New England Highway bypass of Singleton

Review of Environmental Factors

Transport for NSW | December 2019





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Transport for NSW | December 2019

Prepared by AECOM Australia Pty Ltd and Roads and Maritime Services

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Document controls

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Signed:	
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19.1497	New England Highway bypass of Singleton review of environmental
ISBN: 978-1-922338-21-1	factors (REF)

Executive summary

The proposal

Roads and Maritime Services (Roads and Maritime) proposes to build a New England Highway bypass of Singleton (the proposal). The proposal is located to the west of Singleton and connects the New England Highway to the north and south of Singleton. Key features of the proposal include:

- About eight kilometres of new highway (the bypass) with a single lane in each direction
- Connection with the New England Highway at the southern end of the bypass (the southern connection) including a southbound entry ramp and northbound exit ramp
- A 55 metre long bridge over the bypass at the southern connection
- A 1.7 kilometre long bridge over the Main North railway line, the Doughboy Hollow and Hunter River floodplain, Army Camp Road and Putty Road (bridge over the floodplain)
- Connection to Putty Road including a northbound entry ramp and southbound exit ramp (the Putty Road connection)
- A 40 metre long bridge over the entry ramp at the Putty Road connection
- A 100 metre long bridge over Rose Point floodway
- A 205 metre long bridge over the Hunter River
- A 40 metre long bridge over the New England Highway west of the existing Main North railway line overbridge (known as Gowrie Gates)
- Connection with the New England Highway at Gowrie Gates consisting of a southbound entry ramp and northbound exit ramp. The northbound exit ramp would connect to the New England Highway via a new roundabout intersection at Maison Dieu Road
- A 1.7 kilometre northbound climbing lane between Gowrie Gates and the northern connection
- Connection at Magpie Street including providing access to the nearby industrial area (the northern connection), consisting of a southbound entry ramp, southbound exit ramp and northbound entry ramp
- A 60 metre long bridge over the bypass at the northern connection.

Timing for construction of the proposal has not been confirmed and is subject to approval and funding availability. Construction would take around three years to complete.

Need for the proposal

The New England Highway is a major freight and commuter route forming part of the Sydney to Brisbane Corridor of the National Land Transport Network and the primary route connecting the Upper Hunter with Maitland and Newcastle. The highway currently passes through Singleton forming the main access route through town. The traffic flow along this route currently experiences delays and congestion, notably for extended morning and afternoon peak periods, with heavy vehicle movements adding further delays and congestion.

The capacity of the route will be put under further pressure as regional growth continues, with longer delays and increased traffic congestion predicted. The ability of road users to continue their journey on a bypass would reduce the volume of heavy freight vehicles and road users travelling through Singleton.

The proposal is also considered consistent with the objectives of multiple Australian and State government strategic documents including the Australian Infrastructure Plan (Infrastructure Australia, 2016) and the Future Transport Strategy 2056 (Infrastructure NSW, 2018).

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Proposal objectives

The objectives of the proposal are:

- Improve travel reliability on the New England Highway through Singleton, particularly for road freight supporting the Upper Hunter and the North West New England region
- Improve the amenity of Singleton by removing freight traffic
- Improve road safety for through and local traffic in Singleton
- Support future traffic growth along the New England Highway associated with planned land use in the Upper Hunter area
- Provide access for oversize over mass vehicles along the New England Highway.

Options considered

Roads and Maritime has carried out multiple investigations to identify a preferred route for a New England Highway bypass of Singleton. The initial investigations considered multiple corridors for the bypass, with subsequent investigations considering three shortlisted route options.

Selection of the preferred option took into account social, environmental and economic factors as well as community and stakeholder feedback received during a public display period. The preferred option would achieve the most beneficial improvement to traffic flow, travel times and safety on the New England Highway through Singleton by attracting the greatest volume of traffic away from the New England Highway to the proposal.

Statutory and planning framework

The proposal is for road infrastructure facilities and is to be carried out by Roads and Maritime and can therefore be assessed under Division 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). Development consent from Singleton Council is not required. This review of environment factors (REF) has examined and considered all matters affecting or likely to affect the environment by reason of the proposed activity.

A strategic assessment under Roads and Maritime's *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) – Strategic Assessment also applies to the proposal. This REF has been prepared to meet the requirements of the EPBC Act strategic assessment approval for Roads and Maritime activities being assessed under Division 5.1 of the EP&A Act. Therefore a referral to the Australian Department of the Environment and Energy is not required.

Community and stakeholder consultation

Consultation for development of the proposal was carried out between September 2015 and October 2015, including public display of the three shortlisted options. Further consultation activities were carried out to refine the preferred option, which was selected in December 2016, and develop the concept design and REF.

During the development of this REF, Roads and Maritime has consulted with potentially affected property owners, community members, local business owners, relevant government agencies, including Singleton Council and other stakeholders. Matters raised during consultation included impacts to property and acquisition, operational traffic impacts, flooding and construction related impacts such as noise. Comments received during consultation have been considered and addressed in the REF.

Consultation with Aboriginal stakeholders has been carried out in accordance with the Procedure for Aboriginal Cultural Heritage Consultation and Investigation (PACHCI) (Roads and Maritime Services, 2011), the OEH Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010 and the requirements of Clause 60 of the National Parks and Wildlife Regulation 2009.

Roads and Maritime will continue to consult with the community and stakeholders as planning progresses. Information about the proposal is also available on the Roads and Maritime website.

Environmental impacts

The main environmental impacts and benefits of the proposal are summarised below.

Hydrology and flooding

The proposal crosses the Hunter River floodplain between the Hunter River and the southern connection, a length of approximately four kilometres. The floodplain is subject to periodic flooding during events greater than the one in five year flood (20 per cent Annual Exceedance Probability).

The proposal has been designed to achieve a one in 100 year (one per cent Annual Exceedance Probability) flood immunity on the bypass whilst minimising flooding impacts on surrounding land. The proposal would result in minor changes to the peak flood level locally around the Putty Road connection and the southern connection. The impact is localised and typically limited to rural property and the proposal area. In addition, there are reduced peak flood levels through much of Singleton and Glenridding. The proposal would provide additional flood evacuation routes and improve local accessibility during flood events up to and including a one in 20 year event.

Noise and vibration

An assessment of the potential noise and vibration impacts for the proposal was carried out for construction and the following operational scenarios, 'Do Minimum' (without the proposal) and 'Design (with the proposal) in the years 2026 and 2036.

The majority of construction works would be carried out during standard hours. The assessment identified that construction noise may exceed the criteria at a number of receivers during several construction scenarios. Pavement and earthwork activities are anticipated to cause the largest number of exceedances. These impacts would be managed through the implementation of mitigation measures including consultation with the affected community where required.

The operational noise assessment recommended that noise barriers be implemented to minimise impacts. With the six proposed noise barriers in place, 89 noise sensitive receivers are considered to be eligible for the consideration of at-receiver noise treatment.

Socio-economic issues

During construction, the proposal would result in temporary amenity impacts associated with construction activities including noise and vibration, traffic, air quality and visual impacts. The construction period has the potential to benefit the local economy through direct employment, the proposals direct expenditure as well as an increase in expenditure at local businesses by construction workers.

Once operational the proposal has the potential to impact local businesses within Singleton due to the diversion of traffic around the town. Surveys of local businesses and commuters carried out as part of investigations for the proposal identified that the overall impact to businesses is likely to be minor. The surveys identified that a large portion of highway traffic does not stop in Singleton despite travelling through. With this through traffic removed, amenity impacts in Singleton may improve due to reduced vehicle volumes in town. Singleton would remain visible from the bypass, with signage encouraging traffic to continue to stop in town to access local businesses.

The proposal would result in substantial potential benefits for freight vehicle movements. Improvements in the efficiency and reliability of these transport networks would likely result in increased productivity, reduced costs and broader economic benefits.

Biodiversity

The proposal area has been subject to a history of clearing and disturbance primarily as a result of agricultural activities. South of the Hunter River the floodplain is used extensively for cropping activities and the area to the north of the Hunter River has historically been used for grazing. The main area of native vegetation within the proposal area occurs around the northern connection where patches of native vegetation of varying quality exist.

The proposal will result in a loss of around 15.2 hectares of vegetation listed under the *Biodiversity Conservation Act 2016* (BC Act). About 16.9 hectares of the Central Hunter Valley eucalypt forest and woodland, listed as critically endangered under the EPBC Act will also be impacted. This would result in a reduction of habitat, including hollow-bearing trees, for a range of birds and mammals including threatened species, and loss of fauna habitat connectivity. An aerial fauna crossing over the New England Highway would be provided to help reduce potential impacts.

An assessment of significance has been carried out for threatened species and ecological communities that are likely to occur in the proposal area. The assessment found that the proposal is unlikely to have a significant impact on all matters listed under the BC Act. It was found that the proposal is likely to have a significant impact on Central Hunter Valley eucalypt forest and woodland listed as critically endangered under the EPBC Act. Roads and Maritime's strategic assessment has been applied to the proposal.

Aboriginal heritage

The proposal is anticipated to impact 16 Aboriginal archaeological sites, with a total loss of value for 13 sites and partial loss of value for the remaining three sites. One site of cultural significance will also be impacted by the proposal, resulting in a partial loss of value. An Aboriginal heritage impact permit would be sought for the proposal.

In order to manage the impact of the proposal on the identified Aboriginal cultural heritage values of the study area, a number of recommendations have been made.

Non-Aboriginal heritage

The proposal identified a number of listed heritage items within or adjacent to the proposal area. Three locally listed heritage items would be impacted by the proposal. These are the Former Pumping Station, Bebeah and the Woolpack Inn. Direct impacts would occur to the Former Pumping Station resulting in its complete removal. Bebeah and the Wooplack Inn were identified as being directly impacted by the proposal, with works occurring within the curtilage of these two items but not directly impacting the heritage significance of the listed buildings. Measures have been identified to mitigate these impacts through the archival recording and salvaging of material where appropriate.

Justification and conclusion

The proposal is recommended as it would best address the objectives for the New England Highway bypass of Singleton. The proposal is consistent with Government strategic planning at Commonwealth, State and regional levels. While there would be some adverse impacts to the local environment and community, they have been avoided or minimised wherever possible through design and site-specific safeguards.

The proposal is justified because it would help reduce existing congestion and delays along the New England Highway in Singleton, improve access and connectivity within Singleton, improve road safety and meet future traffic needs.

Display of the review of environmental factors

This REF is on display for comment between Monday 16 December 2019 and Sunday 1 March 2020. You can access the documents in the following ways:

Internet

The documents are available as pdf files on the Roads and Maritime website at https://www.rms.nsw.gov.au/projects/new-england-highway/singleton-bypass/index.html

Printed copies

The documents can be viewed at the following locations:

- Singleton Council Civic Centre, 12 Queen Street, Singleton
- Singleton Library, 8-10 Queen St, Singleton.

Copies by request

Printed and electronic copies are available by contacting Joel Rosendahl on 1800 991 254, noting that there may be a charge for hard copies, CD or USB.

Staffed displays

Community information sessions will be held at Quest Hotel Singleton at 5-7 Civic Ave, Singleton at the following times. A formal presentation will not be given so please drop in at any time:

- Thursday 30 January 2020, 10.30am to 1.30pm
- Thursday 30 January 2020, 4pm to 7pm
- Thursday 6 February 2020, 10.30am to 1.30pm
- Thursday 6 February 2020, 4pm to 7pm
- Thursday 11 February 2020, 10.30am to 1.30pm
- Thursday 11 February 2020, 4pm to 7pm

How can I make a submission?

To make a submission about this proposal, please send your written comments to:

Roads and Maritime Services

Writing: Joel Rosendahl

Locked Bag 2030 Newcastle 2300

Email: singleton.bypass@rms.nsw.gov.au

Submissions must be received by 5pm Sunday 1 March 2020. Submissions will be managed in accordance with the Roads and Maritime Services Privacy Statement which can be found here https://www.rms.nsw.gov.au/about/access-to-information/my-privacy.html or by contacting privacy@rms.nsw.gov.au for a copy.

What happens next?

Roads and Maritime will collate and consider the submissions received during public display of the REF.

After this consideration, Roads and Maritime will determine whether or not the proposal should proceed as proposed and will inform the community and stakeholders of this decision.

If the proposal is determined to proceed, Roads and Maritime will continue to consult with the community and stakeholders prior to and during construction.

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1. Introduction

This chapter introduces the proposal and provides the context of the environmental assessment. In introducing the proposal, the objectives and proposal development history are detailed and the purpose of the report provided.

1.1 Proposal identification

Roads and Maritime Services (Roads and Maritime) propose to build a New England Highway bypass of Singleton (the proposal). The proposal is a two lane highway bypass located to the west of Singleton.

The proposal is located in the Singleton local government area (LGA) in the Hunter Valley, 75 kilometres inland from Newcastle, 47 kilometres south-east of Muswellbrook and 200 kilometres north from Sydney (refer to Figure: 1-1).

The New England Highway currently passes through Singleton and forms the main road access through the town and to the town centre. More than 28,000 vehicles, including over 3700 heavy vehicles, use the highway through Singleton each day. In recent years, traffic growth has been high with the coal mining industry, commuters and heavy vehicles identified as major contributors. Traffic volumes are predicted to further increase as a result of population growth, future land developments in and around Singleton and general increase of freight movement across the region.

The New England Highway through Singleton is a two lane road with the corridor restricted by numerous intersections and adjacent buildings with minimal setback from the road. The road performance of the highway through Singleton is expected to gradually worsen over time with increasing traffic volumes. Road users are already experiencing traffic congestion and increased travel times through this corridor, as well as safety issues on the highway through the town.

A bypass at Singleton would improve traffic flow, travel times and safety through Singleton by reduced traffic volumes and improve the movement of heavy freight vehicles.

The proposed bypass route would depart the New England Highway near Newington Lane in Whittingham then head west over the Main North railway line across the floodplain over Putty Road. It would continue over the Hunter River, west of Singleton, before crossing the New England Highway west of Gowrie Gates and continue north before re-joining the highway north of McDougalls Hill.

The proposal, as assessed in this Review of Environmental Factors (REF), would include the following key features:

- About eight kilometres of the bypass of Singleton with a single lane in each direction
- Connection with the New England Highway at the southern end of the proposal, including a southbound entry ramp and northbound exit ramp only (the southern connection)
- A 55 metre long bridge over the bypass at the southern connection
- A 1.7 kilometre long bridge over the Main North railway line, Doughboy Hollow and Hunter River floodplain, Army Camp Road and Putty Road (bridge over the floodplain)
- Connection to Putty Road including a northbound entry ramp and southbound exit ramp (the Putty Road connection)
- A 40 metre bridge over the entry ramp at the Putty Road connection
- A 100 metre bridge over Rose Point floodway
- A 205 metre bridge over the Hunter River
- A 40 metre bridge over the New England Highway west of the existing Main North railway line overbridge (known as Gowrie Gates)

- Connection with the New England Highway at Gowrie Gates consisting of a southbound entry ramp and northbound exit ramp. The northbound exit ramp would connect to the New England Highway via a new roundabout intersection at Maison Dieu Road
- A 1.7 kilometre northbound climbing lane between Gowrie Gates and the northern connection
- Connection at Magpie Street providing access to the nearby industrial area (the northern connection), consisting of a southbound entry ramp, southbound exit ramp and northbound entry ramp
- A 60 metre long bridge over the bypass at the northern connection.

The location of the proposal is shown in Figure: 1-1.

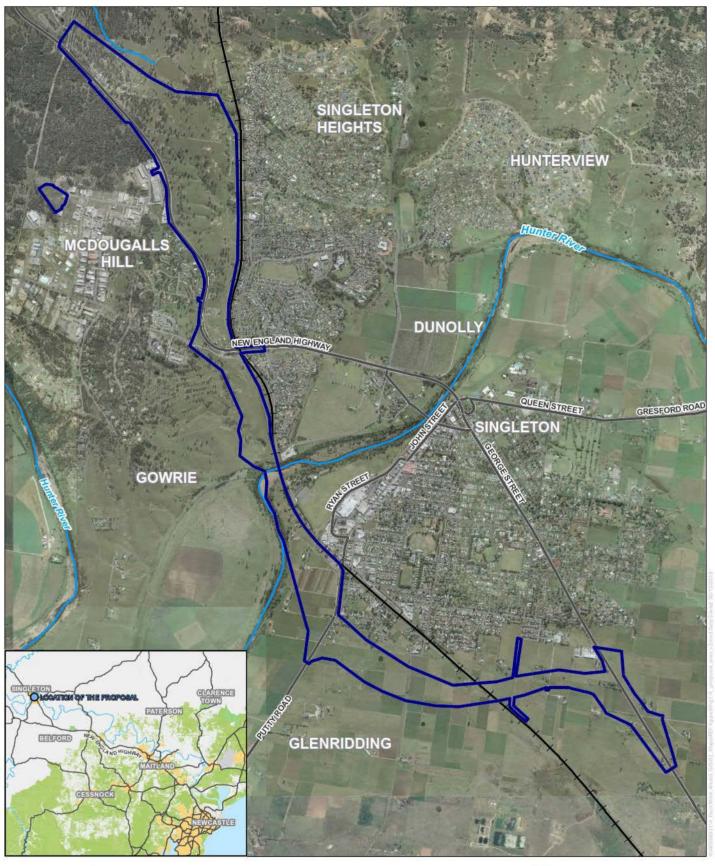


FIG. 1-1 Location of the proposal

Legend

Proposal features ——— Main North railway line

Other features

State roads

---- Watercourse

Proposal area

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1.2 Purpose of the report

This REF has been prepared by AECOM Pty Ltd on behalf of Roads and Maritime. For the purposes of these works, Roads and Maritime is the proponent and the determining authority under Division 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

The purpose of the REF is to describe the proposal, to document the likely impacts of the proposal on the environment, and to detail protective measures to be implemented.

