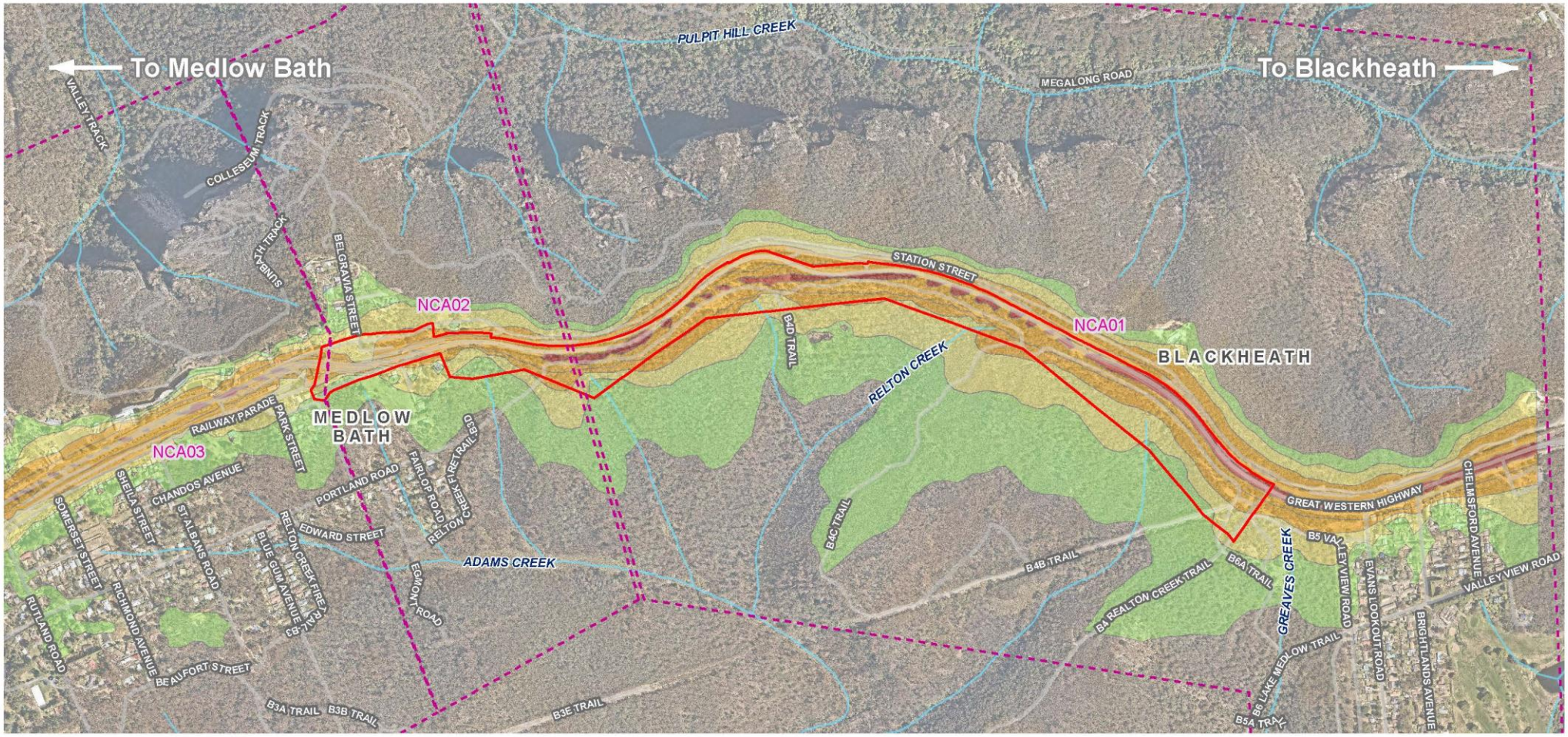
Source: Aurecon, Mott MacDonald, LPI, Nearmap, Renzo Tonin

1:15,000@A4

0 150 300m

Projection: GDA2020 MGA Zone 56

FIGURE 6-10a: Predicted noise levels during operation of the proposal (night-time scenario, 2036)

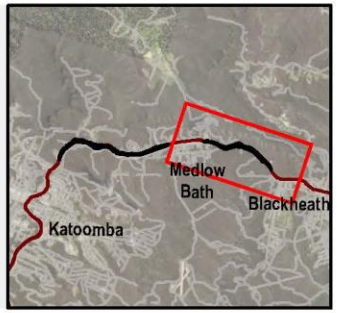


Proposal area

Noise catchment areas (NCA)

Predicted noise levels (dB)

- 50 - 55
- 55 - 60
- 60 - 70
- >70



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Source: Aurecon, Mott MacDonald, LPI, Nearmap, Renzo Tonin

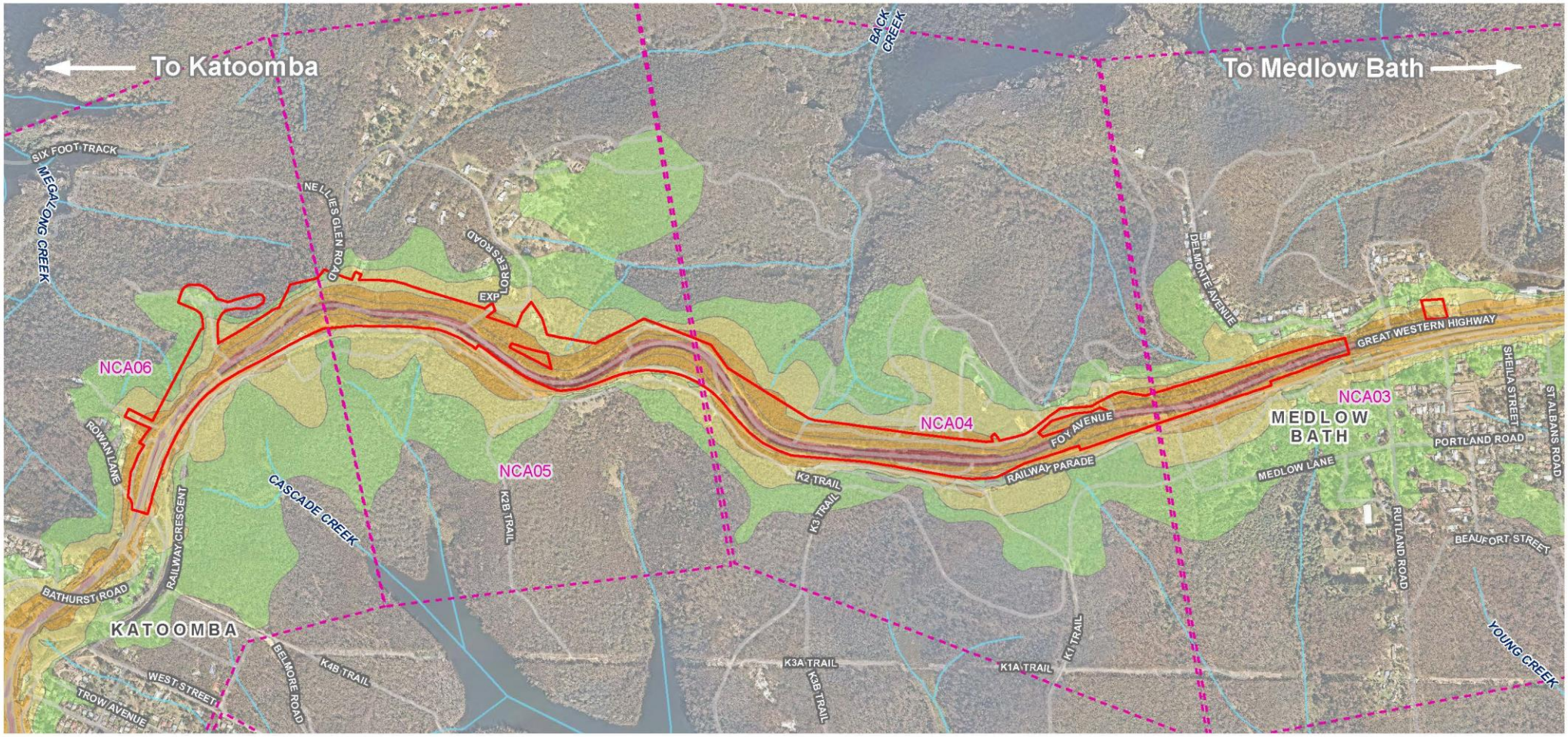
1:14,000@A4

0 150 300m

Projection: GDA2020 MGA Zone 56

Great Western Highway East **Review of Environmental Factors**

FIGURE 6-10b: Predicted noise levels during operation of the proposal (night-time scenario, 2036)

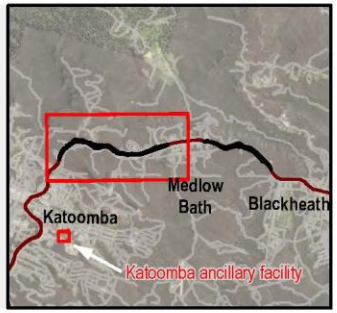


Proposal area

Noise catchment areas (NCA)

Predicted noise levels (dB)

- 50 - 55
- 55 - 60
- 60 - 70
- >70



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Source: Aurecon, Mott MacDonald, LPI, Nearmap, Renzo Tonin

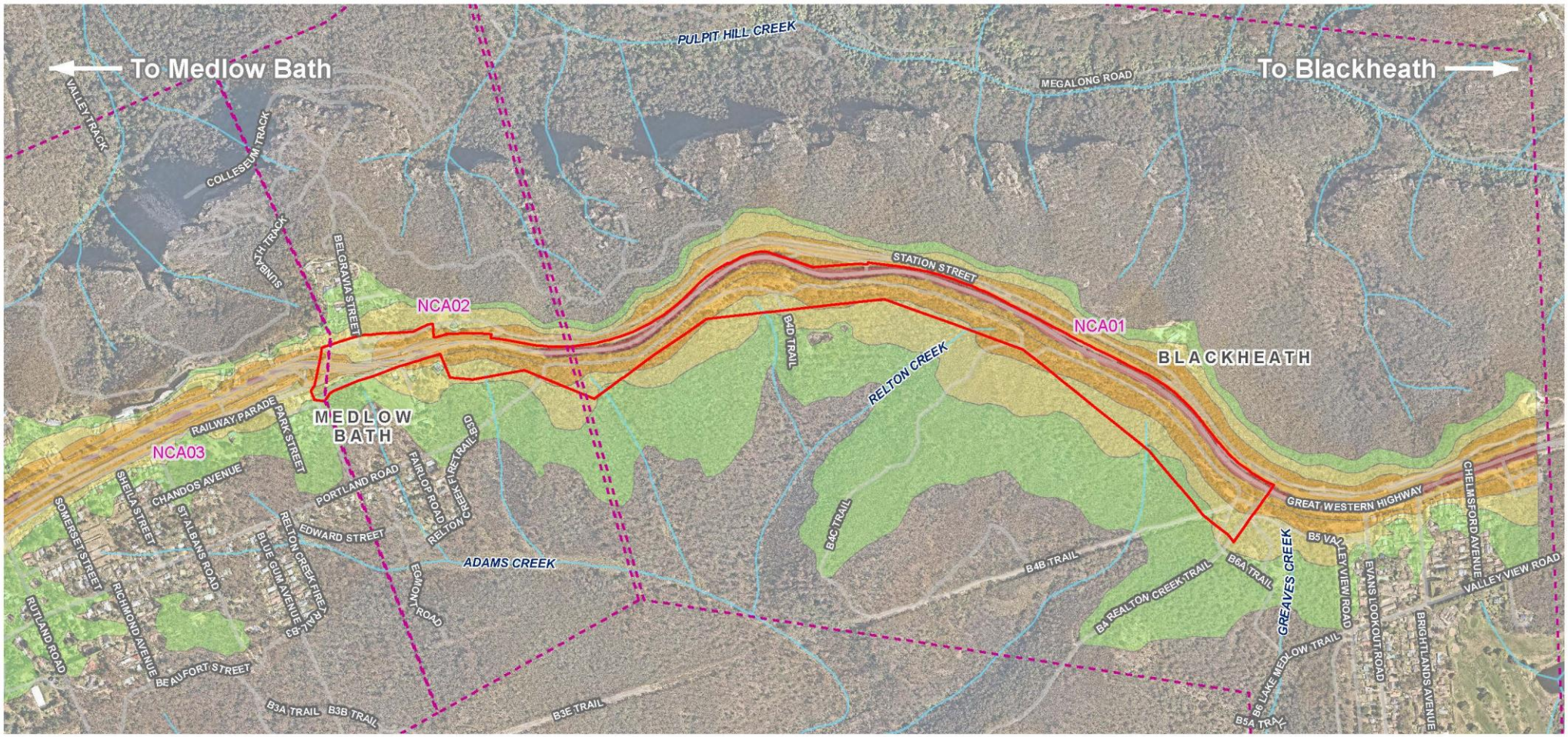
1:15,000@A4

0 150 300m

Projection: GDA2020 MGA Zone 56

Great Western Highway East **Review of Environmental Factors**

FIGURE 6-11a: Predicted noise levels without the proposal (night-time scenario, 2036)

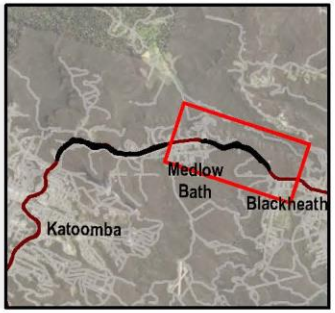


Proposal area

Noise catchment areas (NCA)

Predicted noise levels (dB)

- 50 - 55
- 55 - 60
- 60 - 70
- >70



Source: Aurecon, Mott MacDonald, LPI, Nearmap, Renzo Tonin

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1:14,000@A4

0 150 300m

Projection: GDA2020 MGA Zone 56

Great Western Highway East **Review of Environmental Factors**

FIGURE 6-11b: Predicted noise levels without the proposal (night-time scenario, 2036)

Predicted maximum noise levels

As the proposal would widen and realign the Great Western Highway, there is potential for changes to maximum noise level events in the operational noise study area due to the widening of the road corridor towards sensitive receivers. These predicted changes are presented in Table 6-41. Predicted increase is dependent on the façade of most affected dwelling in each NCA.

Table 6-41: Predicted change in maximum noise level

NCA	Predicted change
01	No change to the predicted maximum noise level as there would be no realignment of road corridor in this NCA.
02	1dB(A) increase in the maximum noise level in this NCA. This would be due to the widening of road corridor about 5 m closer to the nearest receivers on Coachhouse Lane.
03	3dB(A) increase in the maximum noise level in this NCA. Widening of road corridor about 15 to 25 m to the west of the existing Great Western Highway.
04	2dB(A) increase in the maximum noise level in this NCA. Widening of the road corridor about 5 to 10 m closer on the western end and 10 to 15 m closer on the eastern end of the NCA.
05	7dB(A) increase in the maximum noise level in this NCA. Realignment of road corridor along the twin bridges about 100 m closer to receivers. The highway would be elevated above residences, with direct line of sight to heavy vehicle exhausts on the westbound bridge.
06	1dB(A) increase in the maximum noise level in this NCA. Minimal widening of the road corridor would impact some receivers between Watson Way and Rowan Lane.
07	No change as NCA07 is outside of the operational study area

Receivers eligible for consideration of ‘additional noise mitigation’

A total of 31 sensitive residential receiver buildings are predicted to have exceedances of the NCG operational road traffic noise criteria. As such, these receivers are eligible for consideration of ‘additional noise mitigation’. This includes the two receivers identified in the Medlow Bath Upgrade.

Two of these residences in NCA03 have previously been identified for at-property treatment in the noise and vibration assessment prepared for the Medlow Bath Upgrade. Noise mitigation for these properties should consider the results of this assessment in determining the correct mitigation to be established.

6.6.5 Safeguards and management measures

Construction noise mitigation options

Construction noise would be managed in accordance with the CNVG, which provides several standard mitigation measures. The CNVG also notes the need to consider additional mitigation measures, where feasible and reasonable, where construction noise is predicted to exceed the NMLs. The CNVG triggers and related recommended types of mitigation measures are presented in Table 37 in Section 11.5.3 of the noise and vibration assessment, included in Appendix H to the REF.

Further detail regarding the implementation of specific safeguards and management measures at sensitive receivers would be confirmed during detailed design and outlined in the Construction Noise and Vibration Management Plan.

Operational noise mitigation options

The noise assessment considered the range of noise mitigation options for those receivers that exceed the NCG noise criteria. Of the possible options, low noise pavement and at-house treatments were considered reasonable and feasible options for the proposal. Noise barriers or mounds were not considered as it was not in character for the Great Western Highway.

Safeguards and management measures for landscape and visual impacts are presented in Table 6-42.