The description of the proposed work and associated environmental impacts have been carried out in the context of clause 228 of the *Environmental Planning and Assessment Regulation 2000*, the factors in *Is an EIS Required? Best Practice Guidelines for Part 5 of the Environmental Planning and Assessment Act 1979* (Is an EIS required? guidelines) (DUAP, 1995/1996), the *Biodiversity Conservation Act 2016* (BC Act), the *Fisheries Management Act 1994* (FM Act), and the Australian Government's *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

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

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

The findings of the REF would be considered when assessing:

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

2. Need and options considered

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

2.1 Strategic need for the proposal

The New England Highway forms part of the inland Sydney to Brisbane Corridor of the National Land Transport Network (NLTN). This transport network is funded by the Australian, State and Territory governments and is recognised for its strategic importance to national and regional economic growth, development and connectivity.

On a regional scale, the New England Highway is a major freight and commuter route, passing through Singleton and forming the main road access through the town. The route allows for the transport of goods to domestic and international markets via Newcastle and Sydney. Due to mining activities in the region, the route also accommodates the transport of mining equipment and vehicles, which are often oversize and/or over-mass vehicles.

Within Singleton, the New England Highway generally consists of one lane in each direction and has a reduced speed limit of 50 kilometres per hour through the town. Average daily traffic volumes indicate that up to 28,000 vehicles use the highway through Singleton each day, with around 15 per cent of these being heavy vehicles. Based on the existing configuration, volume and mix of road users travelling the highway, traffic efficiency and safety of the existing highway would benefit from separation of local and through vehicles.

The traffic flow along this route currently experiences delays and congestion, notably for extended morning and afternoon peak periods due to the movements of mining workers and then local school and work trips. Heavy vehicle movements on this route add further delays and congestion.

The capacity of the route will be put under further pressure as regional growth continues, with longer delays and increased traffic congestion predicted. The ability of road users to continue their journey on a bypass would reduce the volume of heavy freight vehicles and road users travelling through Singleton. The proposal is expected to improve traffic flow, travel times and safety through Singleton, which would meet the proposal objectives as outlined in Section 2.3.1.

The proposal was identified in the NSW Government's Rebuilding NSW plan which is a \$20 billion program to fund and deliver infrastructure projects in NSW. Under this plan, the NSW Government committed \$92 million towards the New England Highway bypass of Singleton and allocated a further \$2.7 million in 2019-2020 to continue development of the proposal.

The proposal is also considered to be consistent with the objectives of the following Australian and State government strategic documents:

- Australian Infrastructure Plan (Infrastructure Australia, 2016)
- Future Transport Strategy 2056 (NSW Government, 2018)
- State Infrastructure Strategy 2018 2038: Building Momentum (Infrastructure NSW, 2018)
- Premier's Priorities 2015 2019 (NSW Government, 2015)
- NSW Freight and Ports Plan 2018 2023 (Transport for NSW, 2018a)
- Road Safety Plan 2021 (Transport for NSW, 2018b)
- New England Highway Draft Corridor Strategy (Transport for NSW, 2016)
- Hunter Economic Infrastructure Plan 2013 (Hunter Development Corporation, 2013)

- Upper Hunter Strategic Regional Land Use Plan (NSW Department of Planning and Infrastructure, 2012)
- Singleton Land Use Strategy (Singleton Council, 2008).

The consistency of proposal with these plans is discussed further below.

Australian Infrastructure Plan

The Australian Infrastructure Plan (Infrastructure Australia, 2016) recognises the importance of key freight routes. The Plan notes that bottlenecks and pinch points reduce efficiency and that these issues would be further exacerbated by population growth. Domestic freight is projected to grow by 80 per cent between 2011 and 2031, with much of that expected to be handled by road freight. A National Freight and Supply Chain Strategy was recommended in the Plan to define nationally significant freight corridors and precincts, identify the gaps and outline an investment plan to address these challenges. This strategy is currently being developed by the Australian Government. The proposal would address one of the challenges recognised in the Australian Infrastructure Plan, by removing a pinch point and alleviating congestion along a major freight and commuter transport route.

Future Transport Strategy 2056

The Future Transport Strategy 2056 (NSW Government, 2018) is an update of the 2012 Long Term Transport Master Plan for NSW. The Future Transport Strategy 2056 provides the framework for delivery of a transport system which focuses on customer needs and maximises the benefits of emerging technologies and innovation. The strategy sets out six state-wide outcomes for the NSW transport system and ten customer outcomes for the regional NSW transport network which include: ensuring economic development is enabled by regional transport services and infrastructure; providing safe, efficient and reliable movement of people and goods; and providing improved connectivity for customers. The proposal would assist in achieving a number of these outcomes, as it would improve connectivity of communities and industries, improve freight connections to markets and provide better links between the Upper Hunter, New England and Newcastle regions.

State Infrastructure Strategy 2018 – 2038: Building Momentum

The State Infrastructure Strategy 2018 – 2038: Building Momentum (2018 State Infrastructure Strategy) (Infrastructure NSW, 2018) is a 20 year strategy to plan and fund the infrastructure that the NSW Government delivers. The 2018 State Infrastructure Strategy provides an update from the State Infrastructure Strategy 2012: First Things First (2012 State Infrastructure Strategy) and State Infrastructure Strategy 2014: Rebuilding NSW (2014 State Infrastructure Strategy).

The 2012 State Infrastructure Strategy and the 2014 State Infrastructure Strategy identified and prioritised critical public infrastructure projects to drive productivity and growth in NSW, while the 2018 State Infrastructure Strategy identifies the policies and strategies which are needed to continue driving infrastructure delivery.

Included in the 2014 State Infrastructure Strategy was a commitment to develop a corridor strategy for the New England Highway to guide investment priorities. In March 2015, the NSW Government announced a \$92 million commitment for a bypass of the New England Highway at Singleton to address a well-known pinch point. The geographic directions of the 2018 State Infrastructure Strategy identifies that different parts of NSW have different opportunities and needs and that regional NSW needs to be supported by good transport links.

This proposal delivers on the commitment made as part of the 2014 State Infrastructure Strategy which would assist in delivering a regional transport link by alleviating the congestion on the New England Highway through Singleton, improving efficiency and connectivity along a major freight and commuter route. The proposal would also address a key transport recommendation made as part of the 2018 State Infrastructure Strategy, to develop and protect freight and service networks by improving road and rail access for goods and services to local, national and global markets.

Premier's Priorities 2015 - 2019

In 2015 the NSW Premier committed to delivering 12 priorities, including the Delivering Infrastructure priority which aims at delivering key metropolitan, regional and local infrastructure projects. This priority aims to ensure all local communities across NSW have access to the infrastructure they need, including safer and higher quality roads and highways.

The proposal would be consistent with the aims of the Delivering Infrastructure priority, as it would improve the freight and commuter efficiency along the New England Highway and improve congestion and safety for local traffic in Singleton.

NSW Freight and Ports Plan 2018 - 2023

The NSW Freight and Ports Plan 2018 – 2023 (Transport for NSW, 2018a) identifies key issues for the transport sector that need to be considered and incorporated into land use and infrastructure planning. The plan sets out five objectives to encourage economic growth; increase efficiency, connectivity and access; deliver capacity enhancements; and improve safety and sustainability. The plan includes a specific goal for creating a safe freight supply chain, with safe networks, transport, speeds and people.

The New England Highway is identified in the plan as an important regional road for freight. The proposal would contribute to the goals and objectives of the plan as it would improve the efficiency and safety of the highway and local Singleton road network by separating heavy vehicle movements along a bypass instead of through the town of Singleton.

Road Safety Plan 2021

The Road Safety Plan 2021 (Transport for NSW, 2018b) sets out targeted initiatives across six priority areas that will be delivered to progress towards the State Priority Target of reducing fatalities by 30 percent by 2021. Initiatives include infrastructure upgrades on country roads (such as wide centre lines, flexible barriers and sealed shoulders), enhanced planning and design of major roads and upgrades with safety at the core, and development of a new heavy vehicle safety strategy to improve operational safety of road freight in NSW.

Consistent with these initiatives, the proposal has been designed in accordance with relevant safety standards and design criteria (refer to Section 3.2) and would improve road safety for through and local traffic in Singleton. The diversion of traffic, especially heavy freight vehicles, to the bypass would reduce the volume of traffic travelling through Singleton and reduce the potential for crashes involving heavy vehicles.

New England Highway Draft Corridor Strategy

The New England Highway Draft Corridor Strategy (Transport for NSW, 2016) sets out the 20 year plan to manage and guide the development of the road corridor to improve safety, traffic efficiency and sustainability. The strategy sets out the short-term priorities which include selecting a preferred option for a New England Highway bypass of Singleton and preserving the corridor in the Singleton Local Environmental Plan.

The proposal would assist in delivering the preferred option for a New England Highway bypass of Singleton which would also improve safety and traffic efficiency on this route.

Hunter Economic Infrastructure Plan 2013

The *Hunter Economic Infrastructure Plan 2013* (Hunter Development Corporation, 2013) recognises capacity constraints and recommends priority infrastructure improvements that would assist the development of industry and affected communities. The Plan recognises the Singleton township (south and north) as a major pinch point on the road network serving the Hunter region, and recommends the consideration of a New England Highway bypass of Singleton in the medium-term (ie 2015 to 2020).

Consistent with this Plan, the proposal would provide the necessary infrastructure to address the traffic efficiency and safety issues by improving the movement of heavy freight vehicles and other road users along the bypass, rather than through the town of Singleton.

Upper Hunter Strategic Regional Land Use Plan

The *Upper Hunter Strategic Regional Land Use Plan* (The Upper Hunter Strategy) (NSW Department of Planning and Infrastructure, 2012) outlines a framework for supporting growth, protecting the environment and responding to competing land uses in the Upper Hunter region, whilst also preserving the key regional values of the Upper Hunter over the next 20 years. A key objective of the Upper Hunter Strategy is supplying required infrastructure to cater for sustainable economic and population growth in the region. The Upper Hunter Strategy also notes that consideration needs to be given to improved traffic management through towns (in particular Singleton).

The proposal would improve freight efficiency along the New England Highway by supporting the expected increase in road freight due to economic growth and population growth, as well as improving traffic efficiency through Singleton.

Singleton Land Use Strategy

The Singleton Land Use Strategy (Singleton Council, 2008) outlines key land use policies and principles for the Singleton LGA. This Strategy notes that increased traffic along the New England Highway would affect the adequacy and safety of existing traffic arrangements within Singleton and recommends that options for a bypass of Singleton be considered. The Strategy also recognises that determining a suitable bypass route would assist in future planning, particularly in deciding the location and layout of future residential and commercial land.

The proposal would contribute to the future planning of Singleton by reducing current levels of traffic congestion, improving road safety and increasing capacity of existing road infrastructure along the New England Highway. The proposal would also reduce potential crashes associated with heavy vehicles travelling through Singleton.

2.2 Existing infrastructure

The New England Highway is the main access road through Singleton. Access to the town from the south-west is also provided by Putty Road via the Golden Highway as well as from the north-east by Gresford Road and Queen Street. On a regional scale, the New England Highway connects Singleton with Muswellbrook and Scone to the north and Maitland to the south.

Passenger and freight train access is provided by the Main North railway line, which is located along the town's western boundary and includes the Singleton train station. The New England Highway passes under the recently upgraded Main North railway line rail bridge on the north side of Singleton, known as the Gowrie Gates.

Key road infrastructure (based on the connections and services they provide) to Singleton includes the following roads:

- New England Highway
- Putty Road.

The key infrastructure on each of the above roads is described below in Table 2-1 and Table 2-2. The infrastructure descriptions only consider the roads where they are in close proximity to or connect with the New England Highway.

Other roads within the proposal area or immediate vicinity include:

- Bridgman Road which connects Singleton Heights and Hunterview to the New England Highway
- John Street which runs through the Singleton town centre
- Maison Dieu Road which connects the suburb of Maison Dieu with the existing New England Highway
- Magpie Street which facilitates access between the industrial estate at McDougalls Hill and the New England Highway.

Existing infrastructure within the proposal area includes the Main North railway line, which intersects the proposal area at the bridge over the floodplain and then runs along the eastern boundary of the proposal area. Existing utilities within the proposal area include overhead and underground electricity, water, sewage, telecommunications and gas services (further detailed in Section 3.5). The Rixs Creek Rest Area is adjacent to the proposal area to the north-west, on the southbound side of the England Highway and accessed via Rixs Creek Lane. The Rixs Creek Rest Area caters for both heavy and light vehicles and provides amenities, sheltered picnic tables and litter collection facilities.

New England Highway

Table 2-1: Existing road infrastructure on the New England Highway within Singleton

Existing road infrastructure	New England Highway within Singleton
Connections	 This is a major north-south route passing through Singleton It provides access to Singleton town centre, Singleton Heights, coalfields and rural properties in the area
Road configuration	 Generally one lane in each direction The road widens to accommodate turning lanes at major intersections Traffic light controlled at major intersections A bridge over the Hunter River Highway underpass at Gowrie Gates
Posted speed limit	 50 kilometres per hour through Singleton town 60 kilometres per hour between Bridgman Road and Park View Crescent 80 kilometres per hour between Park View Crescent and Rixs Creek
Traffic volumes	About 28,000 vehicles per day
Pedestrian facilities	 Concrete pedestrian paths are on both sides of the road south of the Hunter River bridge and only on one side of the road north of the bridge Signalised pedestrian crossings are at major intersections
Cyclist facilities	 A shared pedestrian and cyclist path is located west of the Main North railway bridge
Parking	 Some sections of this route provide on street parking opportunities that are unrestricted and some that are subject to timed parking restrictions In other places along the route, the kerbside lane is managed by No Stopping and No Parking restrictions
Public transport	 Bus service 403 and 404 operated by Hunter Valley Buses services the New England Highway and George Street within the town centre of Singleton Designated bus zones are provided within this corridor for pick up and drop off of bus passengers and include shelters and signage

Putty Road

Table 2-2: Existing road infrastructure on Putty Road near Singleton

Existing road infrastructure	Putty Road near John Street
Connections	This is a rural arterial road which connects the Golden Highway to John Street, Singleton.
Road configuration	 Generally one lane in each direction Highway passes under the Main North railway line bridge Signalised intersection where Putty Road meets Ryan Avenue with a left turning lane and a through lane in the northbound direction. In the southbound direction, there is a left turning lane and a through lane
Posted speed limit	• 50 kilometres per hour
Traffic volumes	About 6000 vehicles per day
Pedestrian facilities	There are no dedicated pedestrian facilities
Cyclist facilities	There are no dedicated cyclist facilities, however cyclists can use the shoulder of the road
Parking	 There are no on street parking opportunities on Putty Road south of Ryan Avenue North of Ryan Avenue, there are some on street parking spaces subject to timed parking restrictions, as well as sections with 'No Stopping' restrictions (in both the northbound and southbound direction)
Public transport	There are no public transport services on Putty Road near Singleton

2.3 Proposal objectives and development criteria

2.3.1 Proposal objectives

The objectives of the proposal include:

- Improve travel reliability on the New England Highway through Singleton, particularly for road freight supporting the Upper Hunter and the North West New England region
- Improve the amenity of Singleton by removing freight traffic
- Improve road safety for through and local traffic in Singleton
- Support future traffic growth along the New England Highway associated with planned land use in the Upper Hunter area
- Provide access for oversize over mass vehicles along the New England Highway.

2.3.2 Development criteria

The development criteria for the proposal include:

 Provide about eight kilometres of new highway bypassing the town of Singleton with one lane in each direction, undivided with wide centreline treatment, and with provision for a future upgrade to four lanes

- Traffic lane widths to be minimum 3.5 metres
- Provide shoulder widths of three metres (outside shoulder) and 2.5 metres (outside shoulder on viaduct)
- Provide minimum flood immunity along the new highway for a one in 20 year flood event
- Provide connection at both the northern and southern ends of Singleton.

2.3.3 Urban design objectives

Urban design objectives for the proposal include:

- Enhance the urban connectivity and respond to the desired future character and functioning of the area
- Minimise impact on the community
- Design for low maintenance
- Respect the values of the surrounding heritage listed items
- Design the components of the bridges to be complimentary of each other
- Minimise visual impacts to the existing character of the setting.

2.4 Alternatives and options considered

The following sections describe the options that have been considered and assessed over the development of the proposal.