Table 6-42: Safeguard and management measures – noise and vibration

Impact	Environmental safeguards	Responsibility	Timing	Reference
Noise and vibration	A Construction Noise and Vibration Management Plan (CNVMP) will be prepared and implemented as part of the CEMP. The CNVMP will generally follow the approach in the Interim *Construction Noise Guideline* (ICNG) (DECC, 2009) and identify: • all potential significant noise and vibration generating activities associated with the activity • feasible and reasonable mitigation measures to be implemented, taking into account *Beyond the Pavement: urban design policy, process and principles* (Transport, 2014). • a monitoring program to assess performance against relevant noise and vibration criteria • arrangements for consultation with affected neighbours and sensitive receivers, including notification and complaint handling procedures • contingency measures to be implemented in the event of non-compliance with noise and vibration criteria.	Contractor	Detailed design / pre-construction	Section 4.6 of QA *G36 Environment Protection*

Impact	Environmental safeguards	Responsibility	Timing	Reference
Noise and vibration	All sensitive receivers (e.g. schools, local residents) likely to be affected will be notified at least seven days prior to commencement of any works associated with the activity that may have an adverse noise or vibration impact. The notification will provide details of: • the project • the construction period and construction hours • contact information for project management staff • complaint and incident reporting • how to obtain further information.	Contractor	Detailed design / pre-construction	Additional safeguard
Noise and vibration	Less vibration emitting construction methods will be used where feasible and reasonable, for example vibratory rollers can, where practicable, be operated with the vibratory mode switched off to reduce vibration impact.	Contractor	Construction	Additional safeguard
Out of hours work	Out of hours works will be undertaken in accordance with the Construction Noise and Vibration Guideline (Roads and Maritime 2016). This includes: • Offer respite and/or restricted construction hours where noise intensive works are planned over extended periods, especially where they occur outside of standard hours. This may include moving the construction work front to different areas so that sensitive receivers are not impacted for longer than two consecutive days • No more than two consecutive nights of noise with special audible characteristics and/or vibration generating work may be undertaken in the same NCA over any 7-day period, unless otherwise negotiated with affected receivers.	Contractor	Construction	Additional safeguard
Out of hours work	Noisiest activities will be limited to standard construction hours, where practicable	Contractor	Construction	Additional safeguard
Noise and vibration	A register of most affected noise and vibration sensitive receivers (NVSRs) will be kept on site and maintained. The register will include the following details for each NVSR: • Address of receiver • Category of receiver (e.g. Residential, Commercial etc.) • Contact name and phone number. The register is to be included as part of the Proposal's Community Liaison Plan or similar document and maintained in accordance with the requirements of this plan.	Contactor	Construction	Additional safeguard
Noise and vibration	Source controls will be employed to minimise noise impacts, such as using noise screens and mufflers, maximising offset distance, and orienting plant away from sensitive receivers.	Contractor	Construction	Additional safeguard
Noise and vibration	The selection of plant and machinery will consider noise emissions, operated to reduce maximum noise levels, maintained regularly and turned off when not in use	Contractor	Construction	Additional safeguard

Impact	Environmental safeguards	Responsibility	Timing	Reference
Operational road traffic noise	Further assessment of operational road traffic noise impacts will be carried out to inform consideration of appropriate noise mitigation during detailed design. Where a parcel of land would be impacted by multiple projects within the Great Western Highway Upgrade Program, noise treatment options will be considered for the greater of the predicted noise impacts.	Transport	Detailed design	Additional safeguard
Operational road traffic noise	Implement at-property noise mitigation treatments as early as feasible in the construction program in consultation with the property owner.	Transport / Contractor	Pre-construction / construction	Additional safeguard
Woodlands Road ancillary facility	During detailed design, further investigation will be carried out to confirm the use of the Woodland Road ancillary facility as well as traffic movements.	Transport	Detailed design	Additional safeguard

6.7 Traffic and transport

The potential impacts on traffic and transport during construction and operation of the proposal have been assessed as part of the *Traffic and Transport Assessment Report* (Aurecon, 2022c), provided in Appendix I.

6.7.1 Methodology

The methodology for the traffic and transport assessment included:

- collecting traffic volume data, including mid-block and intersection counts, at six locations along the Great Western Highway in March and April 2021
- reviewing the existing and future conditions of the transport network within and surrounding the proposal, using publicly available information, data collected for the proposal and traffic growth forecasts prepared by Transport
- modelling the traffic performance of the concept design, using SIDRA modelling software for intersection performance analysis, for the following scenarios within the study area:
  - 2021 existing conditions – existing traffic network
  - 2026 with the proposal – proposed transport network with projected 2026 weekday and weekend peak traffic volumes
  - 2031 with the proposal – proposed transport network with projected 2031 weekday and weekend peak traffic volumes
  - 2036 with the proposal – proposed transport network with projected 2036 weekday and weekend peak traffic volumes
  - 2036 without the proposal – existing transport network with projected 2036 weekday and weekend peak traffic volumes
- assessing the impacts of the proposal on traffic and transport performance during construction and operation
- recommending mitigation measures to minimise potential traffic or transport impacts from the proposal.

There have been recent changes to the Nellies Glen Road and Foy Avenue intersections after completion of the traffic modelling. These intersections were modelled as follows:

- Nellies Glen Road – left-in, left-out only
- Foy Avenue – left-in, left-out only.

No modelling changes for the existing scenario were deemed necessary as intersection performance would not be impacted.

6.7.2 Criteria

The key intersection performance indicators extracted from the SIDRA network analysis for assessment of traffic and transport impacts in the Katoomba to Medlow Bath section include level of service (LOS). The LOS criteria adopted for intersection performance analysis within this section are outlined in Table 6-43.

The performance of non-intersection road conditions for the Medlow Bath to Blackheath section was assessed using a mid-block capacity analysis in accordance with the *Austroads Guide to Traffic Management Part 3* guidelines. The basic freeway segments LOS criteria adopted for mid-block analysis within this section are outlined in Table 6-44.

LOS range from LOS A (best possible operating conditions) to LOS F (worst possible operating conditions) and identify the performance of an intersection or freeway segment.

Table 6-43: Transport LOS criteria – intersection performance

LOS	Average vehicle delay (seconds)	Traffic signal and roundabout	Give-way and Stop signs
A	Less than 14	Good operation	Good operation
B	15 to 28	Good with acceptable delays and spare capacity	Acceptable delays and spare capacity
C	29 to 42	Satisfactory	Satisfactory, but accident study required
D	43 to 56	Operating near capacity	Near capacity and accident study required
E	57 to 70	At capacity	At capacity, requires other control mode
F	Greater than 71	At signals, incidents will cause excessive delays	Unsatisfactory with excessive queueing, requires other control mode

Table 6-44: Austroads LOS criteria – basic freeway segments

LOS	Maximum density (passenger car per kilometre per lane)	Basic freeway segments
A	7	Free-flow operations
B	11	Reasonably free-flow operations
C	16	Speeds near the free flow speed (the speed at which motorists would feel comfortable to drive with no congestion on the highway)
D	22	Speeds decreased from the free flow speed
E	28	Operation at or near capacity
F	> 28	Unstable flow

6.7.3 Existing environment

Road conditions

The Great Western Highway is a State highway located within the Blue Mountains LGA and managed by Transport. The existing road conditions for the proposal are outlined in Table 6-45.

Table 6-45: Existing road conditions near the proposal

Road	Description	Access	Posted speed limit	Lanes
Great Western Highway – Katoomba to Medlow Bath section	About 3.5 km east-west between Rowan Lane, Katoomba and Bellevue Crescent, Medlow Bath	Access to: • the local roads of Nellies Glen Road, Explorers Road and Foy Avenue • active transport trails • the rail corridor	70 km/h	Mostly a two-lane single carriageway
Great Western Highway – Medlow Bath to Blackheath section	About 1.8 km east-west between the Great Western Highway and Railway Parade intersection and Tennyson Road, Blackheath (in the Blue Mountains National Park)	Access to the rail corridor	60 km/h for about 800 m north of Railway Parade, Medlow Bath and then 80 km/h for about one km until Tennyson Road, Blackheath	Two-lane single carriageway

Road	Description	Access	Posted speed limit	Lanes
Nellies Glen Road	Local road	Access to Pulpit Hill Road, Explorers Road, Six Foot Track (a walking trail) and surrounding properties	50 km/h	Two-lane single carriageway
Explorers Road	Local road	Access to Saywell Road, Pulpit Hill Road, Nellies Glen Road and surrounding properties	50 km/h	Two-lane single carriageway
Foy Avenue	Local road	Access to residential properties and active transport trails	50 km/h	Two-lane single carriageway

There are no parking provisions along the Great Western Highway within the proposal area. However, there are informal emergency stopping locations along areas of the Great Western Highway where the road shoulder is wider. There is also informal parking for about 20 vehicles available on Nellies Glen Road for people to access the heritage interpretation area and surrounding walking trails.

The nearest rest areas on the Great Western Highway for light and heavy vehicles are Kedumba Park in Wentworth Falls and Sutton Park in Blackheath.

Key intersections

The key intersections with the Great Western Highway that are within the proposal area are detailed in Table 6-46. As noted in Table 6-45, there are no intersections within the Medlow Bath to Blackheath section of the proposal.

Table 6-46: Summary of key intersections within the proposal area

Intersection	Existing layout
Great Western Highway / Nellies Glen Road	• Priority controlled one-way intersection, with left-in westbound travel movement only with Nellies Glen Road. • Great Western Highway westbound has a short left-turn lane into Nellies Glen Road and one through lane. • Great Western Highway eastbound has one through lane.
Great Western Highway / Explorers Road	• Priority controlled three-way intersection with all traffic movements. • Left or right turn permitted out of Explorers Road onto the Great Western Highway. • Great Western Highway westbound has one through lane, with left turn permitted into Explorers Road. • Great Western Highway eastbound has one dedicated right turn lane into Explorers Road. This lane continues as a short waiting bay for vehicles exiting Explorers Road turning eastbound onto the Great Western Highway. There is also one through lane.
Great Western Highway / Foy Avenue	• Priority controlled three-way intersection with all traffic movements. • Left or right turn permitted out of Foy Avenue onto the Great Western Highway. • Great Western Highway westbound has one through lane, with left turn permitted into Foy Avenue. • Great Western Highway eastbound has one through lane, with a dedicated right turn lane into Foy Avenue.

Traffic volumes

The traffic counts carried out in March and April 2021 have been analysed to identify average daily traffic volumes for the proposal (refer to Table 6-47). This data was calibrated with data collected near the proposal in 2019 and 2020. This found that COVID-19 conditions at that time did not materially affect traffic numbers.

Traffic counts revealed that average traffic volumes were higher on weekends compared with weekdays, which emphasises the importance of the Great Western Highway for regional and recreational travel. Westbound traffic volumes were higher for both sections of the proposal on weekdays, with eastbound traffic volumes being the dominant direction on weekends. Table 6-47 also shows the importance of the Great Western Highway as a freight route with a high proportion of heavy vehicles. Heavy vehicles made up about 16 to 23 per cent of 24-hour traffic on a weekday and about six to 14 per cent of 24-hour traffic on a weekend. The Great Western Highway forms part of the freight and heavy vehicles network connecting the Central West and Orana, Blue Mountains, Western Sydney and Greater Sydney regions. It currently accommodates freight and heavy vehicles up to 19 metre B-Doubles (over 50 tonnes).

Table 6-47: Average daily traffic volumes for the proposal

Section		Weekday			Weekend		
		Eastbound	Westbound	Total	Eastbound	Westbound	Total
Katoomba to Medlow Bath section	Average daily traffic volume	10,700	11,980	22,680	12,099	11,293	23,392
	Per cent heavy vehicles	22	25	23	13	15	14
Medlow Bath to Blackheath section	Average daily traffic volume	10,053	10,543	20,596	11,608	10,779	22,387
	Per cent heavy vehicles	16	27	22	6	15	11

Hourly traffic volumes show relatively constant weekday traffic volumes throughout the day. On an average weekday:

- During the AM peak (6 – 9am), heavy vehicle volumes are higher, comprising about 29 per cent of total combined traffic on the Katoomba to Medlow Bath section. On the Medlow Bath to Blackheath section, heavy vehicles comprised about 27 per cent of total combined traffic.
- Combined hourly traffic volumes are highest between 3 – 4pm, with 1771 vehicles through the Katoomba to Medlow Bath section and 1656 on the Medlow Bath to Blackheath Section.

On an average weekend:

- Westbound flows are higher than eastbound flows during the AM peak (6 – 9am) while eastbound flows are higher than westbound flows during the PM peak (4 – 7pm), which could be explained by day trips by the local community and tourists within the Blue Mountains.
- Combined hourly traffic volumes are highest between 11am – 12pm, with 2137 vehicles on the Katoomba to Medlow Bath section and 2091 vehicles on the Medlow Bath to Blackheath section.

Existing road performance

Existing intersection performance were assessed for the three key intersections within the proposal. The worst performing approach for these intersections was consistently the local road leg of the intersection. The weekday performance during the most congested hour in the AM and PM peak periods of the local road leg of the intersections are detailed in Table 6-48. The Great Western Highway / Nellies Glen Road and Great Western Highway / Foy Avenue intersections operate at LOS A. The Great Western Highway / Explorers Road intersection was the worst performing intersection. It operates near capacity at LOS D in

the weekday PM peak (with the most congested hour being 3.30 – 4.30pm) due to the right turn movement onto the highway, where it is required to give way to the highway traffic. The performance of this intersection improved to good condition (LOS A) for the weekend PM peak (with the most congested hour being 3 – 4pm) scenario, with lower hourly traffic volumes recorded than the weekday PM peak scenario.

Table 6-48: Existing 2021 weekday intersection performance (local road leg)

Intersection	Peak hour	Traffic volume (vehicles/hour)	Average vehicle delay (seconds)	LOS
Great Western Highway / Nellies Glen Road	AM (8.30 – 9.30am)	1383	10.7	A
	PM (3.30 – 4.30pm)	1632	12.8	A
Great Western Highway / Explorers Road	AM (8.30 – 9.30am)	1376	25.5	B
	PM (3.30 – 4.30pm)	1628	46.0	D
Great Western Highway / Foy Avenue	AM (8.30 – 9.30am)	1356	9.3	A
	PM (3.30 – 4.30pm)	1617	8.5	A

For the Medlow Bath to Blackheath section, mid-block capacity analysis was carried out to determine the road performance as there are no intersections within this section. Results from the analysis during the most congested hour of the AM and PM peak periods are detailed in Table 6-49. The existing performance of this section was satisfactory (LOS C) during weekday conditions, with performance deteriorating on weekends to LOS D. In all scenarios except the weekend PM peak (4 – 7pm) scenario, the LOS decreased on weekends due to increased traffic density on the road corridor in this section.

Table 6-49: Existing 2021 performance – Medlow Bath to Blackheath section

Scenario	Peak hour	Traffic volume per hour	Density (pc/km/ln)	LOS
Eastbound – weekday	AM (6 – 9am)	1014	14.5	C
	PM (4 – 7pm)	1112	15.9	C
Westbound – weekday	AM (6 – 9am)	1014	14.5	C
	PM (4 – 7pm)	1112	15.9	C
Eastbound – weekend	AM (6 – 9am)	1126	16.1	D
	PM (4 – 7pm)	1164	16.6	D
Westbound – weekend	AM (6 – 9am)	1341	19.2	D
	PM (4 – 7pm)	1065	15.2	C

Crash data

Over the 12-year period ending in 2021, there were 37 crashes along the Katoomba to Medlow Bath section. These included:

- one fatal crash due to an opposite head-on collision
- six serious injury crashes, at Nellies Glen Road intersection, west of Explorers Road and near Bellevue Crescenteleven moderate injury crashes
- four minor/other injury crashes
- fifteen non-casualty towaway crashes
- one uncategorised crash.

Most accidents occurred between Nellies Glen Road and to the west of Explorers Road. Most of these accidents are head on collisions, with a small number of rear end and run off bend crashes.

Within the same period, 65 crashes were recorded along the Medlow Bath to Blackheath section of the proposal. These included:

- one fatal crash due to an opposite head-on collision
- seven serious injury crashes
- twenty-nine moderate injury crashes
- no minor/other injury crashes
- twenty-nine non-casualty towaway crashes.

Within the Medlow Bath to Blackheath section, most accidents occurred near about Chainage 5600 – 6000, about one kilometre west of the Great Western Highway / Railway Parade intersection in Medlow Bath.

Public transport

There are a number of bus services that service the Great Western Highway within the proposal area. These services include:

- 690K – Springwood to Katoomba
- 698 – Katoomba to Blackheath (loop service)
- 698V – Katoomba to Blackheath (loop service)
- 8321 – Katoomba to Blackheath Station (school buses)
- 8705 – Springwood High School to Katoomba (school buses)
- 8710 – Wentworth Falls Public School to Blackheath (school buses).

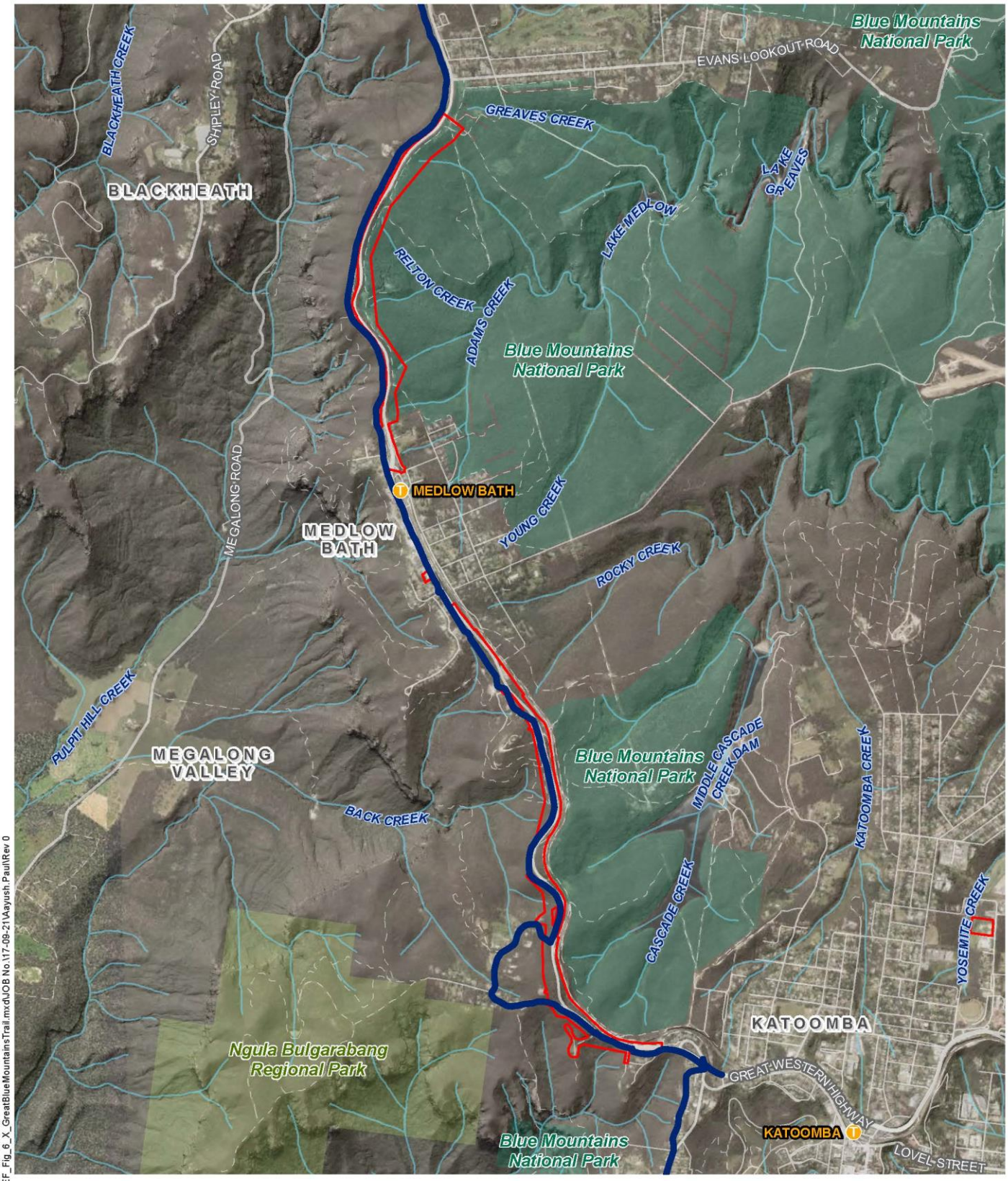
All bus services stop near Bonnie Doon Reserve and Foy Avenue, which are along the western side of the Great Western Highway between Katoomba and Medlow Bath. These bus stops are not sheltered and do not have signage or seating. There are no existing bus stops along the Medlow Bath to Blackheath section.

While the Main Western railway line runs parallel to the Great Western Highway throughout the proposal area, there are no rail stations within either section of the proposal, with the nearest stations located in Katoomba, Medlow Bath and Blackheath. Many of the identified bus routes connect with these train stations.

Active transport

No formal active transport infrastructure is associated with the Great Western Highway. However, the Great Blue Mountains Trail runs on the western side of the proposal, in some locations, following close to the Great Western Highway between Katoomba and Blackheath (refer to Figure 6-12). This includes a 245-metre concrete active transport trail immediately westbound of Rowan Lane.

While marked as a regional on-road cycle route, no formal cycling facilities exist on the Great Western Highway. Shared paths which form part of the Great Blue Mountains Trail are identified on the Blue Mountains Cycling Map, including Explorers Road, which is marked as an on-road cycle route.



Proposal area

Blue Mountains National Park

Ngula Bulgarabang Regional Park

Great Blue Mountains Trail

Watercourses

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Great Western Highway East **Review of Environmental Factors**

Projection: GDA2020 MGA Zone 56

FIGURE 6-12: Great Blue Mountains Trail

6.7.4 Potential impacts

Construction

For the Katoomba to Medlow Bath section, the westbound carriageway would be constructed offline and result in little or no impact to the existing traffic between Katoomba and Medlow Bath. Once completed, the main highway traffic would be diverted onto the westbound carriageway in a contraflow operation, resulting in minimal impacts to traffic during the construction of the new eastbound carriageway. As some work may be undertaken immediately adjacent to the highway, there may be the need to drop the speed limit along the highway during work to assure the safety of workers. This could result in some short-term localised traffic delays.

However, at points where the proposal needs to pass over the existing highway or at the tie in points at the ends of the section, there may be some minor disruption to traffic.

For the Medlow Bath to Blackheath section, the eastbound carriageway would be constructed offline with limited impact to existing traffic between Medlow Bath and Blackheath. Once completed, the main highway traffic would be diverted onto the eastbound carriageway in a contraflow operation, resulting in minimal impacts to traffic during the construction of the new westbound carriageway. As all work may be undertaken immediately adjacent to the highway, there may be the need to drop the speed limit along the highway during work to assure the safety of workers. This could result in some short-term localised traffic delays.

Other traffic and transport impacts associated with the construction of the proposal are outlined in Table 6-50.

Table 6-50: Other traffic and transport impacts associated with the construction of the proposal

Impact	Description
Local road impacts	Upgrades to local roads could result in disruption or delays to local road traffic. Impacts to local roads would occur in the Katoomba to Medlow Bath section: • Nellies Glen Road would be temporarily closed to traffic as the intersection is reconstructed further south of the existing intersection. Access to residents on Pulpit Hill and for visitors to the Six Foot Track would be retained from Great Western Highway via Explorers Road. • When work is occurring to the bridge structure over Explorers Road, disruptions to local traffic may occur including temporary closures of the road. Access to Explorers Road would be retained via the upgraded Nellies Glen Road intersection alignment. During construction of the eastbound carriageway, access to Foy Avenue would be maintained from the highway via a temporary side-track with controlled access.
Construction traffic	The vehicle movements expected during construction would be as follows (refer to Section 3.3.3): • **Katoomba to Medlow Bath section** – 275 average total vehicle movements per day and 550 vehicle movements per day at peak construction periods • **Medlow Bath to Blackheath section** – 255 average total vehicle movements per day and 450 vehicle movements per day at peak construction periods These traffic volumes are low compared with the existing traffic volumes on the Great Western Highway (refer to Section 6.7.3). As such, construction traffic is unlikely to affect the performance of the Great Western Highway during construction. However, a localised increase in traffic may be seen along the road corridor near access points and at intersections.
Active transport	During construction of the westbound carriageway, the active transport trail between Katoomba and Medlow Bath would be closed. This would be reconstructed and reopened upon completion of this carriageway. There would be no impacts to other active transport trails during construction of the proposal. Access to the Six Foot Track would still be possible via Explorers Road when Nellies Glen Road is closed for construction.
Public transport	During construction, the bus stops at Bonnie Doon Reserve and at Foy Avenue would be temporarily relocated. This may increase the distance required to travel to the bus stops for some commuters. Transport would endeavour to keep these bus stops operational in consultation with

Impact	Description
	local bus companies. As such, it is not expected that there would be any changes to any bus routes that run between Katoomba and Blackheath due to the proposal. Individual bus services may experience temporary localised delays due to construction work. Where feasible, the construction workforce would be encouraged to use public transport to access the proposal area, which could increase patronage at the two bus stops and along the public transport network. Any work required which would impact the operation of the rail corridor would be conducted during planned rail possessions when no trains would be running in consultation with Sydney Trains and NSW TrainLink. This would cause no additional impacts to rail services due to the proposal. Transport (Sydney Trains) is relocating the existing Medlow Bath West Sectioning Hut under a separate planning approval as it has reached its end of life.
Emergency services	Emergency service access along the Great Western Highway would be maintained throughout construction. For the Medlow Bath to Blackheath section, at least one emergency service vehicle crossing would be provided where there is separated carriageways during construction.
Parking	Access to the existing parking area on Nellies Glen Road would be removed during the reconstruction of Nellies Glen Road and the upgrades to the heritage interpretation area. As there is a lack of parking along Great Western Highway and nearby local roads, parking for construction workers would be provided at the identified ancillary facilities (refer to Section 3.4). There may be a need for construction vehicles to access the worksite and temporarily park on the worksite.
Property access	Property access would be maintained for residents and business owners on Nellies Glen Road, Explorers Road and Foy Avenue during construction. There may be temporary localised impacts experienced by some property owners. As previously noted, there would be temporary disruption to the Nellies Glen Road and Explorers Road intersections during construction of the proposal. Access to the rail corridor and Blue Mountains National Park for maintenance would be maintained during construction in consultation with the rail and national park authorities on an as-required basis.

Operation

The permanent changes to the Great Western Highway and the key intersections within the proposal area during operation of the proposal are detailed in Section 3.2.3. In addition, a new service road would be created alongside the new bridge structure that would provide alternative southbound access from the highway to connect with Explorers Road and the Pulpit Hill area.

Traffic modelling for the Great Western Highway Upgrade Program indicates that an increase in traffic volumes is expected between the existing scenario and 2036. Without the proposal, daily traffic volumes between Katoomba and Blackheath would increase from about 23,000 in 2021 to about 26,000 in 2036. With the proposal and the opening of other projects within the Great Western Highway Upgrade Program, daily traffic volumes would increase to about 28,000 in 2036 between Katoomba and Blackheath.

Road network impacts

For the Katoomba to Medlow Bath section, the impact of the proposal on key intersection performance has been assessed (refer to Table 6-51 for the 2036 weekday scenarios and Table 6-52 for the 2036 weekend scenarios). The operation of the proposal would result in good operation (LOS A) at the three key intersections within the proposal area in 2026, 2031 and 2036, meaning that all intersections would operate at acceptable levels. The intersection upgrades would be successful in accommodating the expected increased traffic volumes in 2036. Specific impacts of the proposal on each intersection would be as follows:

- **Great Western Highway / Nellies Glen Road intersection** – while the LOS at the intersection would not change when comparing the with and without proposal in 2036, with the increased capacity of the proposal, the average delay would decrease by three to four seconds.
- **Great Western Highway / Explorers Road intersection** – the proposal would improve the LOS from LOS C during the 2036 weekday scenario and LOS B during the 2036 weekend scenario without the proposal to LOS A with the proposal during both the weekday and weekend scenario. In 2036, the

proposal would reduce the average delay from about 36 seconds to seven seconds at this intersection. This is mostly due to Explorers Road no longer connecting with the highway but rather connecting with the service road.

- **Great Western Highway / Foy Avenue intersection** – there would be no change in LOS due to the proposal compared with modelling results for without the proposal in 2036. At this intersection, the proposal would slightly increase average delay time by about three seconds due to the change from a give-way to stop signal control. Queue lengths would be reduced at this intersection, resulting in an improvement of existing conditions in 2036 during of the operation of the proposal.

Table 6-51: Modelled intersection performance – 2036 weekday scenarios

Intersection	Peak hour	2036 weekday scenario without the proposal			2036 weekday scenario with the proposal		
		Traffic volume (vehicles per hour)	Average vehicle delay (seconds)	LOS	Traffic volume (vehicles per hour)	Average vehicle delay (seconds)	LOS
Great Western Highway / Nellies Glen Road	AM (8.30 – 9.30am)	1545	11.5	A	1737	9.5	A
	PM (3.30 – 4.30pm)	1806	14.2	A	2048	10.4	A
Great Western Highway / Explorers Road	AM (8.30 – 9.30am)	1539	36.2	C	108	7.5	A
	PM (3.30 – 4.30pm)	1803	74.2	F	112	7.4	A
Great Western Highway / Foy Avenue	AM (8.30 – 9.30am)	1515	11.6	A	1707	13.9	A
	PM (3.30 – 4.30pm)	1793	9.5	A	2032	10.4	A

Table 6-52: Modelled intersection performance – 2036 weekend scenarios

Intersection	Peak hour	2036 weekend scenario without the proposal			2036 weekend scenario with the proposal		
		Traffic Volume (vehicles per hour)	Average Vehicle Delay (seconds)	LOS	Traffic Volume (vehicles per hour)	Average Vehicle Delay (seconds)	LOS
Great Western Highway / Nellies Glen Road	AM (11am – 12pm)	1575	13.7	A	1801	10.3	A
	PM (3 – 4pm)	1390	11.2	A	1590	9.4	A
Great Western Highway / Explorers Road	AM (11am – 12pm)	1581	25.1	B	88	7.3	A
	PM (3 – 4pm)	1380	16.8	B	86	7.3	A
Great Western Highway / Foy Avenue	AM (11am – 12pm)	1578	9.2	A	1806	10.3	A
	PM (3 – 4pm)	1393	7.5	A	1594	9.5	A

For the Medlow Bath to Blackheath section, the impact of the proposal on mid-block capacity has been assessed to determine the road network, as there are no intersections as part of this section. Refer to Table 6-53 for the weekday scenarios and Table 6-54 for the weekend scenarios.

With the proposal, the Medlow Bath to Blackheath section would operate acceptably at LOS B in 2031 and 2036 under both weekend and weekday scenarios. In 2026, the proposal would have good operation (LOS A) for the westbound AM peak (6 – 9am) weekday, eastbound weekday and PM peak (4 – 7pm) westbound weekend scenarios. Without the proposal, in 2036, the Medlow Bath to Blackheath section would:

- operate at LOS C or D on a weekday
- operate at LOS D in both directions on a weekend.

During operation of the proposal, the volume to capacity ratio, which measures the level of congestion, would increase slightly due to the higher traffic volumes compared to without the proposal. This indicates that the proposal would improve traffic flow along the Medlow Bath to Blackheath section while accommodating for the future estimated increases in traffic volumes.

Table 6-53: Modelled mid-block performance – weekday scenarios

		Eastbound weekday scenarios			Westbound weekday scenarios		
Scenario	**Peak hour**	**Traffic Volume (vehicles per hour)**	**Density (passenger cars per kilometre per lane)**	**LOS**	**Traffic Volume (vehicles per hour)**	**Density (passenger cars per kilometre per lane)**	**LOS**
2036 without Proposal	AM (6 – 9am)	1069	15.3	C	1219	17.4	D
	PM (4 – 7pm)	1168	16.7	D	1314	18.8	D
2026 with Proposal	AM (6 – 9am)	988	6.2	A	1085	6.8	A
	PM (4 – 7pm)	1075	6.7	A	1183	7.4	B
2031 with Proposal	AM (6 – 9am)	1142	7.1	B	1212	7.6	B
	PM (4 – 7pm)	1238	7.7	B	1335	8.3	B
2036 with Proposal	AM (6 – 9am)	1186	7.4	B	1281	8.0	B
	PM (4 – 7pm)	1288	8.0	B	1403	8.8	B

Table 6-54: Modelled mid-block performance – weekend scenarios

		Eastbound weekend scenarios			Westbound weekend scenarios		
Scenario	**Peak hour**	**Traffic Volume (vehicles per hour)**	**Density (passenger cars per kilometre per lane)**	**LOS**	**Traffic Volume (vehicles per hour)**	**Density (passenger cars per kilometre per lane)**	**LOS**
2036 without Proposal	AM (6 – 9am)	1239	17.7	D	1503	21.5	D
	PM (4 – 7pm)	1304	18.6	D	1214	17.3	D
2026 with Proposal	AM (6 – 9am)	1167	7.3	B	1399	8.7	B
	PM (4 – 7pm)	1214	7.6	B	1118	7.0	A
2031 with Proposal	AM (6 – 9am)	1372	8.6	B	1627	10.2	B
	PM (4 – 7pm)	1413	8.8	B	1288	8.1	B
2036 with Proposal	AM (6 – 9am)	1413	8.8	B	1684	10.5	B
	PM (4 – 7pm)	1340	8.4	B	1340	8.4	B

Overall, the proposal would improve the existing performance of the Great Western Highway, even with an increase in traffic volumes in 2036. It would also improve the safety and the performance of the Great Western Highway. These sections of the Great Western Highway would have sufficient capacity to accommodate the expected annual growth after 2036.

Heavy vehicle impacts

The proposal would contribute to the broader upgrade of the Great Western Highway between Katoomba and Lithgow, improving freight efficiency for heavy vehicles as steeply graded sections and lane capacity would be upgraded. Heavy vehicle numbers, composition and vehicle types are not anticipated to change until completion of the entire Great Western Highway Upgrade Program and the heavy vehicle size

restrictions on Mount Victoria Pass is removed. Future performance of the corridor would be assessed by the cumulative impacts of the Blackheath to Little Hartley Upgrade.

The proposal is anticipated to provide a substantial improvement in heavy vehicle safety between Katoomba and Blackheath through improved road alignment and capacity. In addition, truck stopping areas would be provided to help drivers manage fatigue and comply with driving hours regulations and help the freight industry to support safe heavy vehicle operations. One would be located on the new service road eastbound, near Explorers Road, while the other would be provided westbound about one kilometre west of Medlow Bath. The provision of truck stopping areas along the proposal would improve safety for heavy vehicle drivers travelling along the Great Western Highway. This would discourage the current observed behaviour of heavy vehicles stopping in front of the Hydro Majestic and in other informal shoulder areas along the corridor.

Other traffic and transport impacts

Other traffic and transport impacts associated with the operation of the proposal are outlined in Table 6-55.

Table 6-55: Other traffic and transport impacts associated with the operation of the proposal

Impact	Description
Active transport	Within the Katoomba to Medlow Bath section, the proposal would upgrade and realign parts of the Great Blue Mountains Trail, including near the Pulpit Hill heritage interpretation area. This would reinstate the same level of pedestrian and cyclist access currently available, in consultation with relevant community interest groups. Within the Medlow Bath to Blackheath section, the proposal would establish a new active transport trail to the east of the Great Western Highway along the Blue Mountains National Park. This active transport trail would create a new active transport link between Medlow Bath and Blackheath which only exists to the western side of the rail corridor along Station Street. This would improve active transport connections in the area.
Public transport	The proposal would have a minimal impact on the two bus stops within the proposal area. The existing bus stop at Bonnie Doon Reserve on the Great Western Highway would be relocated to the left turn bay into Nellies Glen Road to improve safety for commuters. The existing bus stop at Foy Avenue would be adjusted and upgraded, with a dedicated bus bay constructed on the northern side of the intersection to suit the proposed road alignment. The proposal would have no impacts to bus or rail services.
Emergency services	By increasing the number of lanes from one to two lanes in each direction, the proposal would improve reliability of access for emergency services along the Great Western Highway. The four-lane configuration would provide more opportunities for emergency crossover at intersections. Variable speed limits and Variable Message Signs would improve the ability to manage traffic incidents and emergency events. The proposal would also maintain the ability for emergency services to stop where shoulder width permits along the road corridor in both directions. Access to the rail corridor would be maintained for emergency access.
Fire trails	Through the Medlow Bath to Blackheath section, the provision of the new active transport trail would also allow for maintenance access into the adjoining National Park.
Parking	Proposed changes to the Pulpit Hill heritage interpretation area would formalise parking at this location. This would improve safety and capacity of parking for light vehicles and tourist buses. This would reduce the disruption to residents of buses parking and obstructing property access on Nellies Glen Road and Explorers Road. The proposal would not affect current parking restrictions along the Great Western Highway.
Property access	Where existing rail corridor access would be disrupted by the proposal, alternative access arrangements and new gate locations would be established in consultation with Sydney Trains. There would be minimal impacts to the current access arrangements for the Blue Mountains National Park. However, an access from Coachhouse Lane onto the proposed active transport trail and maintenance access path would be provided.

6.7.5 Safeguards and management measures

Safeguards and management measures for traffic and transport are outlined in Table 6-56.