2.4.1 Methodology for selection of preferred option

Roads and Maritime has carried out multiple investigations to identify a preferred route for a New England Highway bypass of Singleton. The initial investigations considered multiple corridors where the bypass could be placed, with the following investigations considering more specific areas and route options. As the development of the proposal progressed, Roads and Maritime then looked closely at three shortlisted route options and incorporated community feedback as a key component in selecting a preferred route option.

The full options identification and assessment process is described in the *New England Highway Singleton Bypass Options Assessment – Route Options Identification Report* (Roads and Maritime, 2015) and the *Preferred Option Report* (Roads and Maritime, 2016). A summary of how the preferred option was identified throughout this process is summarised in Figure 2-1 and described briefly below.

The shortlisted route options for the bypass are discussed in Section 2.4.2 and an options analysis is provided in Section 2.4.3.

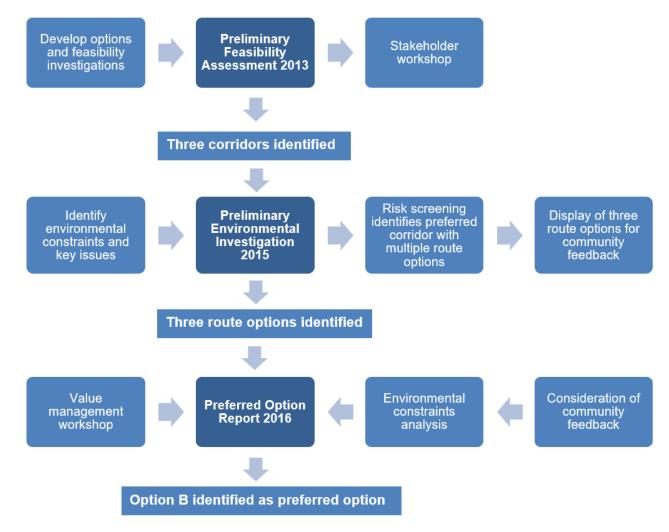


Figure 2-1: Development of the preferred option

Preliminary Feasibility Assessment Report 2013

The Preliminary Feasibility Assessment Report (AECOM, 2013) (Feasibility Assessment) included a corridor identification process which highlighted multiple corridors which could address the objectives of the proposal. The Feasibility Assessment determined the merit in carrying out further detailed investigations and planning for a New England Highway bypass of Singleton.

Four potential corridors were considered, including multiple route options within each corridor. Detailed traffic assessments, environmental constraints mapping and economic analysis were used to analyse the feasibility of each corridor.

The outcomes of the Feasibility Assessment assisted in reducing discussions to four strategic route options within three corridors.

Preliminary Environmental Investigation 2015

The three selected corridors from the Feasibility Assessment were then further analysed within the Preliminary Environmental Investigation Report (PEI) (AECOM, 2015) to identify potential environmental constraints in each corridor. The key environmental constraints considered in the PEI included biodiversity, Aboriginal and non-Aboriginal heritage, noise and vibration, flooding, visual amenity, social and economic factors and land use.

Following identification of the above mentioned environmental constraints in the three corridors, a preliminary environmental risk screening was used to identify multiple route options to be investigated. A total of 12 route options were identified within the Northern, Central and Southern corridors and were

assessed at a Multi Criteria Analysis workshop held in February 2015. The workshop reduced the 12 options to five and further investigations of these five options included detailed traffic investigations, environmental and flooding evaluations, strategic designs, cost estimates and economic analysis. Each option was assessed against a range of factors, including ease of construction, social and environmental factors and how well the road would function, to further reduce the options to three.

Three shortlisted route options (two in the Central Corridor and one in the Northern Corridor) were put on public display for community feedback in late 2015. The display period was held between 28 September 2015 and 23 October 2015, with a total of 168 submissions received. This community consultation is further discussed in Section 5.2.

Preferred Options Report 2016

The Preferred Options Report (AECOM, 2016) brought together community feedback, the results of further technical investigations as well as outcomes of a value management workshop held in March 2016 to compare and assess each of the three shortlisted route options.

In addition to the technical, socio-economic and environmental aspects of each shortlisted route option, the traffic efficiency of the route and how the option would affect flooding in and around Singleton were identified to be key considerations.

Out of the three shortlisted options, Option B was identified as the preferred route which provided a bypass to the west of Singleton which connected to the New England Highway north of McDougalls Hill and at Whittingham. All three shortlisted options are described in Section 2.4.2.

This route was also secured in the Singleton Local Environmental Plan 2013 for the future construction of the New England Highway bypass of Singleton.

2.4.2 Identified options

The main features of the three options considered for a New England Highway bypass of Singleton are described below and the routes are shown in Figure 2-2. The do nothing option has also been considered in this REF.

Do nothing option

This option would result in the New England Highway through Singleton continuing to function in its current state. There would be no New England Highway bypass of Singleton or improvement in traffic flow, travel times and safety though Singleton.

Option A

Option A would bypass Singleton to the west. This option would start south of Singleton and depart from the existing New England Highway at Range Road. A bridge would allow the bypass to cross over the Main North railway line and the bypass would then continue to the west, before curving to the north-west.

The bypass would pass over Army Camp Road via a bridge and would continue north-west with another bridge over both Putty Road and the Hunter River. Once on the northern side of the Hunter River, the bypass curves towards the north-east and then back to the north before crossing the New England Highway, west of Gowrie Gates. The bypass would continue north between the Main North railway line to the east and the New England Highway to the west.

This option would have a connection with Magpie Street at the McDougalls Hill Industrial area and would continue north to tie in with the existing New England Highway, north of McDougalls Hill.

This option would be about 13 kilometres in length.

Option B

Option B would bypass Singleton to the west. Option B would start south of Singleton, departing the New England Highway south of Newington Lane and would head west. The connection to the New England Highway would be located within the Doughboy Hollow floodplain. The main alignment would continue west and then cross over the Main North railway line with a bridge that also crosses Putty Road and then continues north to cross the Hunter River.

After crossing the Hunter River, Option B would curve towards the north-east and then back to the north, before crossing the New England Highway immediately west of Gowrie Gates. From here, Option B would continue in a northerly direction, and is positioned between the Main North railway line to the east and the New England Highway to the west.

This option would have a connection with Magpie Street at the McDougalls Hill Industrial area and would continue north to tie in with the existing New England Highway, north of McDougalls Hill.

This option would be about nine kilometres in length.

Option C

Option C would bypass Singleton to the east, departing the existing New England Highway, south of Newington Lane. It would then head north-east. The connection to the New England Highway would be located within the Doughboy Hollow floodplain, which would be bridged.

Option C would head north-west on a bridge across the Doughboy Hollow floodplain and the Hunter River floodplain. After crossing the Hunter River south of Gresford Road, Options C would curve towards the north through the suburbs of Clydesdale and Fern Gully. It would then run next to the left bank of the Hunter River and would pass over Gresford Road via a bridge.

Option C then curves to the north-west to pass between Hunterview and Wattle Ponds, and then heads west passing to the north of Singleton Heights. At this location Option C would travel over Gresford Road and then under Pioneer Road, Wattle Ponds Road and Bridgeman Road. North of Singleton Heights, Option C would cross over the Main North railway line via a bridge before connecting with the New England Highway north of Rixs Creek Lane. Included in this connection is a link to the McDougalls Hill industrial area.

This option would be about 11.9 kilometres in length.

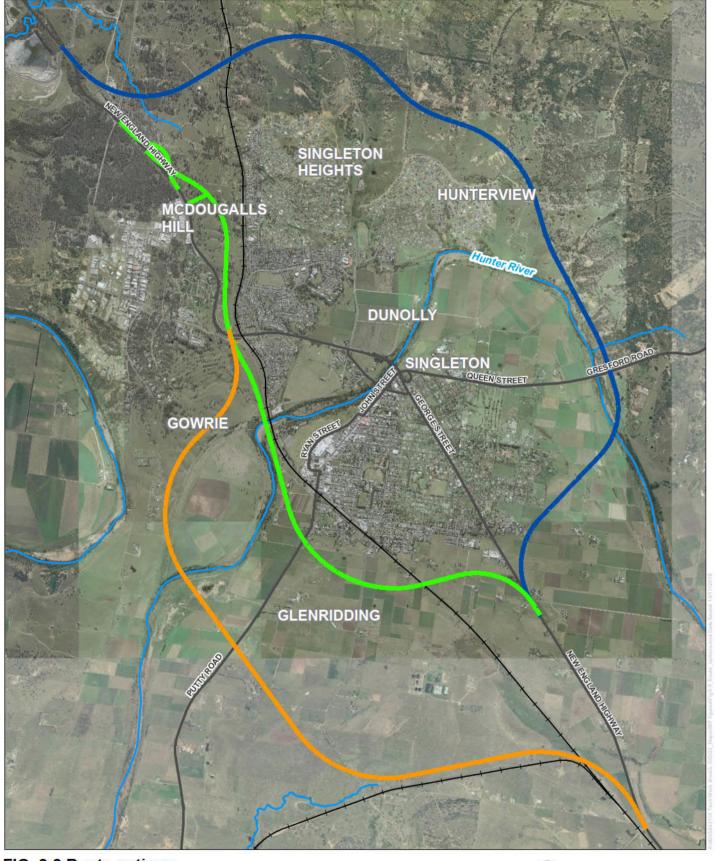


FIG. 2-2 Route options

-Watercourse

--- Main North railway line

Legend

Route option

Option A

Option B

Option C

Other features

-State roads



2.4.3 Analysis of options

The objectives of the proposal are presented in Section 2.3.1. The do nothing option would not meet the proposal objectives. There are some advantages of the do nothing option, including no costs incurred or funding required and there would be no construction traffic disruption or noise impacts. However, the large number of heavy vehicles and road users travelling through Singleton would continue to increase and there would be no improvements to the existing traffic congestion.

While all three of the shortlisted route options would generally meet the objectives of the proposal, some options performed better with regard to improvements to traffic efficiency and impacts to flooding in and around Singleton. As discussed in Section 2.4.1, these matters were identified to be key considerations in the analysis of route options. A comparison of the improvements to traffic efficiency and flooding impacts as a result of each route option as well as other factors assessed is detailed within the Preferred Options Report (AECOM, 2016).

As well as meeting the proposal objectives, Option B provides positive outcomes in terms of traffic efficiency and flooding. Option B was identified to have the shortest travel time and would reduce heavy vehicle and other traffic travelling through Singleton, providing the greatest improvement in overall network efficiency. Option B also provides the safest access to and from Singleton during flood events.

Community feedback also noted a preference for Option A and B (roughly equal in preference) compared to Option C.

2.5 Preferred option

The preferred option is Option B.

This option meets the proposal objectives and provides a significant improvement to traffic efficiency and an effective flood evacuation route, while only having a minor impact on flooding. Option B would achieve the most beneficial improvement to traffic flow, travel times and safety on the New England Highway through Singleton by attracting the greatest volume of traffic away from the New England Highway to the proposal.

Key benefits of the preferred option compared to the other options assessed include the following:

- Providing the best functional, social and environmental outcomes and has the equal lowest cost
- Providing good economic benefits of reduced travel times and congestion
- Having the least environmental impact
- Providing the greatest connectivity of the options reviewed
- Having the least impact on property, local access and community cohesion
- Having the least impact on high quality agricultural land
- Having the least impact on future residential growth precincts in Singleton
- Meeting a range of other benefits such as potential evacuation routes, better access to the town centre and providing a heavy vehicle bypass between the north and west.

As the concept design of Option B has progressed, there have been some design refinements which are discussed in Section 2.6.

2.6 Design refinements

Following selection of Option B as the preferred option, a number of refinements have occurred during the concept design phase. Key design refinements are summarised in Table 2-3.

Table 2-3: Key design refinements

Proposal element	Design refinement	Reason
Length of bridge over the floodplain	Overall length reduced from around 3.1 kilometres to 1.7 kilometres and inclusion of two additional bridges.	Large cost savings attributed to shortening of the bridge structure, with minimal additional flood impacts.
Alignment north of Gowrie Gates	The alignment was shifted west away from a gully area.	Substantial reduction in fill material required for construction.
Putty Road interchange	Refinement from full interchange to connection consisting of a northbound entry ramp and southbound exit ramp.	Refinement of strategic traffic study indicated insufficient demand for northbound exit ramp, and southbound entry ramp. Refer to Section 6.6 for further information.
Northbound exit ramp at the northern connection/Gowrie Gates	The northbound exit ramp at the northern connection was moved to the connection with the New England Highway at Gowrie Gates in conjunction with a new roundabout at Maison Dieu Road	The traffic modelling suggested the roundabout would be utilised by vehicles travelling to Singleton Heights, as an alternative to either driving to the northern connection or travelling through Singleton via the New England Highway. This refinement facilitated the shift of the alignment to the west as described above.

3. Description of the proposal

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

3.1 The proposal

Roads and Maritime proposes to build a New England Highway bypass of Singleton. The proposal is located to the west of Singleton and connects the New England Highway to the north and south of Singleton. The proposal area is shown in Figure: 1-1.

Key features of the proposal are shown in Figure 3-1 to Figure 3-6 and would include:

- About eight kilometres of new highway (the bypass) with a single lane in each direction
- Connection with the New England Highway at the southern end of the bypass (the southern connection) including a southbound entry ramp and northbound exit ramp
- A 55 metre long bridge over the bypass at the southern connection
- A 1.7 kilometre long bridge over the Main North railway line, the Doughboy Hollow and Hunter River floodplain, Army Camp Road and Putty Road (bridge over the floodplain)
- Connection to Putty Road including a northbound entry ramp and southbound exit ramp (the Putty Road connection)
- A 40 metre long bridge over the entry ramp at the Putty Road connection
- A 100 metre long bridge over Rose Point floodway
- A 205 metre long bridge over the Hunter River
- A 40 metre long bridge over the New England Highway west of the existing Main North railway line overbridge (known as Gowrie Gates)
- Connection with the New England Highway at Gowrie Gates consisting of a southbound entry ramp and northbound exit ramp. The northbound exit ramp would connect to the New England Highway via a new roundabout intersection at Maison Dieu Road
- A 1.7 kilometre northbound climbing lane between Gowrie Gates and the northern connection
- Connection at Magpie Street providing access to the nearby industrial area (the northern connection) consisting of a southbound entry ramp, southbound exit ramp and northbound entry ramp
- A 60 metre long bridge over the bypass at the northern connection.

Additional features and aspects of the proposal include:

- Demolition of buildings
- Vegetation clearing
- Tie-in work with the New England Highway at the northern and southern ends of the proposal
- Tie-in work with Putty Road and the New England Highway at Gowrie Gates
- Utility adjustment or relocation, including electricity, water and sewerage, gas and telecommunications
- Operational spill containment basins
- Drainage infrastructure
- Boundary fencing
- Noise walls
- Headlight screen at the southern connection
- Provision of permanent access roads for maintenance activities

- A heavy vehicle stopping bay at the southern connection
- Diversion of an ephemeral creek line north of the Hunter River
- Creek bank stabilisation work near Hunter River bridge northern abutment
- Upgrade to access between Newington Lane and the New England Highway
- Property access adjustments
- Earthworks including construction of embankments
- Temporary ancillary facilities during construction including site offices, site compounds, laydown areas, and temporary access tracks
- An aerial crossing for fauna
- Finishing roadworks including pavement, road stabilisation, kerb and gutter, signage, lighting and line marking works
- Demobilisation of ancillary facilities following the completion of the construction of the proposal
- Landscaping works.

Timing for construction of the proposal has not been confirmed and is subject to approval and funding availability. Construction would take about three years to complete. The NSW Government has committed \$92 million towards the proposal and allocated \$2.7 million in 2019-2020 to continue development of the proposal.