Table 6-56: Safeguards and management measures – traffic and transport

Impact	Environmental safeguards	Responsibility	Timing	Reference
Traffic and transport	A Traffic Management Plan (TMP) will be prepared and implemented as part of the CEMP. The TMP will be prepared in accordance with the Transport *Traffic Control at Work Sites Manual* (Transport, 2020c) and *QA Specification G10 Control of Traffic* (Transport, 2020b). The TMP will include: • confirmation of haulage routes • measures to maintain access to local roads and properties • a provision for the monitoring of delays or queues forming at access points with a suitable response such as temporary detours or cessation of construction access movements to clear the queue • construction traffic control plans outlining site-specific traffic control measures (including signage) to manage and regulate traffic movement • measures to maintain pedestrian and cyclist access where possible • requirements and methods to consult and inform the local community of impacts on the local road network • access to construction sites including entry and exit locations and measures to prevent construction vehicles queuing on public roads • a response plan for any construction traffic incident • monitoring, review and amendment mechanisms.	Transport / Contractor	Detailed design / Pre-construction	Section 4.8 of QA *G36 Environment Protection*
Construction site access	Construction site access will be designed and implemented in consideration of: • road design guidelines and turning paths for heavy vehicles • appropriate sight distances to allow traffic to safely enter and exit • visibility of compliant warning and way finding signs • use of accredited traffic controllers, where appropriate and/or other controls to separate, slow down or temporarily stop traffic for safe entry/exit • minimising use of local roads, where practical • provision of deceleration lanes at accesses next to highly trafficked roads.	Contractor	Pre-construction/ construction	Additional safeguard
Impact on bus stops or routes	For the Katoomba to Medlow Bath section, temporary and permanent bus stop relocation will be discussed with the relevant bus operator. Transport will discuss the temporary relocation of the Bonnie Doon Reserve and Foy Avenue bus stops.	Transport / Contractor	Detailed design / Pre-construction	Additional safeguard

Impact	Environmental safeguards	Responsibility	Timing	Reference
	Transport will inform the community of the temporary relocation of the bus stops prior to the relocation.			
Temporary access changes	Detours during temporary access changes will be implemented with directional signage along alternate routes.	Contractor	Construction	Additional safeguard
Traffic management measures	Any temporary traffic diversions or road closures will be implemented in accordance with Transport Management Centre (TMC) and Blue Mountains City Council requirements and notified to emergency services.	Contractor	Construction	Additional safeguard
Property access	Property access will be maintained where feasible and reasonable and property owners will be consulted well in advance of work starting that may temporarily restrict or control access.	Contractor	Construction	Additional safeguard
Local road or shared path closures	Blue Mountains City Council will be consulted with prior to any local road or shared path closures to identify suitable mitigation measures such as detour routes.	Contractor	Construction	Additional safeguard
Damage to local roads	Any damage to the local road network identified to be caused by construction vehicles for the proposal will be remediated by the contractor to be similar to the existing road condition.	Contractor	Construction	Additional safeguard

6.8 Socio-economic, property and land use

The potential impacts on socio-economic, property and land use during construction and operation of the proposal have been assessed as part of the *Great Western Highway Upgrade – East Project Socio-economic impact assessment* (Aurecon, 2022a), provided in Appendix J.

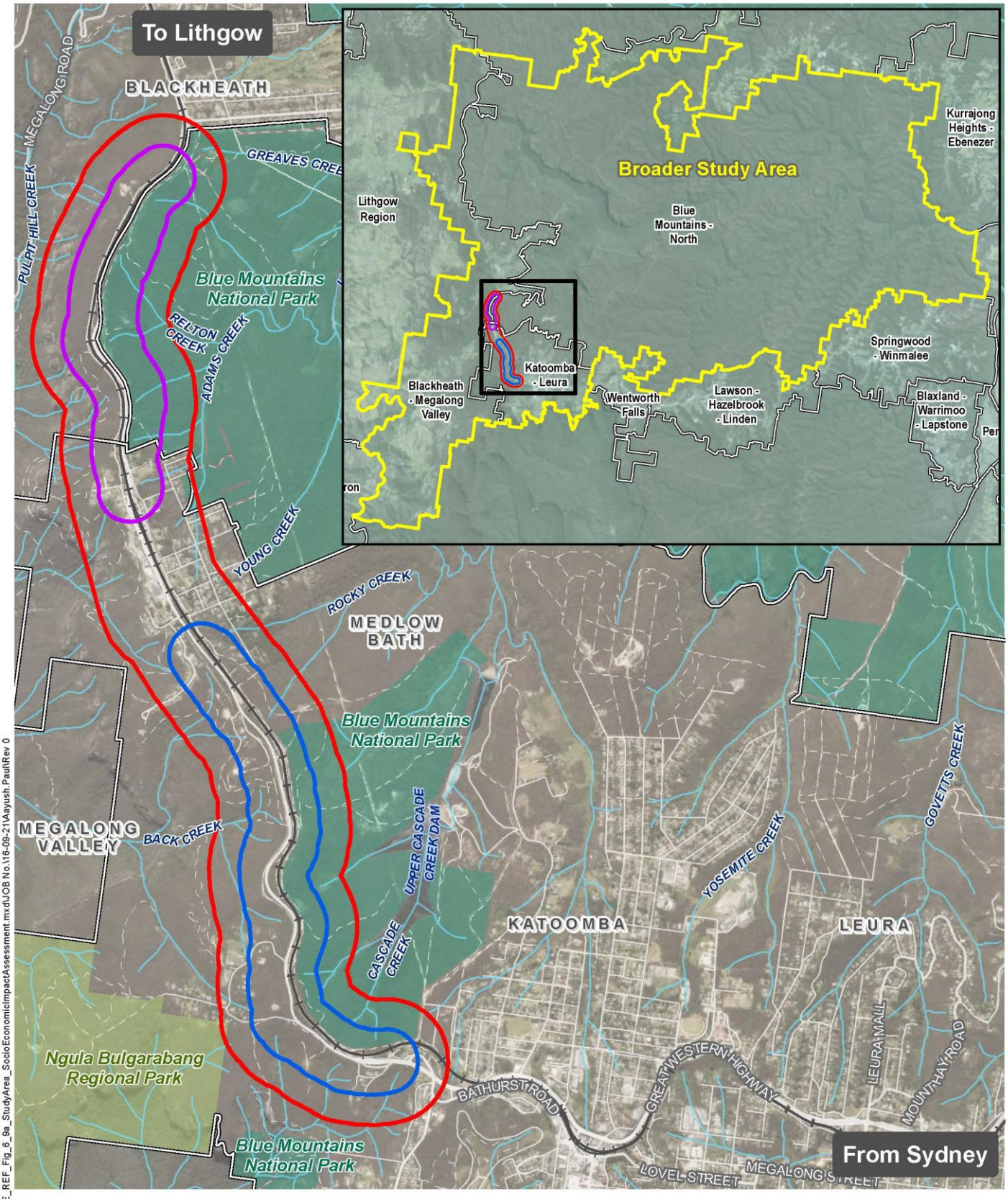
6.8.1 Methodology

The socio-economic impact assessment has been prepared for a 'moderate' level assessment as specified by Transport's *Environmental Impact Assessment Practice Note – Socio-economic Assessment (EIA-N05)* (Transport, 2020a). The methodology for the assessment included:

- a review of statutory planning and legislative requirements, including a review of existing State and local government strategies relevant to the social and economic environment of the study areas, including the *Blue Mountains Community Strategic Plan 2035* and the *NSW Western City District Plan* (Greater Sydney Commission, 2018).
- a site visit on Monday 8 February 2021 to examine the existing environment and assess the potential direct and indirect impacts of the proposal
- identification of the existing socio-economic environment of the study areas, including
  - data on land use and development, population, demographics, local business and industry, employment, income and dwelling characteristics in the study area
  - access, connectivity, existing social infrastructure and community features
  - key community issues from previous community consultation for the overall Great Western Highway Upgrade Program
- identification and assessment of the potential socio-economic impacts of the construction and operation of the proposal
- recommendation of measures to avoid, minimise and manage potential impacts on the socio-economic environment.

Study area

The socio-economic impact assessment consisted of three study areas in line with EIA-N05 (Transport, 2020a), which are shown in Figure 6-13 and outlined in Table 6-57.



Direct study area - Katoomba to Medlow Bath section

Direct study area - Medlow Bath to Blackheath section

Socio-economic study area

ABS Statistical area 2

Railway

Blue Mountains National Park

Ngula Bulgarabang Regional Park

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Source: Aurecon, LPI, DPIE

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Great Western Highway East **Review of Environmental Factors**

Projection: GDA2020 MGA Zone 56 **FIGURE 6-13:** Study area - socio-economic impact assessment

Table 6-57: Study areas for the socio-economic assessment

Study area	Description	How the assessment is informed by the study area
Direct study area	200 m buffer around the Katoomba to Medlow Bath and Medlow Bath to Blackheath sections separately. This includes residents who live just off the Great Western Highway but may still experience direct impacts of the proposal.	Direct impacts are assessed in this area, which include impacts on amenity impacts (noise and visual), property and access, and the surrounding community.
Socio-economic study area	400 m buffer from the outer edge of the design, which encompasses both the Katoomba to Medlow Bath and Medlow Bath to Blackheath sections. This considers the walking distance around the proposal.	Indirect impacts of the overall proposal (primarily impacts to access and connectivity, as well as some amenity impacts that may occur from people using the proposal but not as frequently as those within the direct study area).
Broader study area	Based on the following Australian Bureau of Statistics (ABS) 'Statistical Area 2' areas: • Katoomba – Leura • Blackheath – Megalong Valley • Blue Mountains – North. Comparison of these areas are made against the Blue Mountains LGA and Greater Sydney.	Representative of the surrounding Blue Mountains community likely to use the Great Western Highway corridor through the proposal area. Key features of the surrounding area include train stations, retail, town centres and places of special/community interest and develop context about the existing environment. By understanding the broader study area, movements through and around the Great Western Highway are assessed to determine the potential impacts of the overall proposal.

6.8.2 Criteria

The significance of likely impacts has been assessed based on the sensitivity and magnitude of the impacts. These terms are defined as follows:

- **Sensitivity** – the qualities of the receptor which influence its vulnerability to change and capacity to adapt.
- **Magnitude** – the scale, duration, intensity and scope of the overall proposal including how it will be constructed and operated.

The socio-economic assessment applied the impact grading matrix presented in EIA-N05 to assess the level of significance for potential negative impacts only.

Table 6-58: Criteria applied in the socio-economic impact assessment to assess the level of significance

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

6.8.3 Existing environment

Population and demography

In 2016, the population of the broader study area was 18,798, which was about 23.8 per cent of the Blue Mountains LGA population (ABS, 2016). Key features of the population include that:

- the broader study area has an older population, when compared with the Blue Mountains LGA and Greater Sydney
- there is a high Aboriginal and Torres Strait Islander population (about 2.6 per cent in 2016, compared with 1.5 per cent for Greater Sydney)
- in 2016, Katoomba – Leura and Blackheath – Megalong Valley had lower than average economic and social conditions for people and households compared with the Blue Mountains LGA and whole of NSW
- in 2016, employment in accommodation and food services, health care and social assistance, retail trade and education and training comprised the highest proportion of the work force in both the broader study area and Blue Mountains LGA
- in 2016, the broader study area had the highest proportion of people walking to work or working from home compared to the Blue Mountains LGA and Greater Sydney
- population is expected to increase by about six per cent in the Blue Mountains LGA from 78,835 in 2016 to 83,578 in 2041
- the number of households in the Blue Mountains LGA is expected to increase by 9.55 per cent between 2016 and 2036.

Land use

The proposal is located in the Blue Mountains LGA and occurs in the suburbs of Katoomba, Medlow Bath and Blackheath. The direct study area comprises a mix of land use areas defined in the *Blue Mountains Local Environmental Plan 2015* (LEP), as outlined in Section 4.1.2.

Within the proposal area, the Great Western Highway is a two-lane road zoned as SP2 – Infrastructure. It is located within a wide corridor which has grassed and vegetated areas along its extent. Housing is mostly set back from the Great Western Highway road corridor, except near the towns of Katoomba, Medlow Bath and Blackheath, where some properties are located next to the road corridor.

The Katoomba to Medlow Bath section is bounded by mostly private or Council-owned property to the west and the Main Western railway corridor to the east. Residential properties in this area are set back from the road corridor and accessed via local roads from the western side of the highway.

The Medlow Bath to Blackheath section is bounded by the Main Western railway corridor to the west and the Blue Mountains National Park to the east. While part of the Blue Mountains National Park forms the Greater Blue Mountains World Heritage Area, the section immediately adjacent to the proposal is not part of the World Heritage Area. The direct study area between Medlow Bath and Blackheath is mostly undeveloped, with some dispersed properties to the west.

The socio-economic study area and broader study area contain a range of industrial, commercial, agricultural and residential land uses, including some land in Medlow Bath zoned as SP3 – Tourist and RE1 – Public Recreation. There are accommodation and tourism services, as well as local town centres and villages comprised of small businesses, community services and facilities. To the west of the socio-economic study area is a steep escarpment overlooking Megalong Valley.

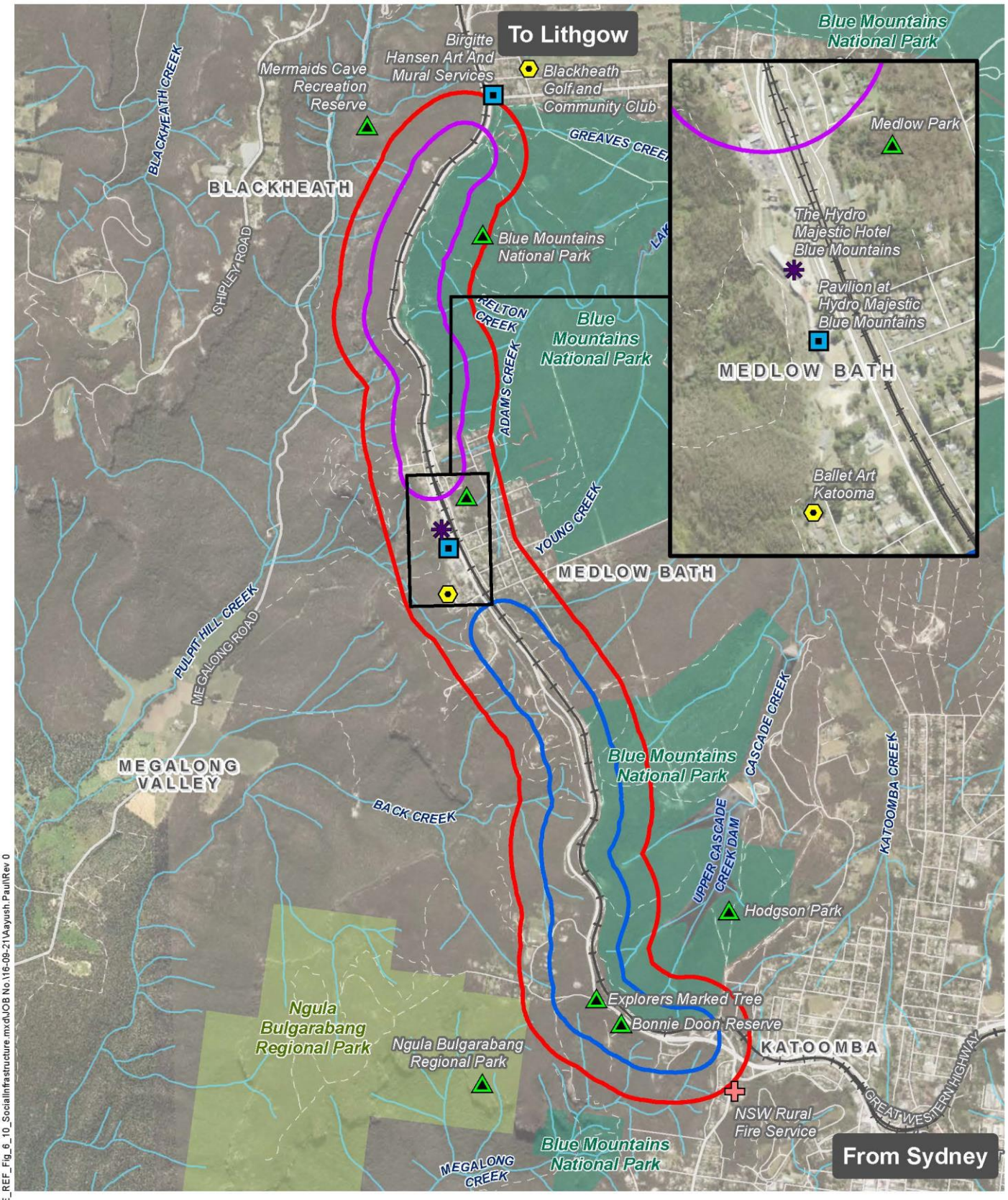
The broader study area is likely to experience some development in the coming years, consistent with existing land uses. The Blue Mountains Wildlife and Tourism Development Park and Great Western Highway Upgrade program are both currently in the planning phase and would improve tourism opportunities and connectivity in the Blue Mountains respectively.

Social infrastructure facilities

The social infrastructure near the proposal is shown in Figure 6-14. Within the direct study area, the key items of social infrastructure are parks and reserves, including the Bonnie Doon Reserve near Katoomba and the Blue Mountains National Park to the east of the proposal. Areas of community interest include:

- Blue Mountains National Park, which has a range of iconic lookouts, waterfalls, Aboriginal culture, historic walking tracks, mountain biking, and other adventure sports. There are notable sites including the 'Three Sisters' at Echo Point, Katoomba, the Blue Mountains Heritage Centre and destinations near Blackheath, such as Govets Leap and Grand Canyon. The Blue Mountains National Park contains pathways, resources and cultural associations important to the local Aboriginal community.
- Pulpit Hill and surrounds, which was identified on an 1814 Survey Map as a key site on the first road west across the Blue Mountains. Pulpit Hill includes areas of heritage significance near the now removed Explorers Tree, convict graves and an old rail house.
- Water NSW Special Catchment Area, which protects water quality by providing buffer zones of bushland around dams and immediate catchment areas. These special catchment areas are not open to the public through areas of National Park.

There is a high degree of mobility of residents and visitors to the proposal area between Katoomba, Medlow Bath and Blackheath. In Katoomba, there is a high level of social infrastructure, including schools, education facilities, and recreation facilities. The Great Western Highway provides an important link to social infrastructure facilities in the broader study area.



Direct study area - Katoomba to Medlow Bath section
Direct study area - Medlow Bath to Blackheath section
Socio-economic study area
Blue Mountains National Park
Ngula Bulgarabang Regional Park
Railway

Social infrastructure

Business
Community facilities, centres, halls
Emergency services
Parks and reserves
Recreational faciilites

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Source: Aurecon, LPI, DPIE

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Great Western Highway East **Review of Environmental Factors**

Projection: GDA2020 MGA Zone 56

FIGURE 6-14: Social infrastructure

Access and connectivity

Private vehicle use

Within the broader study area, residents are typically reliant on private vehicles. In 2016, only 6.5 per cent of households did not own a private vehicle (ABS, 2016).

There is no formal parking along the Great Western Highway in the proposal area. The closest formal parking to the proposal is available in Katoomba, Medlow Bath and Blackheath.

There is an informal parking area on Nellies Glen Road near the heritage interpretation area. At present, this poses an ongoing safety hazard and makes resident access challenging. There are also informal emergency stopping locations along the Great Western Highway where the road shoulder is wider.