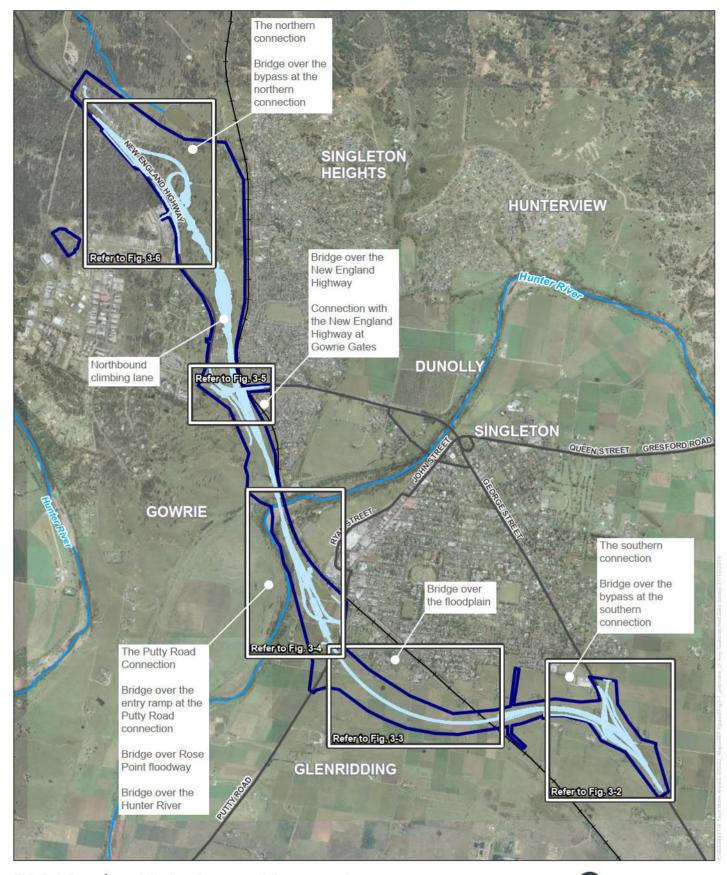


FIG. 3-1 Overview of the key features of the proposal

Legend

Proposal features

Proposal area

Proposal design

Watercourse

Other features

State roads

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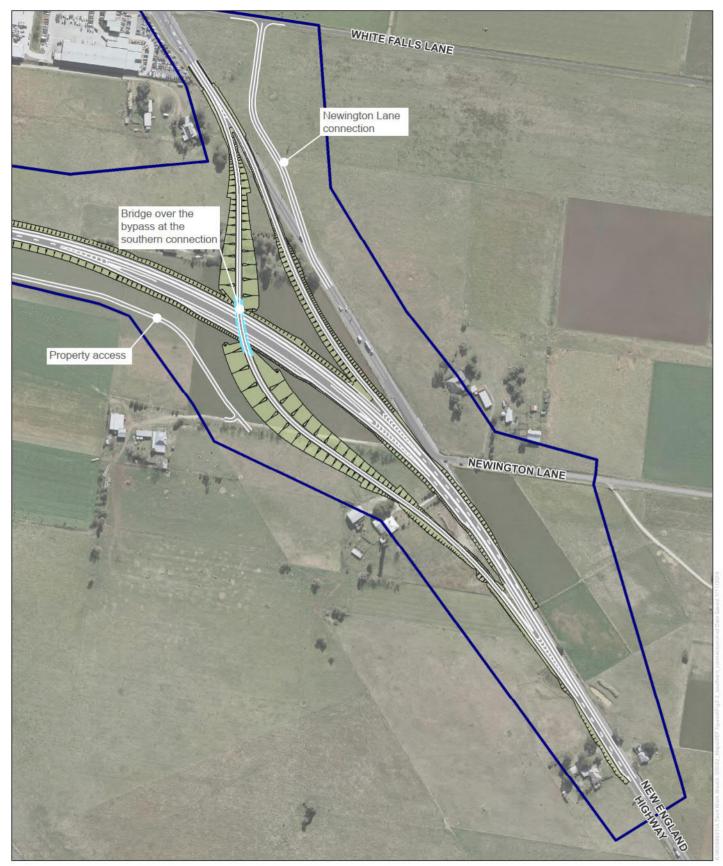


FIG. 3-2 The southern connection

Legend

- -Proposal area
- New road surface
- Median
- Bridge
- Earthworks



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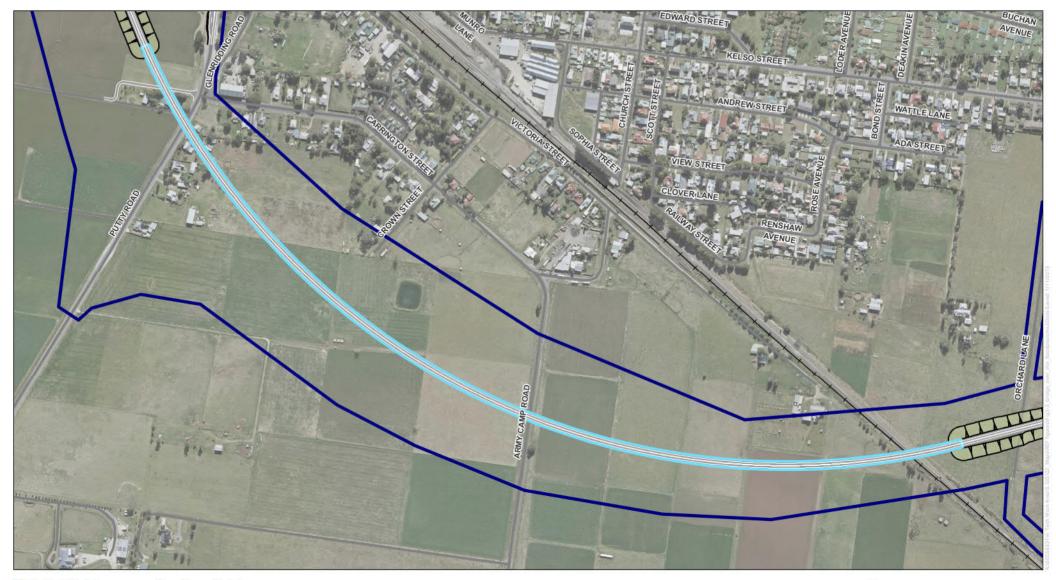


FIG. 3-3 Bridge over the floodplain

Proposal features

-Proposal area

New road surface

Median
Bridge

Earthworks

Other features

-Roads

- Main North railway line



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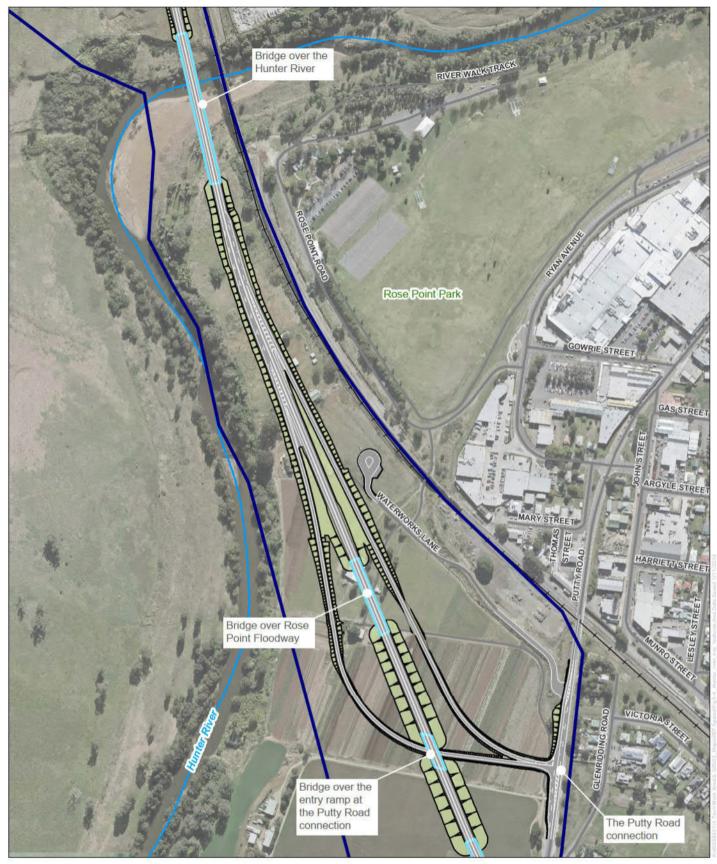


FIG. 3-4 Putty Road connection to the bridge over the Hunter River

Proposal features

-Proposal area

New road surface

Earthworks

Median

Bridge

Other features

-Roads

-- Watercourse

- Main North railway line

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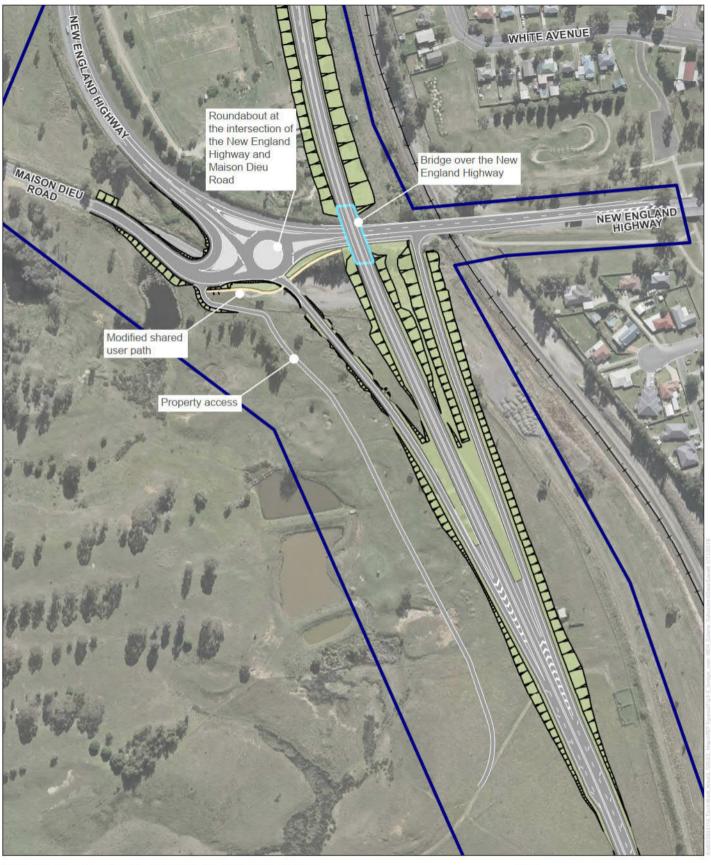


FIG. 3-5 Connection to the New England Highway at Gowrie Gates

Proposal features

-Proposal area

New road surface

Earthworks

Median

Bridge

Shared user path Other features

- Main North railway line

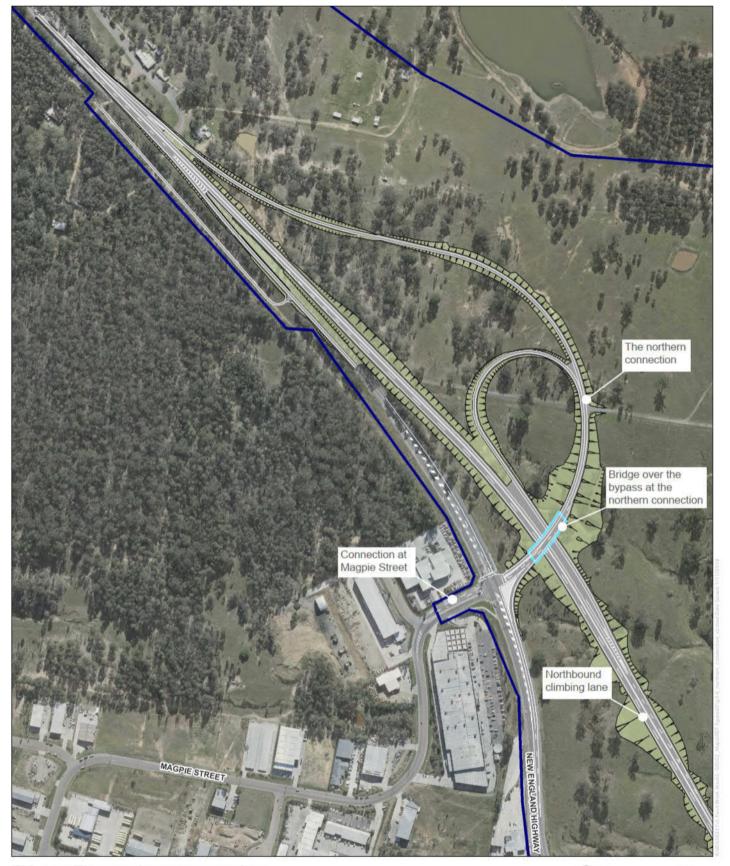


FIG. 3-6 The northern connection

- -Proposal area
- New road surface
- Median
- Bridge
- Earthworks



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3.2 Design

This section describes the concept design which is shown in Figure 3-1 to Figure 3-6. The concept design would be refined during the detailed design phase.

3.2.1 Design criteria

Standards

The concept design was prepared in accordance with a number of road and bridge standards as outlined in Table 3-1.

Table 3-1: Road and bridge standards relevant to the design

Road standards	Bridge standards
Guide to Road Design – Austroads (Austroads, 2019)	Australian Standard 5100 Bridge Design
Guide to Road Safety – Austroads (Austroads, 2009)	Roads and Maritime Bridge and Geotechnical Technical Direction Manual
Roads and Maritime Austroads Guide Supplement (Roads and Maritime, 2019)	Roads and Maritime Bridge Waterway Manual (Roads and Maritime, 1994)
Road Design Guide (Roads and Traffic Authority of NSW (undated))	Austroads Waterway Design (A Guide to the Hydraulic Design of Bridges, Culverts and Floodways) (Austroads, 1994)
Guidelines for Road Safety Audit Practices (Roads and Maritime Services, 2011)	Roads and Maritime Structural Drafting and Detailing Manual
Beyond the Pavement, RTA urban design policy, procedures and design principles (Roads and Traffic of NSW, 2009)	Roads and Maritime Aesthetics of Bridges – Design Guidelines to Improve the Appearance of Bridges in NSW (Roads and Maritime, 2004)
Roads and Maritime Delineation Manual (Roads and Maritime, 2008-2015)	Roads and Maritime PS261 – Concept Design of Bridges
Roads and Maritime Road Technical Directions	Roads and Maritime Bridge Technical Directions
NSW Speed Zone Guidelines (Roads and Traffic Authority of NSW, 2011)	Roads and Maritime QA Specifications - Bridge
	Roads and Maritime Bridge Standard Drawings
Roads and Maritime Supplement to Australian Standard 1742 Parts 1-15 (Roads and	Austroads Guide to Bridge Technology (including Roads and Maritime supplement)
Maritime, 2019)	ARTC Heavy Haul Infrastructure Guidelines

Design criteria

The key design criteria for the proposal are summarised in Table 3-2. The criteria generally apply to the main alignment of the bypass. Other relevant criteria in the guidance listed in Table 3-1 has been applied to other components of the proposal including the connections and bridges.

Table 3-2: Design Criteria

Design element	Design criteria
Roadway	New England Highway – one lane in each direction, undivided with wide centreline treatment
Posted speed	New England Highway – 100 kilometres per hour
Lane width (through lanes)	• 3.5 metres (minimum)
Shoulder widths	 3 metres (generally) 2.5 metres (outside shoulder on the bridge over the floodplain)
Median width	1 metre generally without barrier
Minimum horizontal radius	1200 metres (desirable minimum)875 metres (absolute minimum)
Maximum vertical grade	8 per cent maximum (the actual maximum grade for the proposal is around 4.5 per cent)
Vertical clearance to overhead bridge	 7.1 metres over the Main North railway line 6.5 metres over the bypass at the northern and southern connection 5.4 metres over local roads
Design vehicle	 New England Highway: B-double Turning movement for up to a 19 metre semi-trailer and B-double truck check vehicle
Cut and fill batters	 4 Horizontal:1 Vertical (typical batter slopes) 2 Horizontal:1 Vertical (where height of the batter is greater than 2.5 metres) Minimum 4.0 metre wide bench at each 10 metre height increment
Pavement type	 Flexible with slow setting heavily bound sub-base Minimum asphalt layer thickness 105 millimetres
Safety barriers	 Type F concrete crash barrier (adjacent to bridge piers) W beam or wire rope safety barrier (on approaches)

3.2.2 Engineering constraints

The engineering constraints to the design and construction of the proposal include:

- The need to minimise property acquisition, adjustment and access impacts
- Maintaining the existing flood regime and minimising flooding impacts associated with the construction and operation of the bypass
- Maintaining traffic flow during construction

- Maintaining vehicle access on the New England Highway under the bypass including access for heavy vehicles
- Constructing the bypass to cross over the Main North railway line, the Hunter River and the New England Highway
- Soils associated with floodplains
- · Minimising operational noise impacts
- Minimise impacts to fauna movement corridors
- Minimise impacts to Endangered Ecological Communities (EECs)
- The requirement for intersections to cater for turning movements of heavy/oversized vehicles
- Existing utilities located within the proposal area
- Topographical constraints including hilly regions in the northern section of the proposal and at the northern abutment of the Hunter River.

3.2.3 Major design features

The major design features of the proposal are described in the following sections and shown in Figure 3-2 to Figure 3-6.

Southern connection

The bypass would depart the existing New England Highway at the southern connection in a westerly direction. An exit ramp would be provided for vehicles travelling northbound into Singleton. This ramp would divert to the west, before crossing over the bypass on a bridge, before reconnecting to the existing New England Highway. Vehicles travelling southbound from Singleton would merge with vehicles travelling southbound on the bypass to continue southbound onto the existing New England Highway.

At the southern connection there would be a bridge over the bypass. The bridge would be a deep voided slab bridge with soil wall abutments consisting of two spans. The bridge would be around 55 metres long and around 6.5 metres above ground level.

The bridge at the southern connection has been designed to allow for a potential future northbound carriageway (including provision for an 8.5 metre wide median). This northbound carriageway would be subject to a separate environmental assessment.

The existing intersection of Newington Lane and the New England Highway would be closed to facilitate the nearby construction of the southern connection. Access to the New England Highway from Newington Lane would be via a new access road which would connect to White Falls Lane.

The southern connection is shown in Figure 3-2.

Bridge over the floodplain

West of the southern connection, the bypass would rise up on an embankment and the southern abutment of the bridge would be located east of the Main North railway line. The bridge would span the railway line, and then continue to curve to the north-east over Army Camp Road and Putty Road. The northern abutment of the bridge would be located south of the Putty Road connection, where the main alignment of the bypass would primarily be located on an embankment.

The bridge would be a girder bridge consisting of 51 spans and spill through abutments. The bridge would be around 1.7 kilometres long and seven metres above ground level.

The Doughboy Hollow floodplain is located west of the Main North railway line and acts as a flood channel during flood events. The alignment of the bridge in the floodplain would cross the main flood channels in a perpendicular direction to minimise impacts to peak flood levels.

The bridge over the floodplain is shown in Figure 3-3.

Putty Road connection

The Putty Road connection consists of a southbound exit ramp and northbound entry ramp. It is anticipated that this connection would service a large proportion of the existing heavy vehicles, as it provides a connection between the McDougalls Hill and Mount Thorley industrial areas, along with Muswellbrook and the Lower Hunter Region, avoiding the township of Singleton and existing Hunter River crossing.

There are no southbound entry and northbound exit ramps proposed at this location. Traffic modelling confirmed that traffic demand for these ramps is low, and that the southern connection provides suitable access to the town centre for northbound travellers, with a comparable travel time.

The entry and exit ramps have been designed to be inundated when major flood events (between 20 per cent Annual Exceedance Probability (AEP) and 10 per cent AEP events) occur, allowing flood waters to maintain existing flow patterns through the flood relief structure, beneath the Main North railway line, opposite Rose Point Park. Currently, without the bypass, Putty Road south of the Main North railway line crossing is inundated under major flood events which prevents access in and out of the township of Singleton via Putty Road. The flood immunity of the proposed connection would be generally consistent with the existing conditions.

There would be a bridge over the entry ramp at the connection. The bridge would be a girder bridge consisting of a single span and spill through abutments. The bridge would be around 40 metres long and around 5.4 metres above the entry ramp level.

The Putty Road intersection is shown in Figure 3-4.

Bridge over Rose Point Floodway

A bridge would be constructed to provide an opening in the embankment to maintain the flow path for the Rose Point Floodway through Rose Point Park. The bridge would be a girder bridge consisting of three spans and spill through abutments. The bridge would be around 100 metres long and six metres above ground level.

The bridge is shown in Figure 3-4.

Bridge over the Hunter River

A bridge over the Hunter River is proposed to the west of the existing Main North railway line bridge. The bridge would be a girder bridge consisting of six spans and spill through abutments. The bridge would be around 205 metres long and around 16 metres above the surveyed river level. The bridge includes piers within the Hunter River, consistent with the existing Main North railway line bridge.

The bridge is shown in Figure 3-4.

Bridge over New England Highway

A bridge over the New England Highway would be constructed west of the Main North railway line bridge at Gowrie Gates. The bridge would be a girder bridge with soil wall abutments consisting of a single span. The bridge would be around 40 metres long and around 5.4 metres above the existing road level.

The bridge is shown in Figure 3-5.

Connection with the New England Highway at Gowrie Gates

An entry ramp would be provided for vehicles travelling southbound (only) on the New England Highway to access the bypass and travel south.

An exit ramp would be provided for northbound vehicles on the bypass. The exit ramp would connect to a new roundabout at the intersection of the New England Highway and Maison Dieu Road. This roundabout provides access to Maison Dieu Road (westbound) and the New England Highway (northbound and southbound). The intersection would include a slip lane to allow for the continuous movement of vehicles travelling southbound on the New England Highway.

The connection is shown in Figure 3-5.

Northbound climbing lane

The vertical alignment of the proposal rises from a low point at the Hunter River in the south to a high point near Rixs Creek Lane in the north near the northern connection. An assessment of heavy vehicle speeds and power identified the need for a climbing lane in this section of the proposal, given there would otherwise be no nearby overtaking opportunities. The climbing lane would be 1.7 kilometres in length and allow heavy vehicles to reach an acceptable speed before merging at the end of the climbing lane.

Northern connection

The northern connection located near Magpie Street would comprise of a southbound exit ramp, a southbound entry ramp and a northbound entry ramp. All of the ramps provide access to and from the adjacent McDougalls Hill industrial area.

A bridge would be provided over the bypass, connecting both southbound ramps to the bypass. The bridge would be a girder bridge with soil wall abutments consisting of two spans. The bridge would be around 60 metres long and around 6.5 metres above the proposed bypass level.

The bridge span has been designed to accommodate a potential future southbound carriageway. The southbound carriageway would be subject to a separate environmental assessment.

The southbound exit ramp would provide the northern access to Singleton for vehicles travelling south from Muswellbrook. The ramp includes a slip lane to avoid the traffic signals at Magpie Street.

The southbound entry ramp would be via a small loop on the eastern side of the bypass that would pass over the bridge and loop under the bridge before merging into the bypass.

North of Magpie Street, linemarking would be carried out on the existing pavement to tie the existing New England Highway into the bypass.

The northern connection is shown in Figure 3-6.

Typical cross section

Typical road and bridge cross sections are shown in Figure 3-7 and Figure 3-8 respectively.

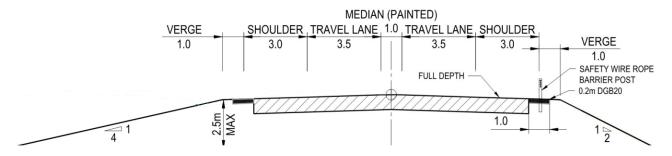


Figure 3-7: Typical road cross section (measurements shown in metres)

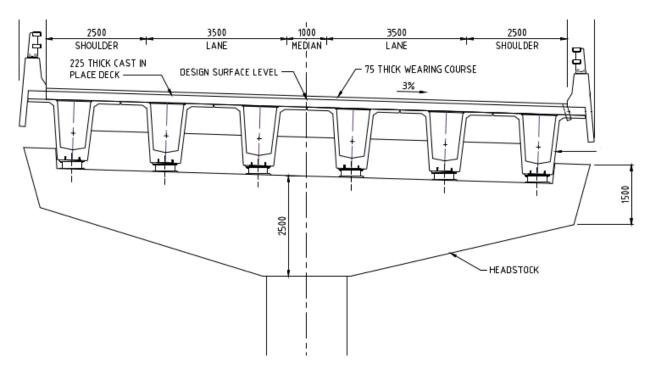


Figure 3-8: Typical bridge cross section (measurements shown in millimetres)

Tie-ins

The proposal would tie in to the existing alignment of the following roads:

- The New England Highway at the southern connection
- Putty Road at the Putty Road connection
- The New England Highway at Gowrie Gates
- Magpie Street at the northern connection
- The New England Highway at the northern extent of the proposal.

Activities to tie the proposal into the existing roads would include pavement work to create consistent levels between existing and new surfaces. The extent of tie-in work would be determined during the detailed design.

Drainage

The proposal crosses the Hunter River and its alluvial floodplain and a series of tributary creeks watercourses.

The drainage design considers:

- Transverse drainage (e.g. transverse culverts) to convey run-off from upslope catchments beneath the bypass
- Longitudinal drainage to convey flows either towards swales or transverse culverts
- Bridge drainage (except for the bridge over the floodplain) would be piped and provide adequate drainage of surface water. Runoff would be discharged via a spill containment basin or to existing drainage infrastructure depending on the location and subject to detailed design
- Drainage from the bridge over the floodplain would be via outlets onto the floodplain
- Operational spill containment, including spill containment basins, would be provided to the north and south of the Hunter River.

Property access

All properties affected by changed access arrangements, as a result of the proposal, would be provided with restored or new permanent access arrangements. Two properties south of the bypass at the southern connection, with existing access from Waddells Lane (Lot 2 DP 744891) and New England Highway (Lot 2/3/4 DP 1139915), would be provided with alternative access via Waddells Lane.

Parking facilities

No permanent parking facilities would be removed or provided by the proposal.

Pedestrian and bicycle facilities

The proposal would not provide any new pedestrian or dedicated bicycle facilities along the bypass. Cyclists would be able to use the road shoulders on the bypass.

A separated shared pedestrian and cyclist path is located adjacent to the New England Highway in the area where the highway passes beneath the Main North railway line at Gowrie Gates. This footpath provides connectivity under the rail bridge. This shared path has been upgraded as part of work to the Main North railway line bridge being carried out by the Australian Rail Track Corporation (ARTC).

The proposal would modify the shared path west of the Main North railway line bridge to pass through the southern entry ramp to the bypass at Gowrie Gates, and beneath the bridge over the New England Highway at Gowrie Gates.

Bus facilities

No dedicated bus facilities would be removed or provided by the proposal.

Public utilities

There are a number of public utilities within the proposal site that would require adjustment or relocation as part of the proposal. Refer to Section 3.5 for further details.

Lighting

New roadway lighting or adjustments to existing lighting would be provided at the Putty Road connection, New England Highway connection at Gowrie Gates, and the northern connection adjacent to Magpie

Street. Lighting would be designed in accordance with relevant guidelines and standards to minimise light spillage into residential properties and minimise glare that could impact on driver visibility. Lighting would be further refined during the detailed design phase.

Urban and landscape design

A Landscape Character, Visual Impact Assessment and Urban Design Objectives Report was prepared for the proposal (refer Appendix B). In recognition of the potential impacts of the proposal, six urban design objectives were developed as follows:

- **Objective 1** Respond to the landform: Embrace the undulating hills and gullies that rise above the Hunter River agricultural floodplains
- **Objective 2** Contribute to the urban structure: Acknowledge the connection the proposal has to Singleton township physically and visually
- **Objective 3** Maximise the travel experience: Utilise the unique characteristics of the region to provide an enjoyable travel experience
- **Objective 4** Respond to landscape patterns: Respond to the colours and shapes in the agricultural floodplains and vegetated lines and hills surrounding the proposal
- Objective 5 Design for minimal lifestyle costs: Design a low maintenance and sustainable landscape
- **Objective 6** Coordinate a simple and consistent design language along the road corridor: Coordinate the urban design treatments for bridges, walls, barriers, landscaping and standard roadside furniture and infrastructure.

The urban design objectives are provided in further detail in Appendix B. These objectives were developed with reference to principles contained in the *New England Highway Urban Design Framework* (Roads and Maritime, 2016). The objectives have been integrated into the concept design and would be considered further in the detailed design phase of the proposal.

Signage and line marking

Appropriate signage and line marking would be provided to suit the proposal.

Safety barriers

The proposal would include the modification of existing safety barriers as required and provision for new safety barriers would also be required in accordance with relevant standards and guidelines.

3.3 Construction activities

Construction activities would be guided by a construction environmental management plan (CEMP) to ensure work is carried out to Roads and Maritime specifications within the specified work area. Construction activities would be carried out within the proposal area (refer to Figure: 1-1).

3.3.1 Work methodology

Detailed work methodologies would be determined during detailed design and construction planning. The indicative work methodology is described below, however activities may vary to suit the construction staging plans, which would be determined by the construction contractor. The proposal is anticipated to involve the following general work methodologies and sequencing:

- Site establishment work including set up of ancillary facilities and compound areas
- Utility adjustments

- · Building demolition
- Vegetation clearing
- Earthworks and drainage
- Bridge construction including approaches
- Pavement construction including local roads
- Landscaping and finishing work
- Removal of ancillary facilities and site rehabilitation.

Site establishment work including set up of ancillary facilities and compound areas

A number of ancillary facilities and compound areas would be set up and would remain in operation for the duration of the construction period. Ancillary facilities included as part of the proposal are further described in Section 3.4.

Establishment work would include:

- Identification and marking out sensitive areas as defined by this REF and the CEMP
- Installation of traffic management measures including temporary traffic signs and barricades
- Installation of fencing
- Property adjustment work including relocation of fences, accesses and boundary features
- Minor earthworks to establish temporary construction roads and level areas for site compounds
- Utility connection work
- Establishment of site compounds and ancillary facilities
- Sediment and erosion control work including installation of temporary sediment basins together with localised treatments such as sediment fences and earth bunds/channels to separate on-site and off-site water
- Minor road work to establish access points.

Utility adjustments

Services and utilities identified within the proposal area that may require relocation or protection include overhead and underground electricity (owned by Ausgrid), water and sewage services (owned by Singleton Council), telecommunications (owned by Telstra, AAPT/TPG and the National Broadband Network (NBN) Corporation) and gas services (owned by Jemena).

Utilities that would be protected or relocated for the proposal are generally located around the southern connection, Putty Road connection, bridge over the New England Highway at Gowrie Gates and northern connection.

Utility relocation is further discussed in Section 3.5.

Activities that would be carried out to relocate utilities include:

- Identification and removal of redundant asbestos cement pipes
- Excavation and construction of new underground cutover locations with the existing utility network
- · Installation of new poles to carry overhead services
- Excavation of trenches along new utility routes
- Installation of bedding material and new utilities within the trenches or onto new poles
- Testing and cutover of utilities into new infrastructure
- Under bore for new utilities beneath the Hunter River
- Decommissions and removal of redundant utilities where required.

Building demolition

As identified within Section 3.6, a number of properties would need to be partially and wholly acquired by Roads and Maritime. Following the acquisition of the required properties by Roads and Maritime, existing buildings within these properties would be demolished as described below. Buildings that would be demolished are generally in the vicinity of the bridge over the floodplain between the existing New England Highway and the Hunter River.

Demolition activities would generally include:

- Identification and removal of asbestos
- Removal fittings and other reusable elements using hand tools
- Progressive demolition of the building structures using modified excavators
- Sorting and temporary storage of demolition material into recyclable and waste components
- Loading and transporting recyclable and waste material to a licenced facility.

Vegetation clearing

Most of vegetation clearing would occur in the northern end of the proposal. Clearing of trees along the Hunter River for the new bridge and some clearing of isolated paddock trees would also be required.

Vegetation clearing would include:

- Identification and marking out of clearing limits and hollow bearing trees
- Identification of suitable habitat nearby for release of fauna that may be encountered
- Checking for the presence of fauna species onsite and relocate if there is the potential for the animal to be disturbed or injured
- Clearing of non-hollow bearing trees including removal of stumps (trees in riparian zones would have their stumps retained wherever possible)
- Checking tree hollows for fauna and then removal of the habitat trees
- Reuse of vegetation or mulch for use in rehabilitation.

Earthworks and drainage

Earthworks are required to achieve the design levels along the entire length of the bypass, including raised embankments and sections of cutting. Some existing drainage systems such as culverts may need to be extended across the new road formation at tie in points with the existing road system. Completely new drainage structures and systems would be installed along the entire length of the bypass.

Earthworks and drainage work include:

- Stripping, stockpiling and management of topsoil and unsuitable material
- Excavate and fill to the road formation levels, including excavation for embankments and cuttings and boxing out of new pavements
- Disposal of unsuitable and surplus material
- Install new drainage lines, temporary sediment basins, sediment fences, earth bunds and channels and protection of existing stormwater pits.

Bridge construction

As described in Section 3.2.3, a number of bridges would be constructed for the proposal. The construction methodology for the bridges would include:

- Stripping, stockpiling and management of topsoil and unsuitable material
- Foundation construction including:
 - Piling
 - Pile cap construction including localised excavations
- Bridge pier or column construction
- Construction of bridge, likely through the placement of pre-cast segments (eg girders) lifted into place using a crane or gantry.

Given the constraints associated with the construction of the bridge over the floodplain and the bridge over the Hunter River, indicative construction methodologies are provided in further detail below.

Construction of the bridge over the floodplain

Construction access for the bridge over the floodplain is unconstrained with good level access. A detailed work methodology for the construction of the bridge would be determined during detailed design, however an indicative methodology is provided below to inform the assessment of the potential impacts in this location throughout the REF:

- Construction of a temporary access road adjacent to the bridge to provide access to the bridge piers and abutments
- Establishment of a crane pads near each pier location to construct pile foundations, piers, and lift and place pre-cast bridge structural components
- To minimise impact on the aquifer, the pile holes will be installed by advancing a steel casing into the
 ground as they are drilled. The steel casing prevents the ground from collapsing into the excavation and
 protects the groundwater from potential contamination
- The steel casing would be advanced into bedrock through the zone of weathering and seal the layers above and below the aguifer
- The steel casing would be backfilled with reinforced concrete to form the bridge foundations.
- Bridge piers would be constructed on the foundations by casting reinforced concrete into formwork supported by temporary scaffold
- Bridge girders and barriers would be lifted into place using cranes.

Construction of the bridge over the Hunter River

The construction of a bridge over the Hunter River is constrained by the river channel and the steep banks lining the river to the north and south. A detailed work methodology for the construction of the bridge would be determined during detailed design, however an indicative methodology is provided below to inform the assessment of the potential impacts in this location throughout the REF:

- Diversion of ephemeral creek channel north of the Hunter River
- Construction of temporary access roads to access the northern and southern bridge abutments
- Construction of a temporary access ramp from the temporary access track down to the southern river bank, to access the sand bed. The northern abutment will be accessed via the alignment of the bypass
- Establishment of a crane pad near the river bank to place pre-cast bridge structural components
- Construction of a temporary rock platform within the Hunter River to provide access for construction of the in-river pier
- Construction of pile casings in the river to prevent the riverbed from collapsing into the excavation

- Excavation of casing and construction of concrete pile
- Pier and superstructure construction through the use of cranes on either side of the Hunter River.