Freight

The Great Western Highway forms part of the freight and heavy vehicles network connecting the Central West and Orana, Blue Mountains, Western Sydney and Greater Sydney regions. It currently carries around 9 million tonnes of road freight each year, with a further 7 million tonnes transported by rail. The Great Western Highway currently accommodates freight and heavy vehicles up to 19 metre B-Doubles (over 50 tonnes).

About half of the freight which passes through Blue Mountains is transported by road, to allow efficient and direct access to retail precincts and industrial areas. This freight includes refrigerated goods, livestock and retail goods. The dominant patterns of freight movement are:

- east to west - manufactured products, food and general freight such as furniture and fuel
- west to east – timber, food and agricultural products and sand and gravel from quarries in the Blue Mountains.

Heavy vehicle traffic makes up about 23 per cent of total traffic volume between Katoomba and Medlow Bath and about 22 per cent of total traffic volume between Medlow Bath and Blackheath. For further details on heavy vehicle traffic, refer to Section 6.7.3.

Active transport

Within the proposal area, there is one formal active transport trail along the Great Western Highway, between Rowan Lane and Bonnie Doon Reserve. This forms part of the Great Blue Mountains Trail, which runs along the western side of the Great Western Highway between Katoomba and Blackheath. Most of the pedestrian activities in the socio-economic study area take place on off-road sealed and unsealed bush walking tracks.

While it is marked as a regional on-road cycle route, no formal cycling facilities exist on the Great Western Highway. Shared paths which form part of the Great Blue Mountains Trail are identified on the Blue Mountains Cycling Map.

Community values

Community feedback received while developing the *Blue Mountains Community Strategic Plan 2035* (CSP; Blue Mountains City Council, 2017) identified the following directions for the CSP:

- Lead: inspiring leadership
- Protect: an environmentally responsible city
- Care: an inclusive, health and vibrant city
- Live: a liveable city
- Move: an accessible city
- Thrive: an economically sustainable city.

These directions contribute to the liveability of the Blue Mountains LGA and this has been reflected within the community consultation undertaken for the proposal (refer to Section 5.2).

The CSP aims to foster the social and economic well-being of the communities, while maintaining and protecting the surrounding World Heritage Area for future generations. It is noted that tourism and events are important to the community across the Blue Mountains LGA.

6.8.4 Potential impacts

Construction

Property acquisition and adjustments

The proposal would require the acquisition and adjustment of properties within the direct study area. In addition, some land parcels would also be temporarily leased for ancillary facilities and construction work. A list of properties impacted and details on the property acquisition process is provided in Section 3.6.

Property acquisition can result in stress and anxiety, particularly for owners that are vulnerable to forced relocation such as requiring assistance, older or of lower levels of economic resources. For the Katoomba to Medlow Bath section, about 36 properties to the west of Great Western Highway would be acquired. Most of these properties are Council owned, so there are limited impacts to private residential properties. There would be six full private property acquisitions, five of which are vacant land.

A portion of the Medlow Bath to Blackheath section is on land currently reserved as national park. The land which would be revoked is not currently publicly accessible due to its location within the Water NSW Blackheath Special Catchment Area so there would not be a loss of recreation land due to this revocation.

Property acquisition and adjustments for the overall proposal would have a moderate social impact. The overall significance would be:

- moderate-low for the Katoomba to Medlow Bath direct study area due to the moderate sensitivity of stakeholders and low magnitude of temporary and permanent changes during construction
- moderate-low for the Medlow Bath to Blackheath direct study area due to the low sensitivity in using existing publicly owned land and moderate magnitude of temporary and permanent changes to land ownership during construction.

Land use

Land use changes during construction would be mostly confined to the proposed ancillary facilities. These areas would be restored to their previous use upon completion of construction. The land use changes associated with construction of the proposal include:

- the bridge launch site, bridge ancillary facility and Bonnie Doon brick pit site ancillary facilities, which are currently zoned C1 – National Parks and Nature Reserves and C2 – Environmental Conservation
- the ancillary facility south of Evans Lookout Road, Blackheath, which is currently zoned C2 – Environmental Conservation.

The land use would change on the part of the Blue Mountains National Park within the Medlow Bath to Blackheath section which would be revoked prior to determination of this REF. This would change the land use from C1 – National Parks and Nature Reserves to SP2 – Infrastructure.

Changes to land use during construction would have minimal social or economic impact. There would be low sensitivity to changes in land use during construction by the community and broader study area of the proposal. This would be due to the type and small number of areas potentially impacted, including areas which are near existing road corridor or not easily accessible by the public. There would be moderate magnitude of the changes, resulting in the overall significance of the impact being moderate-low.

Access and connectivity

The proposal would result in some temporary changes to access and connectivity within and surrounding the direct study area. This would include:

- temporary delays and alternative traffic arrangements for resident, tourist, freight and commercial vehicle movements along the Great Western Highway during construction of the proposal
- temporary changes to local street access for Nellies Glen Road and Explorers Road
- temporary lane closures near Nellies Glen Road and Foy Avenue
- provision of alternative rail corridor and Blue Mountains National Park access as required
- temporary closure of the parking area on Nellies Glen Road
- temporary relocation of bus stops at Bonnie Doon Reserve and Foy Avenue
- detours and temporary closure of the Great Blue Mountains Trail (between Katoomba and Medlow Bath only).

There would be no changes to bus routes between Katoomba and Blackheath. Temporary, localised delays for individual bus services may occur due to traffic management on the operating highway. Emergency service access along the highway and to Coachhouse Lane would also be maintained during construction.

Changes to traffic conditions along the Great Western Highway would impact the liveability of the socio-economic study area. Residents may feel stressed or anxious in response to changes to the road network and temporary access routes. This may also be inconvenient for regular active transport path users, especially those with limited mobility. Lane closures during construction would be timed during low traffic periods (such as at night or outside peak periods) where possible to reduce impacts on the local road network and road users.

Delays due to construction would also lead to increased stress and anxiety for locals and regular users of the Great Western Highway. The magnitude of these impacts would depend on how long delays are expected and the staging of the proposal. Delays that impact on freight movement could have a negative economic impact, resulting in stress and unease for suppliers.

The sensitivity of people to changes in access and connectivity would be moderate. The overall significance would be:

- moderate for the Katoomba to Medlow Bath direct study area due to the moderate magnitude of the temporary changes during construction
- low for the Medlow Bath to Blackheath direct study area due to the low magnitude of the temporary changes during construction.

Social infrastructure facilities

The proposal would result in temporary changes on traffic movement and access points, impacting people accessing social infrastructure such as parks for recreation. There would also be temporary impacts to amenity for people using parks.

Several social infrastructure facilities within the socio-economic study area would be impacted by construction of the proposal, including:

- Bonnie Doon Reserve, which would experience negative short-term impacts. The proposal would impact public access to Bonnie Doon Reserve during construction, due the potential use of the Brick pit site as an ancillary facility. Pathways around the reserve, Nellies Glen Road and the Great Blue Mountains Trail between Katoomba and the reserve would be closed. There would be noise and visual impacts, inconveniencing locals and tourists who use this area for recreation purposes. Where possible, Transport would identify detours or temporary alternative access to Bonnie Doon Reserve.

- Pulpit Hill heritage area, which would experience direct and high non-Aboriginal heritage impacts through road widening, earthworks, bridge construction, intersection upgrades and carpark construction (refer to Section 6.4.2). Temporary impacts to this area include visual amenity and noise impacts which may affect community values around the natural environment. Public access and use of the site during construction would be limited.
- Medlow Park, which would experience accessibility impacts during construction, due to reduced speeds through the proposal area. Patronage may also increase at Medlow Park during construction due to disruption of other recreational sites, including Bonnie Doon Reserve or Pulpit Hill.
- Blue Mountains National Park between Medlow Bath and Blackheath, which would experience visual, noise and air quality impacts. However, this part of the National Park is within the Blackheath Special Catchment Area and so access is already legally restricted. As such, the impacts of the construction of the proposal on surrounding receivers would be limited.

The overall level of significance of impacts would be moderate-low due to moderate sensitivity of social infrastructure to potential construction impacts, including visual and noise impacts and low magnitude of impacts.

Commercial operations and businesses

The construction of the proposal would have minimal negative impacts on commercial operations and businesses, including people working from home. These impacts would be related to visual, air quality, access, noise and vibration during construction. These impacts would be particularly evident near:

- Mountain House, Nellies Glen Road and Karuna Sanctuary, Saywell Road, due to construction of upgraded intersections and the proposed twin bridges. There would be impacts to access during construction due to alternate traffic arrangements and potential delays due to construction on the Great Western Highway. Noise and vibration associated with construction are not expected to impact on business activities due to their setback from the Great Western Highway.
- The United Petroleum due to the presence of construction equipment and machinery at the adjoining proposed ancillary facility. This may impact the patronage to the business due to the reluctance of some patrons to access the petrol station due to construction work.
- Businesses in Medlow Bath which may experience access and connectivity impacts and concerns about loss of passing trade during the construction of the proposal. These businesses, and those located in the Medlow Bath section of the socio-economic area would also be impacted by the Medlow Bath Upgrade. Cumulative impacts of the proposal are discussed in Section 6.11.

The proposal would also create additional employment opportunities for construction and trade workers and lead to an increase in expenditure in the broader study area during construction.

Construction of the proposal may lead to amenity impacts for residents working from home. High levels of construction noise may impact concentration and interrupt work from home, leading to frustration and concern. The construction noise impacts of the proposal are discussed further in Section 6.6.4.

The overall level of significance of impacts would be moderate-low. This is due to low sensitivity of businesses to potential construction impacts because of the existing environment and large distance to construction activities for many of the businesses and moderate magnitude of the impacts.

Amenity and community values

The proposal would result in a reduction of amenity and community values. This would be due to the high sensitivity of the area and substantial changes proposed to the existing heritage interpretation area (Katoomba to Medlow Bath section) and the Blue Mountains National Park (Medlow Bath to Blackheath section).

The greatest temporary amenity impacts during construction would be:

- during construction activities that use noise or vibration intensive equipment for receivers closer to the highway or areas further away from the Great Western Highway due to topography, especially near the valley north of Explorers Road
- noisy work required outside standard construction hours which may have adverse impacts on the health and wellbeing of residents
- visual impacts of construction plant and machinery, including lighting for nightworks would also impact those living within, visiting and travelling through the direct study area
- partial removal of the bushland surrounding the Great Western Highway resulting in a larger cleared area with construction machinery, impacting the spatial character and liveability of the direct study area, particularly surrounding the Pulpit Hill heritage interpretation area
- air quality impacts, including an increase in dust levels from vegetation removal, stripping of topsoil and excavations associated with earthworks, as well as from heavy vehicle movements near the proposal, resulting in the community avoiding social infrastructure.

Construction activities would move along the corridor as construction progressed, so that one group of sensitive receivers would not be exposed to amenity impacts for the entire construction period.

The Blue Mountains City Council CSP identified that the community values the natural environment. The proposal would require vegetation removal for the widening of the Great Western Highway, impacting the natural backdrop for recreational users within this area. This may result in a loss of vegetation (refer to Section 6.3.3) and a sense of loss and impacts to feelings of community character. This would be most noticeable near Pulpit Hill in the Katoomba to Medlow Bath section and near the part of the Blue Mountains National Park proposed for revocation as part of the Medlow Bath to Blackheath section. However, the lack of known Aboriginal cultural heritage sites in the proposal area and management measures to be implemented (refer to Section 7.2), potential impacts to Blue Mountains National Park cultural heritage and values are not expected to be significant.

The CSP also identified that the community also values movement. Construction of the proposal would temporarily impact the accessibility and connectivity of residents, motorists, pedestrians, cyclists and businesses along the Great Western Highway.

The overall level of significance of impacts would be moderate due to high-moderate sensitivity of the community to changes in amenity and values and moderate magnitude of the impacts.

Operation

Property acquisition and adjustments

All property acquisition or adjustments would occur during construction. No further acquisition would take place during operation. As such, the impacts of property acquisition and adjustments during operation of the proposal would be negligible.

Land use

The operation of the proposal would result in minor permanent changes in land use. Most changes to land use would be related to the construction of the proposed road corridor in areas that were previously vegetated or vacant. These areas would be rezoned as SP2 – Infrastructure and be removed from recreational use.

However, the Medlow Bath to Blackheath section, would have a new publicly accessible recreational trail to the east of the Great Western Highway between Medlow Bath and Blackheath. This would provide positive impacts on recreation as the land is currently closed to public access.

The overall significance would be:

- moderate-low for the Katoomba to Medlow Bath direct study area due to the low sensitivity of land occupiers, owners and the community to permanent changes in land use and moderate magnitude of these changes
- moderate for the Medlow Bath to Blackheath direct study area due to the moderate sensitivity of land occupiers, owners and the community to permanent changes in land use and moderate magnitude of these changes.

Access and connectivity

The proposal would result in substantial access and connectivity benefits. Operation of the proposal would improve travel times and safety for motorists and commuters travelling along the Great Western Highway. This would result in decreased motorist stress and anxiety and improved driver confidence through:

- improved resilience of the road corridor during breakdowns, crashes, extreme weather events or other emergencies, with the ability to maintain traffic flow during these events
- reduction in congestion for emergency vehicles along the road corridor
- improved safety of vehicles overtaking
- improved safety of and reduced queuing at intersections, especially Nellies Glen Road and Foy Avenue
- improved safety of bus stops, especially through the relocation of the Bonnie Doon Reserve bus stop to Nellies Glen Road.

There may also be initial confusion and frustration from the community at the proposed changes to the intersections at Explorers Road and Foy Avenue. This would lead to increased travel times for residents.

The proposed upgrade to the Pulpit Hill heritage interpretation area on Nellies Glen Road would result in positive impacts for residents who currently are disrupted by informal parking in this area. Improved connectivity at this location would also lead to an increased likelihood of the community visiting this area for recreation and result in improved physical and mental wellbeing of the community. The reintroduction of a redesigned left-out turn previously removed to safety concerns would also improve safety for motorists using Nellies Glen Road.

Improved freight transport access and efficiency would result in fewer vehicles on the road and positive impacts on the community. A reduction in freight vehicles would decrease frustration from other motorists at congestion and slow movement, increasing liveability in the socio-economic and broader study area. The provision of heavy vehicle stopping bays would also improve safety for heavy vehicle drivers.

The proposal would improve liveability and active transport facilities by maintaining access to, and upgrading parts of, the Great Blue Mountains Walking Trail. This would have a positive impact on pedestrians and cyclists, allowing continued physical and mental benefits of exercise and ongoing enjoyment of important local areas.

Between Medlow Bath and Blackheath, the proposed new active transport trail would have a positive impact on the community who would have a new access link between the villages. Pedestrians and cyclists would no longer need to cross the Great Western Highway at Station Street to travel between Medlow Bath and Blackheath. This would have a positive impact on tourism as trails contribute to the wider attraction of recreation in the Blue Mountains.

The overall level of significance of impacts would be moderate-low due to moderate sensitivity of road and active transport users to changes in access and connectivity and low magnitude of the impacts.

Social infrastructure facilities

Reduced congestion due to the proposal would improve connectivity and access to services and social infrastructure facilities within the direct study area and socio-economic study area.

Several social infrastructure facilities within the socio-economic study area would be impacted by operation of the proposal, including:

- Bonnie Doon Reserve, which would experience positive impacts due to the reopening of the reserve. The proposal would reinstate improved access to nature and natural recreation, which is important to the community.
- Pulpit Hill heritage area, which would be reinstated in line with the Heritage Interpretation Strategy to be developed for the proposal. This would have a positive impact by recognising heritage significance and providing an attractive site for locals and tourists to visit. Parking is also currently an issue in the area and better parking facilities for visitors would be provided.
- Blue Mountains National Park between Medlow Bath and Blackheath, which would experience improved accessibility.

The overall level of significance of impacts would be low due to low sensitivity of social infrastructure during operation of the proposal and low magnitude of impacts.

Commercial operations and businesses

The proposed increase in road capacity and traffic efficiency would benefit commercial operations and businesses near the direct study areas. Tourism businesses are expected to benefit from improved access and connectivity due to the proposal. It is expected that there would be minimal impacts to business patronage due to access changes to Explorers Road. There would also be flow on effects to economic productivity and growth for freight carriers and vehicles travelling on the Great Western Highway and within the broader study area.

The overall level of significance of impacts would be low due to low sensitivity of businesses during operation and low magnitude of the impacts.

Amenity and community values

Community consultation for the proposal identified that the local community values movement and connectivity, especially given high private motor vehicle ownership. The proposal would have positive impacts to all road users by improving movement and reducing congestion as well as by providing access to improved walking and cycling opportunities. These impacts would improve liveability in the socio-economic study area, through reduced time in traffic, reduced frustration from congestion, and access to active transport links. However, the operation of the proposal may result in increased noise within the socio-economic study areas. These impacts are outlined in Section 6.6.4.

Community values of local heritage and amenity would be impacted by the proposal. These impacts include:

- The reduction of natural bushland and changes to the spatial character would impact visual amenity within the Katoomba to Medlow Bath direct study area and northern portion of the Medlow Bath to Blackheath direct study area (refer to Section 6.5.3)
- A sense of cultural and historical loss and impacts to liveability within the socio-economic study area due to heritage impacts to Pulpit Hill and the surrounding environs, during the operation of the Katoomba to Medlow Bath section (refer to Section 6.4.3). However, it is noted that the proposal would include the consolidation and improvement of the Pulpit Hill heritage interpretation area on Nellies Glen Road (refer to Section 3.2.3). The proposal would relocate the Nellies Glen Road intersection, allowing the existing heritage interpretation area to be retained and extended and provide improved visitor parking. This would better connect the individual and separate heritage items associated with Pulpit Hill, to provide a more cohesive Aboriginal and non-Aboriginal interpretation of the area.

The overall level of significance of impacts would be moderate due to high-moderate sensitivity of the community to changes in amenity and values and moderate magnitude of the impacts.

6.8.5 Safeguards and management measures

Safeguards and management measures for socio-economic, property and land use impacts are outlined in Table 6-59. Other safeguards and management measures that would address socio-economic, property and land use impacts are identified in Sections 6.4.4, 6.5.4, 6.6.5, 6.7.5 and 6.9.4.

Table 6-59: Safeguards and management measures – socio-economic, property and land use

Impact	Environmental safeguards	Responsibility	Timing	Reference
Socio-economic	A Communication Plan (CP) will be prepared and implemented as part of the CEMP to help provide timely and accurate information to the community during construction. The CP will include (as a minimum): • people or organisations to be consulted during the delivery of the proposal • procedures and mechanisms for the regular distribution of information about the proposal • mechanisms to keep relevant stakeholders updated on construction activities, schedules and milestones • avenues for the community to provide feedback (including a 24-hour, toll free proposal information and complaints line) or to register complaints through which Transport will respond to community feedback • a process to resolve complaints and issues raised. The CP will be prepared in accordance with the *Community Involvement and Communications Resource Manual* (Roads and Traffic Authority, 2008).	Contractor	Detailed design / pre-construction	Additional safeguard
Community consultation	Transport will continue to consult with the community until the completion of the proposal. Discussions would include the nature and timing of construction work.	Transport	Pre-construction / construction	Additional safeguard
Property acquisition	Land acquisition will occur in accordance with the *Land Acquisition (Just Terms Compensation) Act 1991* and the *Local Government Act 1993*. Transport will continue to consult with Blue Mountains City Council regarding council owned land and assets. The design for the proposal will also be refined during detailed design to minimise impacts on community land, where possible.	Transport	Pre-construction	Additional safeguard
Amenity	Amenity impacts will be managed through other safeguards for the proposal (including those related to noise and vibration, visual changes, heritage and traffic)	Transport	Pre-construction / construction	Additional safeguard
Changes in access	Temporary and permanent changes in access will be discussed with impacted land occupiers (including Sydney Trains and NPWS) prior to commencement of construction and during construction activities should arrangements change. This includes properties which may be impacted by intersection upgrades at Nellies Glen Road, Explorers Road and Foy Avenue.	Transport	Pre-construction / construction	Additional safeguard

Impact	Environmental safeguards	Responsibility	Timing	Reference
Social infrastructure	Transport will consult with local community groups that use facilities including the walking/ hiking trails throughout construction.	Transport	Pre-construction/ construction	Additional safeguard
Relocation of bus stops	Public transport users will be notified in advance of any changes to bus stop locations through signage at the existing bus stop during construction. Public transport users will also be notified of permanent bus stop relocations. Adequate way finding signage will be installed. Consultation with the relevant bus authorities will be undertaken to mitigate potential impacts to bus routes.	Transport	Pre-construction / construction	Additional safeguard
Traffic management for all road users, including pedestrians and cyclists	Transport will consider opportunities for alternative transport arrangements to provide access for vulnerable community members who would normally access the Great Blue Mountains Trail. Alternative routes for active transport users during construction will be clearly identified by signage and the use of traffic controllers where required.	Transport	Pre-construction / construction	Additional safeguard
Provision of parking	Transport will develop a car parking strategy to inform the operation of upgraded car parking opportunities (including near the Pulpit Hill interpretation area) in conjunction with the Great Western Highway Upgrade – Medlow Bath.	Transport	Detailed design / pre-construction	Additional safeguard

6.9 Aboriginal cultural heritage

This section describes the Aboriginal cultural heritage impacts associated with the proposal. It summarises the findings relevant to the proposal area outlined in the *Great Western Highway Duplication – Katoomba to Lithgow Archaeological Survey Report* (Archaeological Survey Report) (Jacobs, 2020), provided in Appendix K. This report is the Stage 2 *Procedure for Cultural Heritage Consultation and Investigation* (PACHCI) outlined in Section 5.3 prepared for the Great Western Highway Upgrade Program.

6.9.1 Methodology

The Archaeological Survey Report assessed a 37-kilometre section of the Great Western Highway between Katoomba and Lithgow. A 50-metre buffer was applied either side of the proposed road alignment, which is the study area for this assessment. The study area included the Katoomba to Medlow Bath and Medlow Bath to Blackheath sections.

A desktop assessment of the study area was conducted, including:

- a review of the environmental context
- a review of the ethnographic and cultural context
- a search and review of the Aboriginal Heritage Information Management System (AHIMS)
- a review of relevant heritage data from previous archaeological assessments.

Consultation with Aboriginal stakeholders was carried out following the requirements described for Stage 2 of PACHCI. This involved Deerubbin Local Aboriginal Land Council (LALC) providing a cultural heritage survey report to Transport.

The desktop assessment and consultation informed an archaeological survey of the study area. Field walkovers of the area covered by this proposal were conducted with representatives from the Deerubbin LALCs between November 2019 and March 2020. All previously recorded AHIMS sites within the study area were visited, where feasible and property access was granted.

Due to the findings of this assessment within the proposal area (refer to sections 6.9.2 and 6.9.3), no further Aboriginal cultural heritage assessments were carried out as part of the proposal.

6.9.2 Existing environment

Aboriginal cultural heritage context

The study area and surrounding region are known to have been important to and extensively used by Aboriginal people. The proposal occurs on the land of the Dharug people, who spoke different dialects depending on their location. The land near the proposal was known as Muru-Marak or mountain pathway (Attenbrow, 2003). The broader study area spans the Aboriginal language groups of the Gundungurra and Wiradjuri peoples as well.

Aboriginal groups in the Upper Blue Mountains exploited the natural resources near the proposal. The resources of the Macquarie River, hunting of game (such as kangaroos and emus) and native flora were valuable sources of food for Aboriginal people. Stone artefactual material identified within the study area is part of the eastern regional sequence. The sequence consists of artefact types changing their appearance, frequencies of production, and use of different materials through time.

Early interaction between Aboriginals and Europeans was minimal. The first European thought to have entered the Blue Mountains was ex-convict John Wilson, who entered Gundungurra territory in 1792. The crossing of Gregory Blaxland, William Lawson and William Charles of the Blue Mountains in 1813 occurred

near the proposal. Aboriginal people assisted their crossing in accessing food and following pathways normally used by Aboriginal groups to cross the mountains. Interaction became more frequent in the 1800s, substantially increasing after the opening of Coxs Road across the Victoria Pass in 1815.

Aboriginal culture has influenced many aspects of Australian culture, including the names of animals, localities, creeks and rivers and endures to this day across the proposal area. The proposal falls within the Deerubbin Local Aboriginal Land Council (LALC). The Gundungurra Area Agreement (NI2014/001) Indigenous Land Use Agreement also covers part of the proposal area. Members of the Aboriginal community continue to experience connection with the proposal area through cultural and family associations.

A search of the Native Title Tribunal Native Title Vision website was carried out on 12 October 2021, with no Native Title claimants identified in the proposal area.

However, there is a lot which is subject to an Aboriginal land claim (undetermined) (Lot 215 DP751657) within the Katoomba to Medlow Bath section. There is also a lot owned by the Deerubbin LALC, located adjacent to the Medlow Bath to Blackheath section.

Archaeological context

The proposal area follows a narrow ridgeline following a north-south alignment in the Upper Blue Mountains. It comprises Narrabeen Sandstone forming abrupt scarp edges and sandstone outcrops exposed within the dissected sandstone plateau landform pattern.

Predictive modelling of archaeological context identified that there was potential for Aboriginal sites within the proposal area. These sites are listed from most likely to not anticipated and included:

- rockshelters on slopes at valley heads
- pigment rock art within rockshelters
- grinding grooves on sandstone surfaces, most likely dipping into water
- scarred trees
- stone artefact sites
- engraved rock art.

During the archaeological survey, the proposal area was found to be highly disturbed as it is mostly within the existing Great Western Highway road corridor. Previous expansion and realignment of the highway has resulted in major landform modifications. These modifications include cutting into the natural rock and clearance of vegetation near the road corridor. Drainage channels and culverts have disturbed any deposits that may have existed within the road corridor. The northern end of the Katoomba to Medlow Bath section near Foy Avenue and the southern end of the Medlow Bath to Blackheath section near Coachhouse Lane are largely disturbed due to the nearby urban settlement. Little to no areas of the natural land surface are visible.

The comparison of historical aerial photographs from 1973 and 2015 indicates that much of the vegetation occurring along the road corridor is relatively young and largely consists of recent regrowth.

Aboriginal cultural heritage register searches

There were no Aboriginal cultural heritage items identified on the AHIMS database within the proposal area when searched in October 2019. There were also no Aboriginal cultural heritage items identified on the State Heritage Register, Schedule 5 of the *Blue Mountains Local Environment Plan 2015* within the proposal area.

A search of the AHIMS database was carried out in September 2021 for the Woodlands Road, Katoomba ancillary facility. No Aboriginal cultural heritage items were identified within a 50 metre radius of this property.

However, the Greater Blue Mountains Area – Additional Values nationally listed nominated heritage item was identified within the Medlow Bath to Blackheath section on the Australian Heritage Database. As this is not an identified Aboriginal cultural heritage item, this heritage item has been assessed as part of the Statement of Heritage Impact attached to the REF as Appendix F, which is summarised in Section 6.4.

6.9.3 Potential impacts

Construction

Construction would involve ground disturbing activities, such as excavation. If present, these activities would impact Aboriginal cultural heritage items. However, as indicated in section 6.9.2, there are no known Aboriginal cultural heritage items within the proposal area and so no impacts are expected.

Construction of the proposal is not expected to result in any impacts to Aboriginal cultural heritage. As noted in Section 6.9.2, a lot subject to an undetermined Aboriginal land claim would be impacted by the Katoomba to Medlow Bath section. However, Transport would continue to consult with the Deerubbin LALC and Crown Lands during detailed design about the impact to this lot. Part of the Medlow Bath to Blackheath section is adjacent to land owned by the Deerubbin LALC. The proposal would not encroach or otherwise disturb the site.

The high levels of previous ground disturbance within the proposal area reduce the likelihood of the discovery of unexpected Aboriginal cultural heritage items during construction. However, an unexpected finds procedure would be put in place, to assure that any items, if found, are managed.

Operation

The operation of the proposal is not expected to impact on any items of Aboriginal cultural heritage.

Transport is currently engaging with specialist heritage consultants GML Heritage and Balarinji Indigenous Design and Strategy to engage stakeholders in developing a cultural interpretation strategy across the Great Western Highway Upgrade Program – Katoomba to Lithgow. This cultural interpretation strategy would look to interpret both Aboriginal and non-Aboriginal heritage along the highway alignment and recognise the Aboriginal cultural significance of the region. The Pulpit Hill heritage interpretation area would be further developed as part of the Great Western Highway Upgrade Program cultural interpretation strategy, in consultation with the Blue Mountains City Council, Heritage NSW, Aboriginal knowledge holders and the local community.

6.9.4 Safeguards and management measures

Safeguards and management measures for Aboriginal cultural heritage are outlined in Table 6-60.

Table 6-60: Safeguards and management measures – Aboriginal cultural heritage

Impact	Environmental safeguards	Responsibility	Timing	Reference
Aboriginal heritage	An Aboriginal Heritage Management Plan (AHMP) will be prepared in accordance with the *Procedure for Aboriginal cultural heritage consultation and investigation* (Roads and Maritime, 2011) and *Standard Management Procedure - Unexpected Heritage Items* (Transport for NSW, 2015d) and implemented as part of the CEMP. It will provide specific guidance on measures and controls to be implemented for managing impacts on Aboriginal heritage. The AHMP will be prepared in consultation with all relevant Aboriginal groups.	Contractor	Detailed design / pre-construction	Section 4.9 of QA *G36 Environment Protection*
Aboriginal heritage	*The Standard Management Procedure - Unexpected Heritage Items* (Transport for NSW, 2015d) will be followed in the event that an unknown or potential Aboriginal object/s, including skeletal remains, is found during construction. Work will only re-commence once the requirements of that Procedure have been satisfied.	Contractor	Construction	Section 4.9 of QA *G36 Environment Protection*
Aboriginal heritage	Transport will develop a cultural interpretation strategy across the Great Western Highway Upgrade Program. This cultural interpretation strategy will look to interpret both Aboriginal and non-Aboriginal heritage along the highway alignment. The Pulpit Hill heritage interpretation area will be further developed as part of this strategy, in consultation with the Blue Mountains City Council, Heritage NSW, Aboriginal knowledge holders and the local community.	Transport	Detailed design	Additional safeguard

6.10 Other impacts

6.10.1 Existing environment and potential impacts

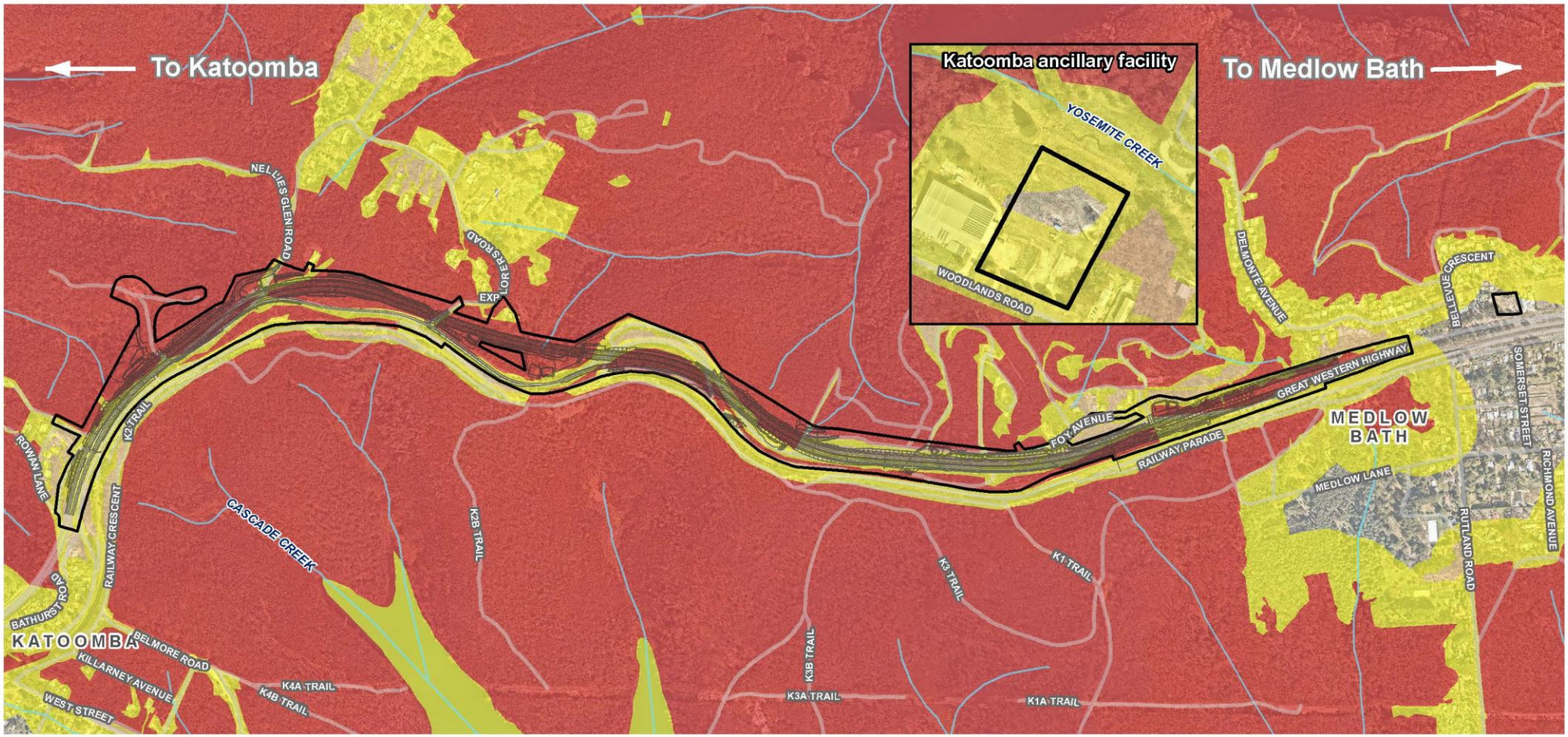
The existing environment and potential impacts of the proposal for other environmental factors are outlined in Table 6-61.

Table 6-61: Existing environment and potential impacts – other impacts

Environmental factor	Existing environment	Potential impacts
Air quality	There are no permanent air quality monitoring stations in the proposal area. However, the closest monitoring station is the Katoomba Air Quality Monitoring Station, which monitored ambient air quality near the proposal between May 2019 and May 2020 as part of the NSW EPA's Blue Mountains and Lithgow Air Watch program. Results from the program showed that the region near the proposal had very good air quality with air pollutants below Australian air quality standards. Local air quality is influenced by emissions and odours from vehicles travelling along the Great Western Highway and local roads, as well as private residences, for example through the emission of woodfire smoke.	During construction, the activities which could generate air emission and dust or odour and impact air quality would include: • clearing of vegetation • stripping, stockpiling and managing of topsoil • building demolition • earthworks, excavation and landscaping • road sub-grade preparation and road pavement work • transport and handling of soil • use of construction vehicles, machinery and plant • spray painting of the road for line marking. These air quality impacts have potential to impact surrounding residential receivers and construction workers. However, impacts would be localised and largely be dependent on daily weather conditions. During operation, air quality is not expected to worsen compared to the existing scenario. The upgraded Great Western Highway would have a higher capacity than the existing road corridor, which could result in increased traffic use and emissions. However, the proposal would result in reduced congestion, which should result in reduced vehicle emissions, even with an increase in traffic volumes. In addition, the impacts on air quality in relation to the clearance of vegetation would be partially offset through revegetation work. Implementation of Transport's *Future Transport 2056 Strategy* and *Future Energy Action Plan 2020-2025* as part of the proposal would result in long-term improvements in air quality. These policies contribute to the NSW Government Climate Change Policy Framework's goal of net zero emissions by 2050. The successful implementation of the Action Plan and achieving the objectives and targets of the overarching Policy and Strategy would likely improve air quality in and around the proposal area in the long-term.