The indicative methodologies represents a worst-case approach to the construction of the bridge regarding potential disturbance area and overall impact. The assessment of environmental impacts at this location throughout the REF is therefore conservative and would potentially be reduced if the contractor chooses to use an alternate construction methodology.

Pavement Construction (including local roads)

Pavement would be laid across the entire length of the bypass (including bridges) and would tie in to existing roads at each connection.

Work would include:

- Rolling and grading of road formation foundation
- Placement and compaction of bound gravel road pavement
- Installation of subsoil interpavement drainage with connections to existing and new drainage pits where required
- Placement of a bitumen material over the bound gravel road pavement
- Placement of an asphalt wearing course and compaction with a roller.

Landscaping and finishing work

Landscape and finishing work would include:

- Installation of new street lights
- Installation of road furniture including signage, noise walls, headlight screens and roadside barriers
- Rehabilitation of disturbed areas and landscaping in accordance with the urban design and landscape plan
- Line marking and installation of raised reflective pavement markers.

Removal of ancillary facilities and site rehabilitation

Upon completion of the work, construction advisory and warning signage would be removed and the road would be opened to traffic. The ancillary facilities would be removed and areas disturbed during construction would be rehabilitated. Once disturbed areas are established, erosion and sediment control measures such as sediment fencing would be removed.

3.3.2 Construction hours and duration

Construction would largely be carried out during standard construction working hours in accordance with the Interim Construction Noise Guideline (DECC, 2009):

- Monday to Friday: 7am to 6pm
- Saturday: 8am to 1pm
- Sundays and public holidays: no work.

Construction activities that involve impulsive or tonal noise emissions would be limited to the following hours in accordance with the Construction Noise and Vibration Guideline (Roads and Maritime, 2016):

- Monday to Friday: 8am to 5pm
- Saturday: 9am to 1pm
- Sundays and public holidays: no work.

To minimise disruption to daily traffic and disturbance to surrounding land owners and businesses, it would be necessary to carry out some work outside of these hours. The following activities are likely to take place outside standard construction working hours:

- Construction activities within the rail corridor during rail possessions
- Delivery of construction materials such as precast bridge structures
- Intersection and tie-in activities of the bypass to existing roads
- Installation and adjustment of barriers and signage for construction zones during each construction stage
- Construction of the bridge over the New England Highway at Gowrie Gates
- Operation of construction compounds to support the above work.

3.3.3 Plant and equipment

A range of plant and equipment would be used during construction. The final equipment and plant requirements would be decided by the construction contractor. An indicative list of plant and equipment which would be used in each construction stage is provided below in Table 3-3.

Table 3-3: Indicative plant and equipment to be used during the construction period

Stage	Equipment
Establishment work including set up of ancillary facilities and site compounds	 Medium rigid truck Road truck Scissor lift Franna crane Grader Vibratory roller Dump truck Water cart Power generator Light vehicles Front end loader Concrete vibrator and pump
Utility relocations	 35 tonne tracked excavator 20 tonne franna crane Crane (up to 300 tonne) Pneumatic hammer Concrete saw Vacuum truck Backhoe Power generator
Building removals	Bulldozer D935 tonne tracked excavator

Stage	Equipment
	ChainsawDump truckHydraulic hammer23 tonne front end loader
Vegetation clearing	 Bulldozer D9 35 tonne tracked excavator Chainsaw Mulcher Dump truck
Earthworks and drainage	 Backhoe 20 tonne franna crane 35 tonne tracked excavator Concrete truck Truck compressor Vibratory roller Road truck
Bridge construction including approaches	 Crane (up to 600 tonne) 20 tonne franna crane Pilling rig (driven and bored) Power generator Concrete pump and truck Compressor Pneumatic hammer Welding equipment
Pavement construction including local roads	 Pavement laying machine Asphalt truck and sprayer Concrete truck Smooth drum roller Concrete saw
Landscaping and finishing works	Road truckScissor lift20 tonne franna craneLine marking truck
Removal of ancillary facilities and site rehabilitation	 Medium rigid truck Road truck Scissor lift Franna crane Dump truck Power generator Light vehicles Front end loader

3.3.4 Earthworks

Earthworks activities required for the proposal include excavation where the design of the road is lower than the existing ground level, construction of fill embankments where the design of the road is above the existing ground level (such as approaches for bridges) and boring into the ground for bridge structural supports.

The estimated quantities of materials associated with earthworks are provided in Table 3-4. Precise quantities will be identified during detail design.

Table 3-4: Indicative earthwork quantities

Area	Cut (m³)	Fill (m³)
Southern connection to Putty Road	5250	122,350
Putty Road to Gowrie Gates	65,200	87,650
Gowrie Gates to northern connection	486,800	198,600
Total	557,250	408,600
Balance	148,650 surplus	

3.3.5 Source and quantity of materials

The construction of the proposal would require (but is not limited to) the materials listed in Table 3-5. The exact quantities of materials required would be confirmed during the detailed design.

Imported materials would be sourced from Roads and Maritime pre-qualified commercial suppliers in nearby areas, wherever possible. As part of the concept design, a preliminary assessment of potential sources of material was completed and identified that suitable material is available at local quarries.

Table 3-5: Source and quantities of materials required for the proposal

Material	Quantity	Source
Earthworks materials (limited to select fill, other fill to be sourced from excavations for the proposal)	46,000 m ³	
Road base for the construction of a flexible road surface	4050 m ³	Roads and
Asphalt	4000 tonnes	Maritime prequalified
Precast concrete elements for drainage construction (culverts, pits and headwalls) and miscellaneous work	950 tonnes	suppliers and locally, where practical
Structural steel	1650 tonnes	
Conduits, pits, cables and pipes	28,800 metres	
Bridge materials (concrete)	78,550 tonnes	

Material	Quantity	Source
Bridge materials (steel reinforcement)	6150 tonnes	
Linemarking, raised reflective pavement markers and signs, and safety barriers	Painted area – 8900 m ² Reflective markers – 3300 Signs – 150	
Safety barriers	Steel post and rail – 1050 metres Wire rope – 4300 metres Concrete – 3950 metres	
Steel for barrier railings and reinforcement in concrete	6350 tonnes	
Noise wall materials (concrete)	524 tonnes	
Noise wall materials (steel reinforcement)	15 tonnes	
Water	The amount of water that would be required during construction is unknown at this stage. The amount would depend on material sources and methodologies applied by the contractor.	Construction sources such as sediment basins or alternatively from the local water supply network.
Concrete for drainage construction, road surface construction, and miscellaneous work such as barrier kerbs, paving, kerbs and gutters and signpost footings	8850 tonnes	Roads and Maritime prequalified suppliers and locally, where practical.

Re-use opportunities

Material excavated to the north of Gowrie Gates would be used as a source of fill material across the proposal, reducing the need to import fill material. Excess fill left over from other local road projects could be used for this proposal where suitable.

3.3.6 Traffic management and access

Construction traffic numbers

Construction of the proposal would generate a total of up to 220 light and heavy vehicle movements per day. These construction vehicle movements would mainly be associated with:

- Movement of construction workers
- · Delivery of construction materials
- Spoil and waste removal
- Delivery and removal of construction equipment and machinery.

The estimated number of construction vehicle movements is shown in Table 3-6.

Table 3-6: Indicative construction vehicle movements

Vehicle type	Peak number of movements per day
Light vehicles	80
Heavy vehicles	140

Access for construction vehicles

Construction vehicles would access the site via arterial roads wherever possible. Indicative construction traffic access points are shown on Figure 3-9 and would generally be via the New England Highway.

Indicative heavy vehicle haulage routes have been identified for the movement of spoil between different locations within the proposal area during construction. The routes to and from the New England Highway are shown on Figure 3-9. The haulage routes have been designed to minimise use of local roads where possible.

Traffic management measures

It is expected that temporary speed limits and lane closures would be required during the construction phase. Final construction methods would be refined to minimise traffic and transport impacts, however traffic restrictions would be unavoidable during some construction activities, such as piling work for the bridge supports, foundation and road surfacing work at tie in points with the southern and northern connections, Putty Road connection and connection with the New England Highway at Gowrie Gates.

Local property access management

Property access would be maintained as far as practicable throughout the construction period, however there may be temporary disruptions to private property access. The management of property access would be considered by the construction contractor and detailed as part of the final staging plan for the proposal. Refer to Section 6.12.2 for further information.

Temporary construction access roads

Temporary access roads would be built to facilitate the movements of construction vehicles and construction materials (e.g. girders for bridges) to key construction work areas for bridges and bypass connection points.

Pedestrian and cyclist access

A separated shared pedestrian and cyclist path is located adjacent to the New England Highway in the area where the New England Highway passes beneath the Main North railway line, providing connectivity under the rail bridge. This shared path has been upgraded as part of work to the Main North railway line bridge carried out by the ARTC.

The shared pedestrian and cyclist path west of the Main North railway line bridge would be temporarily impacted during activities required for the construction of the bridge over the New England Highway and southern entry ramp at Gowrie Gates. Connectivity would be maintained through localised diversions where feasible, however temporary diversion of the shared path into the road shoulder, with temporary concrete barriers for protection, may be required.

There is an informal pedestrian access to the Hunter River beneath the Main North railway line near Rose Point Road. The informal access is used primarily to access the Hunter River for recreational activities. This access would be closed during the construction of the proposal due to the work required for the bridge over the Hunter River.

Recreational users of the Hunter River would continue to have the option to access the river east of the proposal area, to the north of Rose Point Park.

3.4 Ancillary facilities

Construction ancillary facilities have been identified for the proposal which are shown in Figure 3-9 and described further below. Potential compound sites have been investigated using the following criteria:

- Proximity to the proposal
- Where possible, away from residential and sensitive receivers
- Where possible outside of the 1 in 10 year Average Recurrence Interval (ARI) floodplain
- At least 40 metres away from the nearest waterway
- On land of low heritage conservation significance
- Does not require clearing of native vegetation
- Relatively flat ground that does not require substantial reshaping
- In plain view of the public to deter theft and illegal dumping.

Should the need for additional or alternative ancillary facilities be required, the positioning of additional or alternative compound sites would be carried out in consideration of the above criteria.

Construction compound sites would include portable buildings with amenities such as toilets, secure and bunded storage areas for site materials, including fuel and chemicals, office space for on-site personnel, and associated parking.

Stockpiling would be undertaken at the Waterworks Lane, Gowrie Gates and Northern connection construction compounds. Stockpile locations would be refined during the detailed design phase using the criteria set out in the Stockpile Management Guideline (RTA, 2011).

Sites would be securely fenced with temporary fencing. Signage would be erected advising the general public of access restrictions. Upon completion of construction, the temporary site compound, work areas and stockpiles would be removed, and the site cleared of all rubbish and materials. It would then be rehabilitated.

An overview of the key construction activities to be carried out at the ancillary facilities is provided in Table 3-7.

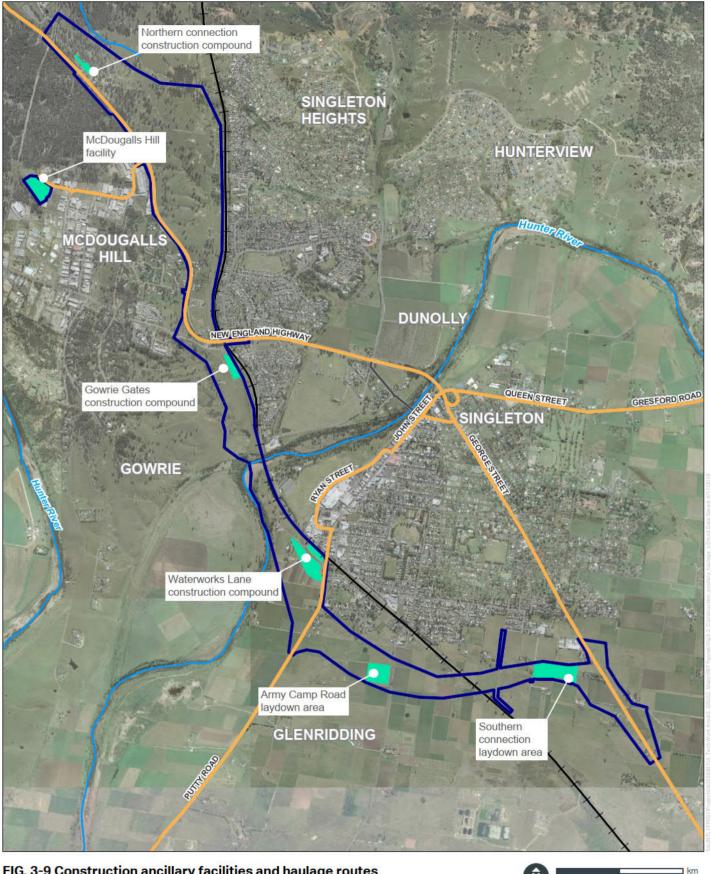


FIG. 3-9 Construction ancillary facilities and haulage routes

Proposal features Other features Proposal area State roads Haulage routes Watercourse Construction ancillary facilities - Main North railway line

3.4.1 Southern connection laydown area

The southern connection laydown area would be located west of the New England Highway at the southern extent of the proposal. The construction compound would be located on land currently used for agricultural purposes and would be accessed from the New England Highway. The land is currently privately owned and is within the area required to be acquired by Roads and Maritime for the construction of the proposal (refer to Section 3.6).

Construction activities to be carried out at this location would primarily include the laydown of construction materials and equipment required to support the construction of the southern connection and bridge over the Main North railway line, and the Doughboy Hollow and Hunter River floodplains. Key construction activities to be carried out at and supported by the southern connection laydown area are summarised in Table 3-7.

3.4.2 Army Camp Road laydown area

The Army Camp Road laydown area would be located west of Army Camp Road. The construction compound would be located on land currently used for agricultural purposes and would be accessed via Putty Road. The land is currently privately owned and is within the area required to be acquired by Roads and Maritime for the construction of the proposal (refer to Section 3.6).

Construction activities to be carried out at this location would primarily include the laydown of construction materials and equipment required to support the construction of the bridge over the Main North railway line, and the Doughboy Hollow and Hunter River floodplains. Key construction activities to be carried out at and supported by the Army Camp Road laydown area are summarised in Table 3-7.

3.4.3 Waterworks Lane construction compound

The Waterworks Lane construction compound would be located on both sides of Waterworks Lane, between the Main North railway line to the east and the Putty Road connection to the west. The eastern section of the compound would be located on an existing hardstand area that is currently owned by the ARTC, which would be leased for the duration of the construction of the proposal. The western section of the compound is currently privately owned and is within the area required to be acquired for the construction of the proposal. The construction compound would be accessed from Waterworks Lane via an existing access point until the Putty Road connection is constructed, which will then be used as the primary access.

Key construction activities to be carried out at and supported by the Waterworks Lane construction compound are summarised in Table 3-7 and would include supporting the construction of the bridge over the Main North railway line, and the Doughboy Hollow and Hunter River floodplains and the bridge over the Hunter River.

3.4.4 Gowrie Gates construction compound

The Gowrie Gates construction compound would be located south of the existing Main North railway line bridge over the New England Highway. The compound is located within land owned by ARTC and would be temporarily leased by Roads and Maritime for the construction of the proposal.

The construction compound would be located in an area of cleared land adjacent to the Main North railway line and would be accessed via Maison Dieu Road.

Key construction activities to be carried out at and supported by the Gowrie Gates construction compound are summarised in Table 3-7 and includes construction activities to support the construction of the bridge over the New England Highway and connection with the New England Highway at the Gowrie Gates.

3.4.5 Northern connection construction compound

The northern connection construction compound would be located east of the existing New England Highway west of the Main North railway line. The compound is currently located within privately owned land and is within the area required to be acquired by Roads and Maritime for the construction of the proposal. The compound would be accessed via the existing private property access road which connects to the New England Highway.

Key construction activities to be carried out at and supported by the northern connection construction compound are summarised in Table 3-7 and includes construction activities to support the construction of the northern connection.

3.4.6 McDougalls Hill facility

The McDougalls Hill facility would be located within an area of vacant land in the McDougalls Hill industrial area west of the New England Highway near the proposed northern connection. The facility would be used for site offices, laydown and light vehicle parking. The facility is shown on Figure 3-1.

Table 3-7: Summary of construction activities at ancillary facilities

Construction activities	Southern connection laydown area	Army Camp Road laydown area	Waterworks Lane construction compound	Gowrie Gates construction compound	Northern connection construction compound	McDougalls Hill facility
Vegetation clearing	Yes	Yes	No	No	Yes	No
Utility works including protection and/or adjustment of existing utilities, removal of redundant utilities and installation of new utilities	No	No	Yes	Yes	Yes	No
Establishment of site offices, amenities and temporary infrastructure including fencing	No	No	Yes	Yes	Yes	Yes
Laydown and storage of materials	Yes	Yes	Yes	Yes	Yes	Yes
Chemical storage	Yes	Yes	Yes	Yes	Yes	No
Crushing	Yes	Yes	Yes	Yes	Yes	No
Delivery of materials, plant and equipment	No	No	Yes	Yes	Yes	No
Stockpiling	Yes	Yes	Yes	Yes	Yes	No
Demobilisation	Yes	Yes	Yes	Yes	Yes	Yes

3.5 Public utility adjustment

Consultation with public utility authorities has been carried out as part of the development of the concept design to identify and locate existing utilities and incorporate utility authority requirements for relocations and/or adjustments. Preliminary investigations have indicated that the following existing utilities were found to be within the extents of the proposal and would need relocating or protection:

- Overhead and underground electricity Ausgrid
- Water and sewage services Singleton Council
- Telecommunications Telstra, AAPT/TPG and the National Broadband Network (NBN) Corporation
- Gas services Jemena.

Specifically, utilities within the proposal area to be relocated or protected include:

- High voltage (11 and 33 kilovolt) power lines located around the northern connection and southern connection
- High voltage (66 kilovolt) power lines located around Orchard Lane
- Singleton Council's Waterworks Lane facility including water pump station, depot and stand pipe
- Fibre optic cable located underground near the Hunter River
- Fibre optic cable located underground between Gowrie Gates and the northern connection.

The proposal may also impact on the ability of utility providers to access maintenance locations for their utilities and services. Consultation would continue with the public utility authorities during the detailed design. This consultation would allow the public utility authorities to provide input into the most appropriate relocation options for the services and utilities. Modifications to the affected utilities would be in accordance with the design and construction methods approved by the relevant utility stakeholder.

The proposal area assessed as part of this REF includes areas likely to be required for utility adjustments. If it is determined during detailed design that utility work is required outside of the proposal area, then a separate environmental assessment may be required.

3.6 Property acquisition

Based on the concept design and subject to negotiations in accordance with the *Land Acquisition (Just Terms Compensation) Act 1991* (NSW) and the reforms announced in October 2016 (NSW Government 2016), the acquisition or temporary lease of the properties in Table 3-8 would be required. These properties are shown on Figure 3-10.

The need for property acquisition would be further refined during the detailed design phase. Roads and Maritime has commenced the acquisition process for some properties and will carry out ongoing consultation with affected landholders.

Table 3-8: Property acquisition for the proposal

Description	Percentage of lot impacted	Acquisition type	Current owner	Lot and DP	Land use zone (LEP)
Rural residential	100%	Full acquisition	Roads and Maritime	1 DP196016	RU1
Rural property	100%	Full acquisition	Roads and Maritime	2 DP1240047	RU1

Description	Percentage of lot impacted	Acquisition type	Current owner	Lot and DP	Land use zone (LEP)
Rural property	100%	Full acquisition	Roads and Maritime	28 DP1104815	RU1
Rural property	100%	Full acquisition	Roads and Maritime	5 DP1153724	RU1
Rural property	5%	Partial acquisition	Private	4 DP36999	RU1
Rural property	<5%	Partial acquisition	Private	1 DP1122748	RU1
Rural property	9%	Partial acquisition	Private	20 DP1129695	RU1
Rural property	100%	Full acquisition	Private	1 DP1130681	RU1
Rural property	<5%	Partial acquisition	Private	111 DP855355	RU1
Rural property	100%	Full acquisition	Private	1 DP1139915	RU1
Rural property	27%	Partial acquisition	Private	101 DP1048703	RU1
Rural property	91%	Partial acquisition	Private	2 DP1139915	RU1
Rural property	100%	Full acquisition	Private	3 DP1139915	RU1
Rural property	13%	Partial acquisition	Private	4 DP1139915	RU1
Rural property	33%	Partial acquisition	Private	110 DP1137689	RU1
Rural property	19%	Partial acquisition	Private	15 DP1117570	RU1
Rural property	6%	Partial acquisition	Private	4 DP1089420	RU1
Rural property	7%	Partial acquisition	Private	2 DP1062689	RU1
Rural property	18%	Partial acquisition	Private	1 DP8695	RU1
Rural property	13%	Partial acquisition	Private	11A DP37001	RU1
Rural property	21%	Partial acquisition	Private	1 DP1100628	RU1
Rural residential	100%	Full	Private	1 DP1100026	RU1

Description	Percentage of lot impacted	Acquisition type	Current owner	Lot and DP	Land use zone (LEP)
		acquisition			
Rural property	100%	Full acquisition	Private	2 DP798801	RU1
Rural property	<5%	Partial acquisition	Private	31 DP1108474	RU1
Rural property	17%	Partial acquisition	Private	3 DP1108792	RU1
Rural residential	100%	Full acquisition	Roads and Maritime	1 DP796721	RU1
Rural property	100%	Full acquisition	Private	2 DP1108792	RU1
Rural property	100%	Full acquisition	Private	1 DP999044	RU1
Rural property	6%	Partial acquisition	ARTC	1 DP1050582	SP2
Portion of Waterworks Lane	<5%	Partial acquisition	The Minister for Public Works	5 DP1159019	RU1
Pumping station	100%	Full acquisition	The Minister for Public Works	3 DP1159019	RU1
Pumping station	100%	Full acquisition	The Minister for Public Works	4 DP1159019	RU1
Pumping station	100%	Full acquisition	The Minister for Public Works	2 DP1159019	RU1
Pumping station	100%	Full acquisition	The Minister for Public Works	1 DP1159019	RU1
Rural property	100%	Full acquisition	Roads and Maritime	1 DP360940	RU1
Riverbed	100%	Full acquisition	Singleton Council	3 DP883810	RU1
Riverbed	9%	Partial acquisition	The State of NSW	2 DP883810	RU1
Rural land	20%	Partial acquisition	Singleton Council	4 DP1195454	RE2
Rural property	20%	Partial acquisition	Private	2 DP1195454	RE2/R1

Description	Percentage of lot impacted	Acquisition type	Current owner	Lot and DP	Land use zone (LEP)
Rural property	35%	Partial acquisition	Private	1 DP1195454	RE2
Rural property	9%	Partial acquisition	Private	1221 DP599260	R1
Rural property	20%	Partial acquisition	Private	1 DP1001760	RU1
Rural property	14%	Partial acquisition	Private	1 DP118590	RU1
Rural residential	100%	Full acquisition	Private	1 DP1047239	RU1
Rural residential	100%	Full acquisition	Private	2 DP1063069	RU1
Rural property	31%	Partial acquisition	Private	1000 DP1147316	RU1
Rural property	100%	Full acquisition	Private	3 DP614110	RU1
Rural property	<5%	Partial acquisition	Private	2 DP614110	RU1
Rural property	100%	Full acquisition	Private	1 DP614110	RU1
Rural property	66%	Partial acquisition	Private	11 DP583232	RU1
Rural property	21%	Partial acquisition	Private	26 DP248630	RU1
Rural property	<5%	Partial acquisition	Private	221 DP1046820	RU1
Rural property	6%	Partial acquisition	Private	1 DP736773	RU1
Rural property	100%	Full acquisition	Private	1 DP 561939	RU1

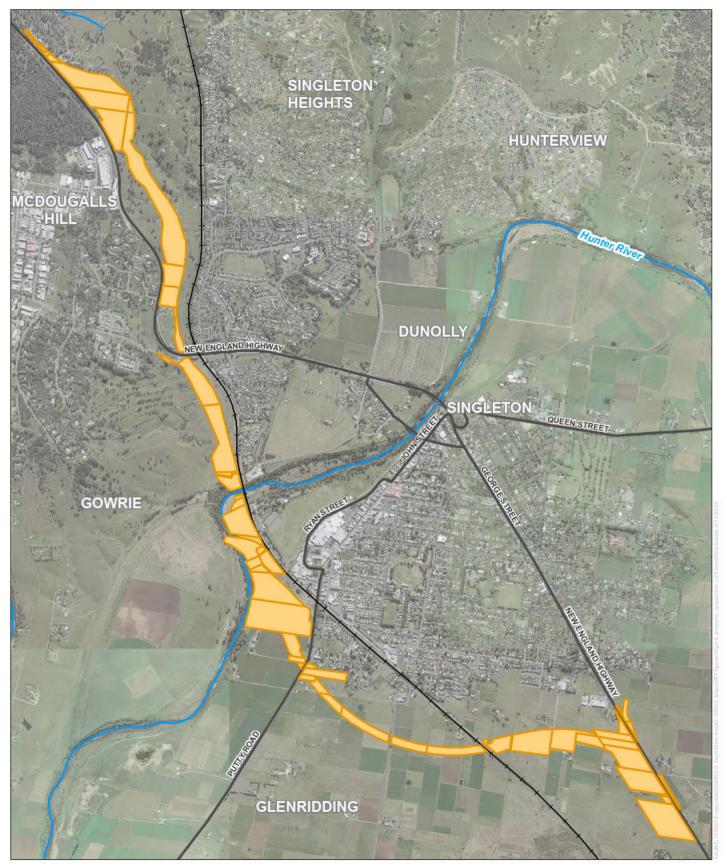


FIG. 3-10 Property acquisition for the proposal

Proposal features

Property acquisition

- Watercourse

Other features

-State roads

--- Main North railway line

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4. Statutory and planning framework

This chapter provides the statutory and planning framework for the proposal and considers the provisions of relevant state environmental planning policies, local environmental plans and other legislation.

4.1 Environmental Planning and Assessment Act 1979

4.1.1 State Environmental Planning Policies

State Environmental Planning Policy (Infrastructure) 2007

State Environmental Planning Policy (Infrastructure) 2007 (ISEPP) aims to facilitate the effective delivery of infrastructure across the State.

Clause 94 of ISEPP permits development on any land for the purpose of a road or road infrastructure facilities to be carried out by or on behalf of a public authority without consent.

As the proposal is for road infrastructure facilities and is to be carried out by Roads and Maritime, it can be assessed under Division 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). Development consent from council is not required.

The proposal is not located on land reserved under the *National Parks and Wildlife Act 1974* and does not require development consent or approval under the State Environmental Planning Policy (Coastal Management) 2018, State Environmental Planning Policy (State and Regional Development) 2011 or State Environmental Planning Policy (State Significant Precincts) 2005.

Part 2 of the ISEPP contains provisions for public authorities to consult with local councils and other public authorities prior to the commencement of certain types of development. Consultation, including consultation as required by ISEPP (where applicable), is discussed in Section 5 of this REF.

4.1.2 Local Environmental Plans

Singleton Local Environment Plan 2013 (LEP 2013)

The proposal is located within the Singleton LGA. There are two local environmental planning instruments that apply to the Singleton LGA. These are the:

- Singleton Local Environmental Plan 1996 (Singleton LEP 1996)
- Singleton Local Environmental Plan 2013 (Singleton LEP 2013).

The Singleton LEP 1996 remains in force for portions of the Singleton LGA which are identified as deferred matters on the Singleton LEP 2013 land zoning maps. No elements of the proposal would be on land that is identified as a deferred matter in the Singleton LEP 2013, therefore no further consideration of the Singleton LEP 1996 is required.

Clause 5.10 of the Singleton LEP 2013 provides for the protection of heritage items within the Singleton LGA. There are four heritage items within the proposal area that are listed in the Singleton LEP 2013, including the Cokes Ovens, Former Pumping Station, Bebeah, and the Woolpack Inn. An assessment of the potential impacts of the proposal on these heritage items is provided in Section 6.9.

As outlined in Section 4.1.1, Clause 94 of ISEPP overrides the requirement for development consent from Singleton Council and therefore the consent requirements of the Singleton LEP 2013 do not apply.

Nevertheless, the land uses prescribed by the Singleton LEP 2013 have been considered in development of the proposal and are discussed below.

Under the Singleton LEP 2013, the proposal would be located on land zoned:

- RU1 Primary Production
- RE2 Private Recreation
- R1 General Residential
- SP2 Infrastructure Classified Road and Railway.

RU1 Primary Production

The objectives of this zone under the Singleton LEP 2013 are to encourage diverse and sustainable primary industry production, to minimise the fragmentation of resource lands and to minimise conflict between land uses.

The proposal would be primarily located on land zoned RU1 Primary Production. The proposal has been designed to minimise the extent of land fragmentation where possible, however the proposal would involve the acquisition of some properties zoned and used for agricultural purposes. As described in the assessment of socio-economic impact of the proposal in Section 6.12, the impact to agricultural productivity within the Singleton LGA is considered to be minor.

RE2 Private Recreation

The objectives of this zone under the Singleton LEP 2013 are to enable the use of land for recreational purposes and to provide a range of recreational settings.

The proposal traverses an area of land zoned RE2 Private Recreation located to the north of the Hunter River and to the west of the Main North railway line. Given the lack of access to this land for private recreation and the availability of higher amenity recreational land in the area, impacts to private recreational land in the Singleton LGA as a result of the proposal would be minor.

R1 General Residential

The objectives of this zone under the Singleton LEP 2013 are to provide a variety of housing types and densities to suit the needs of the community and to enable other land uses that provide facilities and services to meet the needs of residents.

The proposal traverses an area of land zoned R1 General Residential, located to the south of the Gowrie Gates to the west of the Main North railway line. The proposal would lead to a reduction in the available R1 zoned land within the Singleton LGA, however the impact on residential land supply would be minor given the size of the parcel of land affected.

SP2 Infrastructure:

The objectives of this zone under the Singleton LEP 2013 are to provide for infrastructure and related land uses and to prevent development that is not compatible with infrastructure.

The proposal would meet the objectives of this zone.

4.2 Other relevant NSW legislation

4.2.1 Roads Act 1993

The objects of the *Roads Act 1993* (Roads Act) include classifying roads, declaring Roads and Maritime Services and other public authorities as roads authorities, and regulation of various activities on public roads.

Under section 143 of the Roads Act, a roads authority can use a public road in the exercise of a function conferred by the Roads Act, so long as the function is exercised in a way that will not unduly interfere with the rights of passage and access that exist with respect to the public road. As outlined in Section 6.6 of this REF, there would be short term impacts to traffic movements as a result of the proposal, however safe access would be maintained throughout the construction period.

4.2.2 Biodiversity Conservation Act 2016

The purpose of the *Biodiversity Conservation Act 2016* (BC Act) is to maintain a healthy, productive and resilient environment for the greatest well-being of the community consistent with the principles of ecologically sustainable development.

Under Part 2 of the BC Act it is an offence to harm animals and plants; damage areas of outstanding biodiversity value; damage habitat of threatened species or ecological communities. Under Part 2, Division 2 of the BC Act it is a defence to a prosecution if the harm or damage was necessary for the carrying out of a Division 5.1 EP&A Act activity undertaken in compliance with the determination, or undertaken consistent with a state significant infrastructure approval under Division 5.2 of the EP&A Act.

Section 7.3 of the BC Act establishes a test to determine whether a proposed development or activity is 'likely to significantly affect threatened species'. If an activity under Division 5.1 of the EP&A Act is likely to significantly affect threatened species then a Species Impact Statement (SIS) or a Biodiversity Development Assessment Report (BDAR) is required to be prepared.

An assessment of the potential impacts to biodiversity and measures to manage potential impacts are discussed in Section 6.1. The assessment found that the proposal is unlikely to have a significant impact on any threatened species or communities under the BC Act therefore an SIS or BDAR is not required for the proposal.

4.2.3 Biosecurity Act 2015

The *Biosecurity Act 2015* (Biosecurity Act) covers all biosecurity risks, including pest animals, plant diseases and noxious weeds and introduces the legally enforceable concept of a General Biosecurity Duty. As outlined in Section 6.1 of this REF, a number of weed species have been identified in the proposal area during biodiversity inspections. Management measures have been recommended to manage these weed species in accordance with the requirements of the Biosecurity Act.

4.2.4 Fisheries Management Act 1994

The *Fisheries Management Act 1994* (FM Act) provides for the protection of threatened fish and marine vegetation and for the management of associated threatening processes. Part 7A Division 4 of the FM Act

prohibits, without a licence or permit, activities that damage habitats or harm threatened species, populations or ecological communities.

The proposal would impact the Hunter River which is an identified 'Key Fish Habitat' under the FM Act. Activities which may require a permit under the FM Act include, but are not limited to, dredging works, reclamation work and works that would block fish passage.

The construction of temporary in stream structures during construction may be considered to be reclamation work in accordance with the definition at s198A of the FM Act. However, section 199 of the FM Act states that an approval is not required for a public authority to undertake dredging or reclamation work. The public authority is required to give the Minister written notice of the proposed work and consider any matter received from the Minister within 21 days of the notice.

Section 219 of the FM Act makes it an offence to obstruct fish passage without a permit issued under Part 7 of the FM Act. The proposal will require in-stream structures in the Hunter River, such as rock platforms, which may obstruct fish passage subject to the extent of works. The detailed work methodology will be determined during detailed design, however these in stream structures are not expected to obstruct the full width of the Hunter River and therefore would not obstruct fish passage.

Consultation regarding the proposal has already been carried out with the Department of Primary Industries, NSW Department of Planning, Industry and Environment (DPIE) as summarised in Section 5.5.

4.2.5 Water Management Act 2000

The *Water Management Act 2000* (WM Act) provides for the management of surface water and groundwater in NSW. The proposal is located within the area of the Water Sharing Plan for the Hunter Regulated River.