Environmental factor	Existing environment	Potential impacts
Bushfire hazard and risk management	The proposal area is surrounded by highly vegetated landscapes, including public land as well as vegetated private properties. To the west of the proposal area, there is a steep densely vegetated escarpment overlooking Megalong Valley. To the east of the proposal area is the Blue Mountains National Park. Bushfire prone land near the proposal area is shown in Figure 6-15a-b. The existing road corridor is mostly categorised as a bushfire buffer zone. Surrounding vegetation is identified as being mostly Category 1 high risk bushfire prone land and otherwise Category 2 low risk bushfire prone land. This is due to the proposal area's setting surrounded by mature vegetation and steep topography. During the summer 2019-2020 bushfire season, about 79 per cent, or 855,310 hectares of the Greater Blue Mountains World Heritage Area, was burnt (Smith, 2021). While these bushfires did not occur within the proposal area, on 21 December 2019, the Great Western Highway was closed between Katoomba and Hartley between 2.45pm and 5.30pm due to the bushfire risk. As such, the risk of bushfires which impact the proposal area is present and ongoing danger.	Construction activities that may increase bushfire risk during construction include mulch stockpiling, hot work such as welding, as well as fuel/chemical storage and plant operation near densely vegetated areas. Any disruption to access along the Great Western Highway during construction could impact the safety of the community who might need to evacuate along the road corridor during a bushfire emergency. However, as noted in Section 3.3.8, the road corridor would remain operational during construction, with only minor delays expected. During a bushfire emergency, work would stop on the Great Western Highway, which would further reduce the potential delays due to construction work experienced by residents evacuating along the road corridor. Once operational, the proposal would improve the resilience of the Great Western Highway and surrounding community to respond to natural disasters and traffic incidents. The proposal would widen the road corridor and increase the width of the buffer zone which exists across the road. Trees would be cleared where appropriate to maintain required driver sight lines. Where the Great Western Highway adjoins the rail corridor, the buffer zone would increase to a width of about 75 metres. This would improve the likelihood of the Great Western Highway remaining trafficable during bushfire periods. The proposal would also improve emergency access to the communities of Katoomba, Medlow Bath and Blackheath. The new second, separated carriageway would allow contraflow if one carriageway is required to close due to a bushfire (as was the case in the summer 2019-2020 bushfires). The proposal would also increase capacity of the road network in the event of an emergency.
Spoil, waste and resource management	The resource management hierarchy principles in order of priority as outlined in the *Waste Avoidance and Resource Recovery Act 2001* would be applied to the proposal. These are: • avoidance of unnecessary resource consumption • resource recovery (including reuse, reprocessing, recycling and energy recovery) • disposal. By adopting the above principles, Transport encourages the most efficient use of resources and reduces cost and environmental harm in accordance with the principles of ecologically sustainable development.	During construction, the proposal would require a number of resources including road base, concrete, steel and landscaping materials. Details of the materials and estimated volumes are provided in Section 3.3.7. Waste generated during construction would be mostly located at ancillary facilities. Waste sources may include: • residual road and building materials including concrete, asphalt and aggregate • packing materials including pallets, crates, plastics • domestic garbage including food waste and general site waste and litter • wastewater from facilities, vehicle wash down and dust suppression • residual chemical including oils, lubricants, waste fuels and batteries • green waste including timber, vegetation and weeds • hazardous waste including asbestos, oils, lubricants, waste fuels and batteries.

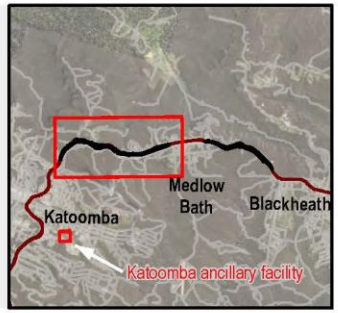
Environmental factor	Existing environment	Potential impacts
		There would be about 333,000 cubic metres of cut material due to the proposal. The Katoomba to Medlow Bath section would have about 272,000 cubic metres and Medlow Bath to Blackheath section would have 61,000 cubic metres. The Medlow Bath to Blackheath section would reuse all the cut material generated and would use an additional 63,000 cubic metres from the Katoomba to Medlow Bath section. There would be an excess of 111,000 cubic metres in cut material from Katoomba to Medlow Bath section. Where possible, this excess material would be used for landscaping in the section; otherwise it would be disposed of at an off-site waste facility. Inappropriately managed waste has the potential to result in impacts to air quality, human health, water quality contamination and visual impacts which are details in the relevant sections. Waste would be reused and recycled on site where possible, however surplus or contaminated material would be classified and disposed of at a licensed waste facility in accordance with EPA Waste Classification Guidelines (NSW EPA, 2014). During operation, waste sources would likely include: • roadside litter • waste material associated with roadside maintenance • green waste from landscape maintenance • illegal dumping.



The design
Proposal area

NSW bushfire prone land

Vegetation Category 1
Vegetation Category 2
Vegetation Category 3
Vegetation Buffer



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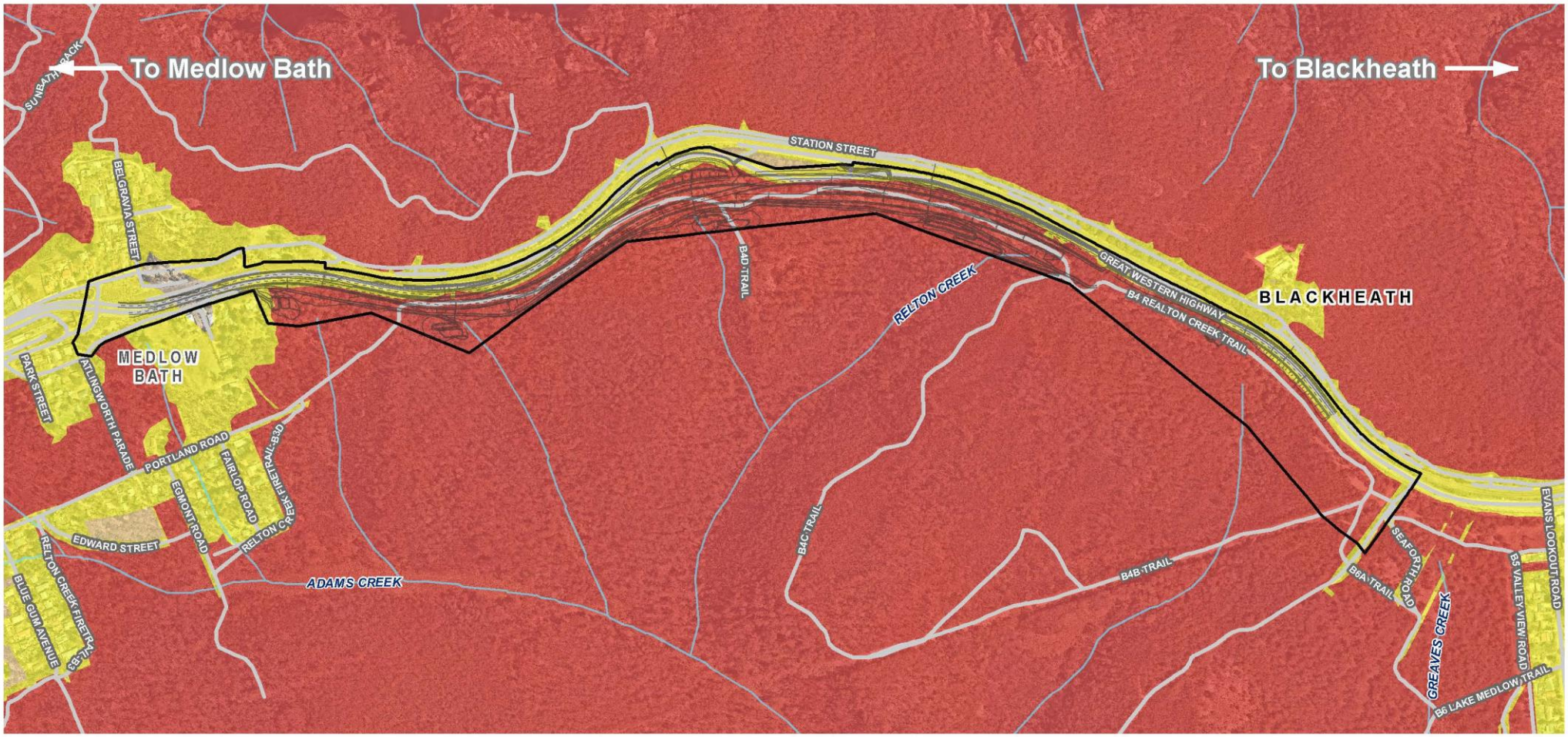
Source: Aurecon, Mott MacDonald, LPI, Nearmap, RFS

1:13,500@A4
0 150 300m

Projection: GDA2020 MGA Zone 56

Great Western Highway East **Review of Environmental Factors**

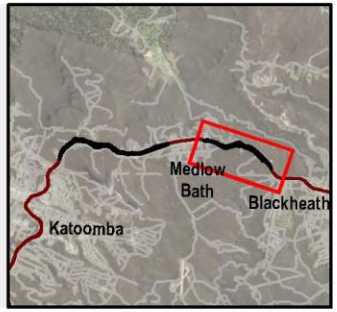
FIGURE 6-15a: Bushfire prone land map



The design
Proposal area

NSW bushfire prone land

Vegetation Category 1
Vegetation Category 2
Vegetation Category 3
Vegetation Buffer



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Source: Aurecon, Mott MacDonald, LPI, Nearmap, RFS

1:10,000@A4
0 100 200m

Projection: GDA2020 MGA Zone 56

FIGURE 6-15b: Bushfire prone land

6.10.2 Safeguards and management measures

Safeguards and management measures for other impacts are outlined in Table 6-62.

Table 6-62: Safeguards and management measures – other impacts

Impact	Environmental safeguards	Responsibility	Timing	Reference
Air quality	An Air Quality Management Plan (AQMP) will be prepared and implemented as part of the CEMP. The AQMP will include, but not be limited to: • potential sources of air pollution • air quality management objectives consistent with any relevant published EPA and/or Energy, Environment and Science (EES)/Department of Planning, Industry and Environment guidelines • mitigation and suppression measures to be implemented • methods to manage work during strong winds or other adverse weather conditions • a progressive rehabilitation strategy for exposed surfaces.	Transport / Contractor	Detailed design / pre-construction	Section 4.4 of QA G36 Environment Protection
Waste and resource management	A Waste Management Plan (WMP) will be prepared and implemented as part of the CEMP. The WMP will include but not be limited to: • measures to avoid and minimise waste associated with the project • classification of wastes and management options (re-use, recycle, stockpile, disposal) • statutory approvals required for managing both on and off-site waste, or application of any relevant resource recovery exemptions • procedures for storage, transport and disposal of spoil and waste • monitoring, record keeping and reporting. The WMP will be prepared taking into account the *Environmental Procedure - Management of Wastes on Roads and Maritime Services Land* (Roads and Maritime, 2014) and relevant Transport for NSW Waste Fact Sheets.	Transport / Contractor	Detailed design / pre-construction	Section 4.2 of QA G36 Environment Protection
Waste and resource management	If vegetation is to be mulched and transported off site for beneficial reuse, it is to be assessed for the presence of weeds, pest, and other disease and a Mulch Management Plan prepared in accordance with the Roads and Maritime Technical Procedure: Mulch Management	Transport / Contractor	Detailed design / pre-construction	Additional Safeguard
Waste and resource management	Recycling facilities will be provided at site compounds for recycling paper, plastic, glass and other re-useable materials. Liquid wastes, such as paints and solvents, will be disposed of in accordance with the Waste Classification Guidelines Part 1: Classifying Waste (DECCW, 2009) and the POEO Act.	Transport / Contractor	Detailed design / pre-construction	Additional Safeguard

Impact	Environmental safeguards	Responsibility	Timing	Reference
Bushfire hazards and risk management	The CEMP will include a bushfire management plan prepared in accordance with Planning for Bush Fire Protection 2019 (NSW Rural Fire Service, 2019). Measures to be implemented to manage bushfire risk include: • monitoring of weather and local bushfire ratings • consultation requirements for community notifications in the event of a bushfire • maintaining equipment in good working order • ensuring plant and equipment are fitted with appropriate spark arrestors, where practicable • ensuring site workers are informed of the site rules including designated smoking areas and putting rubbish in designated bins. • obtaining hot work permits and implementing total fire bans as required • implementing adequate storage and handling requirements for potentially flammable substances in accordance with the relevant guidelines.	Contractor	Pre-construction / construction	Additional Safeguard
Bushfire hazards and risk management	Consultation with emergency services, including the Rural Fire Service and Fire and Rescue NSW to: • ensure emergency access is maintained during construction • co-ordinate any bush fire emergency actions as outlined in the project's Bushfire Management Plan.	Contractor	Construction	Additional Safeguard

6.11 Cumulative impacts

This section discusses the potential cumulative impacts that may arise as a result of the construction and operation of the proposal and the combined impacts of this and other projects near the proposal. The cumulative impacts relate to both the individual environmental and social impacts of the proposal as well as the combined effects of this and other proposals that form part of the Great Western Highway Upgrade Program.

6.11.1 Study area

The cumulative impact assessment has considered other projects and developments in the Blue Mountains region near the Great Western Highway. It has considered projects which would be under construction at the same time as, or close to, the proposal.

6.11.2 Broader program of work

The proposal is part of the Great Western Highway Upgrade Program, which is an infrastructure program of national importance. The NSW Government has progressively upgraded sections of the Great Western Highway to make it safer and more reliable for all road users. The broader program would complete the final 34-kilometre connection of a modern dual-carriageway link across the Blue Mountains.

The Great Western Highway Upgrade Program consists of four projects, which are:

- Great Western Highway East – Katoomba to Blackheath (Katoomba to Blackheath Upgrade, this proposal). Refer to Section 3.2.3 for details on the proposal.
- Great Western Highway Upgrade – Medlow Bath (Medlow Bath Upgrade). This project involves upgrading and duplicating the existing surface road corridor with intersection improvements and a new pedestrian bridge. The western end of the Katoomba to Medlow Bath section of this proposal would tie in to the eastern end of this project. The REF for this project was exhibited for consultation between July and September 2021, with construction beginning late 2022.
- Great Western Highway Blackheath to Little Hartley (Blackheath to Little Hartley Upgrade). This project involves the construction of a tunnel bypass of Blackheath and Mount Victoria, with connectivity between the two proposed tunnels currently under further investigation. The western end of the Medlow Bath to Blackheath section of this proposal would tie in to the eastern end of this project. It is anticipated that the Environmental Impact Statement would be exhibited for consultation mid-2022.
- Great Western Highway Upgrade Program – Little Hartley to Lithgow (West Section) (Little Hartley to Lithgow Upgrade). This project involves upgrading, duplicating and widening the existing surface road corridor, with connections to a tunnel portal at Little Hartley. The REF for this project was exhibited for feedback from 23 November 2021 to 16 January 2022.

These four projects would be constructed at similar times and consecutively geographically. They have the potential to result in cumulative impacts to local communities as well as road users throughout the Blue Mountains area.

This cumulative impact assessment has considered those projects that have progressed sufficiently enough to understand the impacts of each project. These projects are all in the planning stage, however only the Medlow Bath Upgrade and Little Hartley to Lithgow Upgrade have assessed the environmental impacts of the projects so that they could be considered as part of this cumulative impact assessment.

Transport (Sydney Trains) is also replacing and relocating the Medlow Bath West Sectioning Hut which is at the end of asset life. The sectioning hut is located within the Medlow Bath to Blackheath section of this proposal. This work is being assessed through a separate Minor Works REF.

6.11.3 Other projects and developments

The other projects and developments which have been identified as relevant when considering the cumulative impacts of the proposal are outlined in Table 6-63. The Blackheath to Little Hartley Upgrade has not progressed sufficiently to understand the impacts of the project. Cumulative impacts of this project would be considered at a later stage as part of its own environmental assessment.

Table 6-63: Relevant future projects

Project	Construction impacts	Operational impacts
Great Western Highway Upgrade – Medlow Bath • Upgrade of the Great Western Highway from two lanes to four lanes in Medlow Bath • Construction expected to commence in 2022, pending planning approval	Construction impacts of this project include: • temporary delays to motorists and increased construction traffic • change in pedestrian and cyclist access through Medlow Bath • bus service delays • temporary localised air quality, noise and vibration and visual amenity impacts due to construction work • physical impact to non-Aboriginal heritage items.	Operational impacts of this project include: • improved traffic flows and road safety through Medlow Bath • provision of new public transport and active transport facilities through Medlow Bath • capacity for larger freight vehicles to use the Great Western Highway, reducing the number of heavy vehicles. • visual impacts to the mountain village from the duplication of the highway and the new pedestrian bridge.
Great Western Highway Upgrade Program – Little Hartley to Lithgow (West Section) • Upgrade of the Great Western Highway from two lanes to four lanes between Little Hartley and Lithgow • Construction expected to commence in 2022, pending planning approval	Construction impacts of this project include: • removal of 75.19 ha of native PCT vegetation and 215.32 ha of non-PCT vegetation • minor increases in traffic volumes due to construction traffic • localised noise and vibration impacts to sensitive receivers and structures, including from blasting near River Lett Hill • direct and indirect impacts to Aboriginal heritage sites • direct and indirect impacts to non-Aboriginal heritage items, including major impacts to one listed heritage item and three unlisted heritage items • acquisition of private and public land • temporary local visual amenity impacts from light spill during night work and vegetation clearing.	Operational impacts of this project include: • improved safety and road network performance between Little Hartley and Lithgow, with an expected 57 per cent reduction of the total crash rate on this section of the Great Western Highway • reduced pollutant loads compared to existing conditions, resulting in a beneficial effect on water quality • increased localised flooding near River Lett and Rosedale Creek • increased road traffic noise levels for sensitive receivers due to the revised alignment of the Great Western Highway • long term positive impacts on access and connectivity between the Central West, Blue Mountains and Sydney • safer access and enhanced amenity for residents and businesses within the Little Hartley Village • provision of an upgraded active transport network.

Project	Construction impacts	Operational impacts
Medlow Bath West Sectioning Hut • Construction expected to be complete by 2023	Construction impacts of this project include: • localised noise and vibration impacts to sensitive receivers near Coachhouse Lane, Belgravia Street, Kanimbla Street and Station Street, Medlow Bath • minor native and non-native vegetation removal, including up to 0.47 ha of low condition PCT 1248 (native vegetation) and up to 0.12 ha of non-native vegetation • increased construction traffic and temporary traffic detours.	Operational impacts of this project include noise impacts from use of a temporary generator during maintenance periods and increased visual dominance of the rail corridor and infrastructure for motorists and pedestrians using Station Street.

6.11.4 Potential impacts

The potential cumulative impacts of the proposal and other nearby projects have been assessed during the period of construction and within 10 years of opening of the proposal, where sufficient information on impacts is publicly available.

Traffic and transport

Construction of the proposal would partially overlap with the construction of the Medlow Bath Upgrade and would be constructed simultaneously with the Little Hartley to Lithgow Upgrade. Concurrent construction work between the projects near Medlow Bath would be staged to minimise concurrent traffic impacts through Medlow Bath and between Katoomba and Blackheath. The proposal has been developed to enable the continual operation of the highway by maintaining traffic flow in line with the existing conditions during construction.

The Great Western Highway between Katoomba and Lithgow and the broader Blue Mountains road network may experience some traffic fatigue between 2023 and 2027 during construction of these projects. Motorists travelling along the Great Western Highway between Katoomba and Lithgow would be most affected by these ongoing disruptions. There would be localised traffic disruptions such as short-term stoppages, traffic switches and incident response during construction along this length of the highway. Access to ancillary facilities and work sites would be in discrete locations that may cause traffic delays through the proposal area and cause frustration for motorists, pedestrians or cyclists. These delays would be most noticeable on weekends and during peak holiday periods, when the Great Western Highway is known to experience higher traffic volumes.

The Blackheath to Little Hartley Upgrade would still be under construction once the other projects within the Great Western Highway Upgrade Program are operational. This may see additional construction vehicles and heavy machinery travelling along the highway until construction of this project is completed.

Once all projects within the Great Western Highway Upgrade Program are operational, there would be positive cumulative impacts associated with improved travel time, safety, freight efficiency, resilience and reduced congestion along the road corridor between Katoomba and Lithgow. The Great Western Highway Upgrade Program would deliver more efficient and reliable journeys for those travelling in, around and through the Blue Mountains, and better connect communities in the Central West.

Transport would also seek to maintain and enhance active transport opportunities along the length of the Great Western Highway Upgrade Program, with these benefits to be realised once construction of the program is complete.

Surface water, groundwater and flooding

Potential impacts to surface water for these projects would be relatively confined to particular catchments, but if not managed appropriately would affect water quality and sensitive receiving environments more broadly in the Blue Mountains area.

Of particular concern would be any downstream impacts to the Blue Mountains National Park and the Special Catchment Areas. The Medlow Bath Upgrade would result in a beneficial effect on surface water quality through an operational water quality treatment process involving the installation of an onsite stormwater detention basin. This process is designed to remove gross pollutants and reduce residual pollutants from surface water runoff from the Great Western Highway. This would minimise the potential for cumulative contamination of surface water sources due to this project and the proposal.

The Little Hartley to Lithgow Upgrade is also expected to result in reduced pollutant loads and a beneficial effect on surface water quality compared to existing conditions through cross and longitudinal drainage and permanent dry biofiltration basins. Cumulative impacts associated with surface water and flooding between this project and the proposal are not expected.

Localised flooding impacts associated with the Medlow Bath Upgrade would be minimised through drainage upgrades. The potential for cumulative impacts between this project and the proposal are anticipated to be minor. These cumulative impacts have been minimised by considering the section of the Medlow Bath Upgrade that drains towards Foy Avenue in the drainage and water quality design for this proposal.

Blockage or diversion of local drainage lines during construction could result in localised flooding upstream of work. This could carry additional contaminants into receiving watercourses, resulting in minor and localised impacts. Across all projects, Transport would appropriately manage runoff from construction in accordance with industry best practice.

The Great Western Highway Upgrade Program would result in a cumulative increase to existing impervious areas and horizontal/vertical alignments along the upgraded road corridor. At present, there is minimal piped infrastructure. This would increase the volume and flow of surface water into receiving catchments and reduce the rate of recharge of groundwater. Changes in stormwater and groundwater interactions may also cause an increase in groundwater and soil salinity.

However, the proposed design for the Great Western Highway Upgrade Program includes provision for capture of surface runoff with a large pit and pipe network and lead to a minimal impact on the receiving surface water sources. This would result in an improvement along the entire Great Western Highway road corridor between Katoomba and Lithgow compared to the existing scenario. Transport would continue to work with Blue Mountains City Council, Lithgow City Council and Water NSW to develop a water quality strategy across the upgrade program to improve water runoff from the highway.

Heritage

The Great Western Highway Upgrade Program would result in impacts to both Aboriginal and non-Aboriginal heritage items between Katoomba and Lithgow. The entire Blue Mountains region has a high level of Aboriginal and non-Aboriginal cultural significance. This includes a high number of heritage items connected with European exploration of the region near the road corridor as well as Aboriginal objects, sites, and places including those registered on AHIMS.

The Great Western Highway Upgrade Program would generate positive outcomes for both non-Aboriginal and Aboriginal heritage values in the Blue Mountains. Transport is currently engaging with specialist heritage consultants and stakeholders to develop a heritage interpretation strategy across the Great Western Highway Upgrade Program – Katoomba to Lithgow. This heritage interpretation strategy would look to interpret both Aboriginal and non-Aboriginal heritage along the highway alignment.

Non-Aboriginal heritage

The Medlow Bath Upgrade would impact non-Aboriginal heritage items including those near Medlow Bath Railway Station, Avenue of Trees and Bellevue Crescent. The project has also avoided impact to other heritage items through the village of Medlow Bath.

The Little Hartley to Lithgow Upgrade would impact listed and unlisted heritage items, including major impacts to four items (including one locally listed heritage item) and moderate impacts to four items (including two State and one locally listed heritage items).

Cumulatively, the Great Western Highway Upgrade Program would result in impacts to multiple individual non-Aboriginal heritage items between Katoomba and Lithgow. However, each project has avoided, minimised or mitigated impacts to these items where possible. Impacts to non-Aboriginal heritage across all projects are not significant when considered cumulatively.

Aboriginal cultural heritage

An Aboriginal Cultural Heritage Assessment Report (Transport, 2021c) has been carried out for the Great Western Highway Upgrade Program.

No AHIMS records have been identified near the proposal or the Medlow Bath Upgrade. The study areas for these projects are highly modified as a result of previous development of the existing Great Western Highway and associated infrastructure and the townships of Medlow Bath and Blackheath. The high levels of previous ground disturbance within these study areas reduces the likelihood of the discovery of unexpected Aboriginal cultural heritage items during construction.

The project area for the entire Great Western Highway Upgrade Program (inclusive of adjacent sites) contains a total of 25 Aboriginal sites. The overall significance of these Aboriginal sites falls within a range of low to high. These have been identified near the Blackheath to Little Hartley Upgrade and Little Hartley to Lithgow Upgrade. These sites located near the Great Western Highway are of increased significance due to their rarity in an increasingly developed environment. Any impact to these sites during construction of each project would minimise the broader cumulative Aboriginal cultural heritage impacts of the Great Western Highway Upgrade Program.

Biodiversity

Residential and infrastructure development near the Great Western Highway (particularly between Mt Victoria and Lithgow) in historic and recent times has led to extensive vegetation clearing near the identified projects. In some areas, remaining remnant vegetation and habitat has also been affected by a variety of disturbance mechanisms, including clearing of undergrowth, altered fire regimes, feral animals and weed invasion. In other areas, large extents of vegetation remain close to the highway, include remnant bushland that wraps around town development and areas that have regenerated such as around Pulpit Hill.

The Great Western Highway Upgrade Program would result in further vegetation removal. This would result in long-term effects such as habitat fragmentation and some loss of wildlife connectivity corridors in the area. Invasion and further spread of weeds, pests and pathogens, and changes to surface hydrology may occur due to these projects and the associated vegetation removal. The direct biodiversity impacts of the identified projects to native vegetation, where publicly available, are identified in Table 6-64.

Table 6-64: Direct impacts to native vegetation

Plant Community Type (PCT)	Direct impacts to native vegetation (hectares)			
	Katoomba to Blackheath Upgrade (this proposal)	Medlow Bath Upgrade	Medlow Bath West Sectioning Hut	Little Hartley to Lithgow Upgrade
PCT 85 – River Oak forest and woodland wetland of the NSW South Western Slopes and South Eastern Highlands Bioregion	-	-	-	4.3
PCT 731 – Broad-leaved Peppermint – Red Stringybark grassy open forest on undulating hills, South Eastern Highlands Bioregion	-	-	-	30.13
PCT 732 – Broad-leaved Peppermint – Ribbon Gum grassy open forest in the north east of the South Eastern Highlands Bioregion	-	-	-	6.42
PCT 963 – Narrow-leaved Peppermint - Mountain Gum - Brown Barrel moist open forest on high altitude ranges, northern South Eastern Highlands Bioregion	-	-	-	1.2
PCT 967 – Narrow-leaved Peppermint – Silvertop Ash – Mountain Grey Gum shrubby open forest of the upper Blue Mountains, Sydney Basin Bioregion	0.76	-	-	-
PCT 1103 – Ribbon Gum – Yellow Box grassy woodland on undulating terrain of the eastern tablelands; South Eastern Highlands Bioregion	-	-	-	23.42
PCT 1155 – Silvertop Ash – Narrow-leaved Peppermint open forest on ridges of the eastern tableland, South Eastern Highlands Bioregion and South East Corner Bioregion	-	-	-	9.72
PCT 1248 – Sydney Peppermint – Silvertop Ash heathy open forest on sandstone ridges of the upper Blue Mountains, Sydney Basin Bioregion	46.8	0.34	0.47	-

Most of the vegetation likely to be affected by the proposal is located adjacent to the Great Western Highway and has been subject to historic clearing and edge effects. It is thinned in areas and some areas are dominated by a range of introduced species. This increase is considered unlikely to significantly exacerbate impacts on biodiversity such that the critical threshold would be reached or that there cumulative significant impacts.

The implementation of a biodiversity offset strategy for individual projects within the Great Western Highway Upgrade Program (where required) would mean that offsets are attributed to the relevant projects. As such, further offsets beyond those identified for each project are not required. The significance of impacts and requirement for offset strategies for each project is as follows:

- This proposal is not likely to significantly impact threatened species or ecological communities or their habitats. However, it requires a biodiversity offset strategy due to the area of vegetation impacted under Transport's guidelines. Refer to Section 6.3.5 for details.
- The Medlow Bath Upgrade is not likely to have a significant impact on threatened species, ecological communities and their habitats. Residual impacts are to be minimised and mitigated. As such, a biodiversity offset strategy is not required for this project.
- The Little Hartley to Lithgow Upgrade is likely to have a significant impact on the critically endangered ecological community White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland, listed as critically endangered under the BC Act. A biodiversity offset strategy would be prepared for this project under the BAM.

Indirect impacts on biodiversity from noise, dust, light and contaminant pollution are likely to result from the projects and would likely result in incremental cumulative effects. The environmental safeguards and mitigation measures implemented as part of each project would minimise potential impacts such as appropriate controls to manage dust emission, runoff, spills and leaks during construction.

Even though the Little Hartley to Lithgow Upgrade is likely to have a significant impact on threatened species or ecological communities or their habitats, this finding does not change the non-significant impact finding of this proposal.

As part of the Great Western Highway Upgrade Program, Transport is considering a parcel of land which may be suitable to meet its biodiversity offset requirements as well as provide compensatory land for the national park revocation. This offset land could be protected as part of the Blue Mountains National Park.

Property and land use

The Medlow Bath Upgrade would result in the full acquisition of eight properties and partial acquisition of one property. The Little Hartley to Lithgow Upgrade would result in the full acquisition of 11 properties (including four properties owned by the NPWS) and the partial acquisition of 50 properties. While this proposal would also result in property acquisition, impacts to affected property owners would be localised. This would minimise the potential for any cumulative impacts due to property acquisition.

However, as noted, both this proposal and the Little Hartley to Lithgow Upgrade would impact part of the Blue Mountains National Park. Transport is seeking to revoke the land required for the program.

There could be cumulative impacts to the natural and cultural resources which exist within the national park by reducing its extent. However, the area proposed for revocation is a small part of the entire Blue Mountains National Park and is adjacent to the existing highway, with numerous access trails. Part of the revocation process is providing compensatory lands to the national park being revoked in all areas of the Great Western Highway Upgrade Program. Transport is investigating opportunities for additional land near the Great Western Highway to be gazetted as national park to offset the cumulative impact on national park in the area. This would result in more land in the Blue Mountains region being protected as national park and enhance protection of the natural and cultural resources of the regional landscape. These discussions are ongoing between Transport and NPWS.

Noise

Construction noise impacts from the Medlow Bath Upgrade, the Little Hartley to Lithgow Upgrade and this proposal would be expected to impact some sensitive receivers during construction.

The Little Hartley to Lithgow Upgrade would result in construction noise impacts to receivers, including sparsely distributed rural residential properties and a small number of commercial properties. This project and the proposal are not expected to cause cumulative construction noise impacts due to the length of the project and because the noise impacts would be localised.

The construction of the Medlow Bath Upgrade has been staged to be complete before main construction work commences for this proposal (refer to Section 3.3.2). This is to deliver access improvements in Medlow Bath and limit the amenity impacts of multiple construction projects running in and around Medlow Bath at the same time.

Construction staging would mean that construction work from both projects would not be occurring simultaneously. This would mean that there is no cumulative increase in construction noise levels for sensitive receivers near Coachhouse Lane, Foy Avenue and Delmonte Avenue, Medlow Bath, near the tie-in of the proposal with the Medlow Bath Upgrade. However, there may be some sensitive receivers in these areas who may also experience noise impacts over a longer duration due to the projects. However, the impacts would not be for the full construction period of the proposal and the Medlow Bath Upgrade.

Transport would work with eligible receivers to provide appropriate mitigation, including respite periods where feasible.

There would also be cumulative operational noise impacts on some receivers in these areas. The noise and vibration assessment carried out for this proposal identified two sensitive receivers as being eligible for at-property treatment which were also identified as part of the Medlow Bath Upgrade. These cumulative noise impacts would be considered when determining noise mitigations for individual receivers. Transport would also make sure that noise impacts are treated consistently across all projects within the Great Western Highway Upgrade Program.

Landscape character and visual impact

Construction work for the Great Western Highway Upgrade Program would be linear, and as such, static receivers such as townships or receivers would experience limited cumulative landscape character and visual impacts. Medlow Bath residents who travel regularly to Katoomba or Blackheath would be exposed to the visual impacts of the proposal, the Medlow Bath West Sectioning Hut project and the Medlow Bath Upgrade. These future projects would have localised visual impacts in the township.

The largest cumulative visual impacts from the upgrade program would be motorists and active transport users travelling along the Great Western Highway beyond one project area.

There would be a change in landscape character between Katoomba and Lithgow due to the entire Great Western Highway Upgrade Program. The removal of vegetation and widening of the Great Western Highway road corridor from one to two lanes in each direction would lead to cumulative operational visual impacts. This would be most noticeable for motorists travelling the length of the upgraded highway. However, the Great Western Highway Upgrade Program has applied a consistent urban design framework across all projects. The design of the Medlow Bath Upgrade is an integrated design that fits with the existing visual qualities, ecology and character of Medlow Bath and the Blue Mountains. This proposal has also considered the urban design and visual impacts on the township of Medlow Bath. The design of the Little Hartley to Lithgow Upgrade integrates the project within the surrounding rural landscape and minimises the visual impact of the proposal.

The application of the consistent urban design strategy would minimise the potential for inconsistent landscape character impacts along the upgraded road corridor between Katoomba and Lithgow.

Socio-economic

Some residents of the Blue Mountains community may be impacted by consultation for and construction of multiple upgrades within the Great Western Highway Upgrade Program. This may lead to consultation and construction fatigue for local communities and stakeholders, with construction of these projects spanning from 2023 to 2027.

Cumulative impacts from construction would be in the form of reduced amenity and disruptions for road users during the construction of the Medlow Bath Upgrade, Little Hartley to Lithgow Upgrade and this proposal. There would be air quality, noise and visual impacts which could impact on the health and wellbeing of sensitive receivers who live near the Great Western Highway between Katoomba and Lithgow. These impacts would also be experienced by active transport users travelling between Katoomba and Blackheath along the existing active transport network. While the Medlow Bath Upgrade may be completed prior to the main construction work of this proposal, there would be extended impacts along the road corridor beyond the length of one of the projects. However, due to the linear nature of the projects, impacts at any one location would be localised for only part of each project's construction period. Transport would manage the staging of construction of the Great Western Highway Upgrade Program to minimise these impacts on receivers.

Cumulatively, the projects within the Great Western Highway Upgrade Program would improve connection to social infrastructure and provide new active transport opportunities along the Great Western Highway. There would be long term positive impacts on access and connectivity for local and regional communities, business and industry. The projects would improve resilience for local traffic movements, including during peak travel periods and emergencies. The Medlow Bath Upgrade would provide better east/west connectivity for residents, visitors and recreation users on the proposed shared user path. This would enhance the tourism reputation of the town of Medlow Bath and broader Blue Mountains area. The Little Hartley to Lithgow Upgrade also includes provision for the future development of shared paths near that project. These features would also provide wellbeing benefits to residents and visitors, who would be more easily able to access recreational sites in the region.

Significance of impacts

The impact of this proposal, when considered cumulatively with other projects, would not increase to the extent that would change a non-significant impact (identified in Sections 6.1 to 0) to a significant impact. For biodiversity, the significant impact from Little Hartley to Lithgow Upgrade due to TEC impacts would not result in a cumulatively larger impact or change the impacts of this proposal to be significant. As such, there would not be significant cumulative assessed impacts of the Great Western Highway Upgrade Program.

Overall, a number of positive cumulative impacts would occur across the Great Western Highway Upgrade Program through completion of upgrades to the last section of the Great Western Highway (between Sydney and Lithgow). This would result in improved:

- resilience and emergency management conditions
- connectivity for all road users along and across the corridor
- active transport links
- consistency of travel conditions
- network efficiency and freight productivity
- safety for all road users
- quality of surface water run off to the surrounding environment
- local amenity through heritage interpretation.

6.11.5 Safeguards and management measures

Safeguards and management measures for cumulative impacts are outlined in Table 6-65.

Table 6-65: Safeguards and management measures – cumulative impacts

Impact	Environmental safeguards	Responsibility	Timing	Reference
Cumulative impacts	Ongoing consultation will be carried out between proponents and construction contractors of nearby projects to identify the potential for cumulative impacts to occur should construction occur concurrently with the proposal.	Transport / Contractor	Detailed design / Pre-construction / Construction	Additional safeguard
Cumulative impacts	Co-ordination of traffic management controls will be considered to minimise cumulative traffic impacts, particularly during peak holiday periods.	Transport / Contractor	Detailed design / Pre-construction / Construction	Additional safeguard
Cumulative impacts	Co-ordination of out of hours work will be considered across the Great Western Highway East – Katoomba to Blackheath and the Great Western Highway Upgrade – Medlow Bath in Medlow Bath to minimise out of hours work periods and minimise ongoing out of hours work noise to sensitive receivers and ensure respite periods are achieved where required.	Transport / Contractor	Detailed design / Pre-construction / Construction	Additional safeguard