Section 56 of the WM Act establishes access licences for the take of water within a particular water management area. Under clause 21(1) of the Water Management (General) Regulation 2018 (Water Management Regulation) and schedule 4 part 1, Roads and Maritime, as a 'roads authority', is exempt from the need to obtain an access licence in relation to water required for road construction and road maintenance.

Sections 89 to 91 of the WM Act establish three types of approvals that a proponent may be required to obtain. These are water use approvals, water management work approvals (including water supply work approvals, drainage work approvals and flood work approvals) and activity approvals (including controlled activity approvals and aquifer interference approvals).

'Controlled activities' include the erection of a building or carrying out of a work, removal of material or vegetation, the deposition of material, and the carrying out of an activity that affects the quantity or flow of water in a water source. Typically a controlled activity approval would be required under section 91E(1) of the WM Act to allow for construction within 40 metres of a watercourse. However, Clause 41 of the Water Management Regulation, exempts public authorities such as Roads and Maritime from section 91E(1) of the WM Act in relation to all controlled activities that they carry out in, on or under waterfront land. This allows Roads and Maritime to carry out controlled activities on waterfront land.

Under the NSW Aquifer Interference Policy, the proposal is exempt from requiring an aquifer interference approval. Section 3.3 of the policy states that cuttings trenches and pipelines (intersecting the water table) would be considered as having a minimal impact on water-dependent assets, if a water access licence is not required. Therefore, the proposal would be defined as a minimal impact aquifer interference activity given that a water access licence is not required.

An assessment of the potential impacts to surface water and groundwater and measures to manage potential impacts are discussed in Section 6.8.

4.2.6 National Parks and Wildlife Act 1974

The *National Parks and Wildlife Act 1974* (NP&W Act) governs the establishment, preservation and management of national parks, state reserves, historic sites and certain other areas, and the protection of certain fauna, native plants and Aboriginal heritage.

The NP&W Act, administered by the Heritage Division, Department of Premier & Cabinet, is the primary legislation for the protection of Aboriginal cultural heritage in NSW. The NP&W Act gives the Secretary of the Department of Premier & Cabinet responsibility for the proper care, preservation and protection of 'Aboriginal objects' and 'Aboriginal places'. Section 86 of the NP&W Act identifies offences relating to the harm of Aboriginal objects or places. An Aboriginal Heritage Impact Permit (AHIP) issued under section 90 of the NP&W Act is required if impacts to Aboriginal objects and/or places cannot be avoided.

Potential impacts to Aboriginal cultural heritage as a result of the proposal have been assessed in accordance with Roads and Maritime's *Procedure for Aboriginal Cultural Heritage Consultation and Investigation* (NSW Roads and Maritime Services, 2011) (PACHCI).

A total of 25 Aboriginal archaeological sites and one Aboriginal cultural site have been identified within the proposal area. Of these sites, disturbance activities as a result of the proposal were anticipated to impact 16 of the 25 Aboriginal archaeological sites and one of the cultural sites. An AHIP will be required for sites to be impacted by the proposal. A summary of the Aboriginal cultural heritage assessment undertaken for the proposal are summarised in Section 6.8.

4.2.7 Heritage Act 1977

The *Heritage Act 1977* (Heritage Act) aims to protect and conserve non-Aboriginal cultural heritage, including scheduled heritage items, sites and relics. The Heritage Act makes provision for a place, building, work, relic, moveable object, precinct, or land to be listed on the State Heritage Register. If an item is the subject of an interim listing, or is listed on the State Heritage Register, a person must obtain approval under section 60 of the Heritage Act for works or activities that may impact on these items.

A non-Aboriginal heritage assessment was completed to inform the REF and is summarised in Section 6.9. No items listed on the State Heritage Register or on a register under section 170 of the Heritage Act were identified within the proposal area.

Under section 139 of the Heritage Act, approval is also required prior to the disturbance or excavation of land if it would, or is likely to, result in a relic being discovered, exposed or damaged. Prior to ground disturbance impacts at the Former Pumping Station (I21), a permit under Section 140 of the *Heritage Act* 1977 would be obtained given the potential for archaeological relics at this location.

4.2.8 Contaminated Lands Management Act 1997

The Contaminated Lands Management Act 1997 (CLM Act) establishes a process for investigating and remediating land where required. The CLM Act allows the NSW Environmental Protection Authority (EPA) to declare land as significantly contaminated land. The EPA may order a public authority to carry out actions or prepare a plan of management for significantly contaminated land. The CLM Act imposes a duty on landowners to notify the EPA and potentially investigate and remediate land contamination if levels are above EPA guidelines.

A Phase 1 Preliminary Site Investigation was carried out to inform the REF and is summarised in Section 6.5. A search of the list of NSW contaminated sites notified to the EPA identified that there are no areas of declared contamination within the proposal area. One EPA listed site (the former Singleton Gasworks) is located 300 metres north-east of the proposal area. The assessment of potential impacts to contaminated

land is described in Section 6.5 and includes measures recommended to manage risks associated with unexpected contamination finds.

4.2.9 Protection of the Environment and Operations Act 1997

The NSW *Protection of the Environment Operations Act 1997* (POEO Act) aims to protect, restore and enhance the environments of NSW and reduce potential risks to human health and the environment. The POEO Act outlines pollution offences relating to land, water, air and noise pollution and includes a duty to report pollution incidents.

Under the provisions of the POEO Act, Roads and Maritime is required to notify the EPA if a 'pollution incident' occurs that causes or threatens 'material harm' to the environment.

Under Section 120 of the POEO Act a person who pollutes any waters is guilty of an offence and Roads and Maritime is obliged not to pollute during the construction period or when the site is operational.

Under Part 3.2 of the POEO Act, an environmental protection licence is required for scheduled activities or scheduled development work as defined in Schedule 1. Schedule 1, Clause 35 (road construction) is potentially relevant to the proposal. Road construction is defined by Clause 35(1) as '...the construction, widening or re-routing of roads, but does not apply to the maintenance or operation of any such road'. Road construction is considered a scheduled activity under Clause 35(3)(a)(i) where extraction of more than 50,000 tonnes of materials is proposed over the life of the proposal, where the proposal will be carried out in the regulated area. The POEO Act regulated area definition includes the Singleton LGA and the proposal is expected to require extraction of approximately 557,000 cubic metres of material, which is over the 50,000 tonnes threshold. This would require the proposal to be carried out under an Environmental Protection Licence.

4.2.10 Land Acquisition (Just Terms Compensation) Act 1991

The Land Acquisition (Just Terms Compensation) Act 1991 (The Land Acquisition Act) applies to the acquisition of land (by agreement or compulsory process) by a public authority authorised to acquire the land by compulsory process. It provides a guarantee that, when a public authority requires the acquisition of land, the amount of compensation will not be less than the market value of the land. The Land Acquisition Act would apply to the acquisition of any land required for the proposal. Property acquisition is further discussed in Section 6.11.

4.2.11 Aboriginal Land Rights Act 1983

The Aboriginal Land Rights Act 1983 (ALR Act) provides for the land rights for Aboriginal persons and for representative Aboriginal Land Councils in New South Wales.

Crown Land parcel Lot 2 DP883810 adjacent to the Hunter River within the proposal area, was subject to an Aboriginal land claim under the ALR Act. The claim was lodged on 3 March 2015 by the NSW Aboriginal Land Council and was refused by the Crown Lands Minister on 13 December 2018.

4.3 Commonwealth legislation

4.3.1 Environment Protection and Biodiversity Conservation Act 1999

Under the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth) (EPBC Act) a referral is required to the Australian Government Department of the Environment and Energy for proposed actions that have the potential to significantly impact on matters of national environmental significance or the environment of Commonwealth land. These are considered in Appendix A and chapter 6 of the REF.

A referral is not required for proposed road activities that may affect nationally listed threatened species, endangered ecological communities and migratory species. This is because requirements for considering impacts to these biodiversity matters are the subject of a strategic assessment approval granted to Roads and Maritime under the EPBC Act by the Australian Government in September 2015.

However potential impacts to these biodiversity matters are considered as part of chapter 6 of the REF and Appendix A.

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

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

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

The assessment of the proposal's impact on nationally listed threatened species, endangered ecological communities and migratory species found that there is likely to be a significant impact on the Central Hunter Valley eucalypt forest and woodland listed as critically endangered under the EPBC Act. Roads and Maritime's strategic assessment has been applied to the proposal as described above. Chapter 6 of the REF describes the safeguards and management measures to be applied to minimise or mitigate impacts. Chapter 6.1 also details the Biodiversity Offset Strategy to be implemented to address residual significant impacts on nationally listed biodiversity matters.

4.3.2 Other relevant Commonwealth legislation

Native Title Act 1993

The proposal is located within an area subject to a registered claim NC2013/006 made by the Plains Clans of the Wonnarua People under the Commonwealth *Native Title Act 1993* (Native Title Act). Consultation with the Plains Clans of the Wonnarua People was undertaken in accordance with Roads and Maritime PACHCI, as detailed in Section 5.3 of this REF.

4.4 Confirmation of statutory position

The proposal is categorised as development for the purpose of a road and road infrastructure facilities and is being carried out by or on behalf of a public authority. Under Clause 94 of the ISEPP the proposal is permissible without consent. The proposal is not State significant infrastructure or State significant development. The proposal can be assessed under Division 5.1 of the EP&A Act.

Roads and Maritime is the determining authority for the proposal. This REF fulfils Roads and Maritime's obligation under clause 5.5 of the EP&A Act including to examine and take into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of the activity.

Under the POEO Act an Environmental Protection Licence would be required from the NSW EPA for road construction.

Under the NP&W Act, an AHIP is required for the proposal.

5. Consultation

This chapter discusses the consultation undertaken to date for the proposal and the consultation proposed for the future.

5.1 Consultation strategy

Roads and Maritime has endeavoured to keep the community and stakeholders informed and proactively consulted throughout the development of the proposal. Consultation has been carried out in accordance with the Community and Stakeholder Engagement Plan prepared for the proposal. The purpose of consultation is:

- To keep community informed and increase understanding of the proposal
- To gain local knowledge and consider comments and issues relating to the proposal and preferred route option
- To ensure stakeholders potentially impacted by the proposal are provided clear information about possible property impacts
- To provide clear and timely information and advise the community on how they may obtain information and communicate concerns, complaints and suggestions.

Refer to Sections 5.2 to 5.5 for a summary of consultation carried out to date.

The REF is to be displayed for a minimum four week period. During this time, community information sessions would be held. Stakeholders and the community would be encouraged to participate, provide feedback and make a submission on the REF.

5.2 Community involvement

Community engagement to select preferred bypass route

Community consultation was carried out in 2015 to inform the community and stakeholders of the three shortlisted route options, invite feedback and gather local knowledge to help with the selection of a preferred bypass route.

The three shortlisted options were displayed for community and stakeholder feedback between 28 September and 23 October 2015 and 168 submissions were received in response to the display. Responses included 97 emails, 27 letters and 44 telephone calls.

A total of 27 issues were raised in the submissions received. Commonly raised issues relevant to the proposal included potential impacts to flooding, property impacts (including acquisition, fragmentation and land value), traffic forecasts and impacts to local businesses.

A number of submissions included a preference for a particular route option along with key reasons for this preference. Options A and B were roughly equal in preference ahead of Option C. The community feedback received on the three shortlisted options, along with technical investigations and cost benefit analysis was used to select Option B as the preferred bypass route. In December 2016, the preferred bypass route was announced and a community update was distributed.

Option B has progressed into concept design, with some design refinements adopted as part of the proposal.

Consultation activities since selection of a preferred bypass route

Roads and Maritime has involved the community during the concept design planning phase and the REF preparation phase of the proposal. Consultation activities have been carried out during the preparation of the concept design and REF, including:

- Community update was distributed to the community in August 2018
- Operation of a dedicated website for the proposal
- Operation of a dedicated proposal phone number and email address to allow the community to ask questions and provide feedback
- Meetings with land owners, and local businesses
- Consultation with government agencies
- Briefings with Singleton Council and local Members of Parliament.

Key issues raised during this phase are summarised in Table 5-1.

Community and stakeholder consultation was carried out as part of the Socio-Economic Impact Assessment Technical Working Paper (AECOM, 2019) which was prepared to identify the potential socio-economic impacts that may arise as a result of the proposal and to inform Section 6.12 of this REF. The community and stakeholder consultation included business surveys of 39 businesses and 257 stopper surveys in November and December 2018.

The findings of the business impact survey and stopper survey are provided in more detail in Section 6.12 and Appendix D.

Table 5-1: Summary of issues raised during consultation

Key issue	Response
	Potential impacts to property are assessed in Section 6.11. The proposal would involve full and partial property acquisition which would be carried out in accordance with the <i>Land Acquisition (Just Terms Compensation) Act 1991</i> (NSW). The concept design has aimed to minimise the need for property acquisition while achieving the proposal objectives. Roads and Maritime are consulting directly with potentially affected property owners in relation to property acquisition. All properties affected by changed access arrangements as a result of the proposal would be provided with restored or new permanent access arrangements, in consultation with the property owner.
Property values	Many aspects influence property values such as location and use. Landowners are encouraged to contact the project team to discuss their circumstances and property impacts, including the process of acquisition. Directly affected landowners are being consulted where property acquisition is required. Appropriate compensation would be negotiated in line with the Land Acquisition Information Guide (Roads and Maritime 2014c) and the Land Acquisition (Just Terms Compensation) Act 1991.
Next steps	The ongoing consultation process, display of the REF and submissions report is described in Section 5.6 and Section 5.7.
Impacts to adjacent land uses	Potential impacts to adjacent land uses are assessed throughout Section 6.0.

Key issue	Response
Traffic forecasts, and use of local roads	The proposal would improve traffic flow, travel times and safety through Singleton by reducing traffic volumes and the movement of heavy freight vehicles through town. It is expected that up to 1500 vehicles per hour (two-way) would be removed from the existing New England Highway through Singleton, improving traffic conditions and reducing congestion. The traffic assessment for the proposal is summarised in Section 6.5.
Changes to hydrology and potential impacts to local flooding	Changes to hydrology and flooding are summarised in Section 6.2. Flood modelling indicates that the proposal would result in minor increases and decreases the peak flood level in different locations.

5.3 Aboriginal community involvement

The Aboriginal community has been involved throughout the development of the proposal in accordance with the requirements of DPIE's *Aboriginal Cultural Heritage Consultation Requirements for Proponents* (DECCW, 2010) (Consultation Requirements) and Roads and Maritime's Procedure for Aboriginal Cultural Heritage Consultation and Investigation (PACHCI), which is a staged process for investigating potential impacts to Aboriginal cultural heritage as a result of Roads and Maritime road planning, development, construction and maintenance activities.

The four stages of PACHCI and the Aboriginal community consultation carried out in each stage are identified below in Table 5-2. Consultation carried out with the Aboriginal community is documented in Appendix E and summarised in Table 5-2.

Table 5-2: Summary of Roads and Maritime Procedure for Aboriginal Cultural Heritage Consultation and Investigation carried out for the proposal

Stage	Description			
Stage 1	Initial Roads and Maritime assessment			
	An initial desktop risk assessment was carried out by Roads and Maritime as part of the initial scoping to determine if the proposal is likely to harm Aboriginal cultural heritage or not. No direct consultation with the Aboriginal community was completed during this stage.			
Stage 2	Site survey and further assessment			
	The aim of Stage 2 is to undertake further assessment and a survey with specific Aboriginal stakeholders and an archaeologist to assess the proposal's potential to harm Aboriginal cultural heritage, and to determine whether formal Aboriginal community consultation and a cultural heritage assessment report is required. Aboriginal stakeholders consulted as part of the Stage 2 PACHCI assessment include the Plains Clans of the Wonnarua People (PCWP) registered native title claimant group and the Wanaruah Local Aboriginal Land Council (Wanaruah LALC). Both parties participated in an archaeological survey of the proposal area carried out over five days (26 to 29 March			
	2018 and 3 April 2018).			
Stage 3	Formal consultation and preparation of a cultural heritage assessment report			
	Stage 3 of the PACHCI requires a formal program of Aboriginal community consultation in accordance with legislative requirements and DPIE's 'Aboriginal Cultural Heritage Consultation Requirements for Proponents' (DECCW, 2010) and the preparation of an			

Stage	Description
Stage	Aboriginal Cultural Heritage Assessment Report (ACHAR). Consultation activities carried out as part of Stage 3 have included: Information regarding relevant Aboriginal persons and organisations requested from following agencies: Department of Planning, Industry and Environment (DPIE) Wanaruah Local Aboriginal Land Council New South Wales Aboriginal Land Council Office of the Registrar, Aboriginal Land Rights Act 1983 The National Native Title Tribunal NTSCORP Limited Singleton Council Singleton Catchment Management Authority.
	 Aboriginal organisations and persons identified by the agencies were issued invitations to register interest in participating in the proposal's community consultation process. Public notices published in four newspapers (National Indigenous Times, Koori Mail, Singleton Argus and Newcastle Herald) outlining the proposal and its location and calling for expressions of interest Draft assessment methodology sent to all Registered Aboriginal Parties (RAPs) with minimum 28 day review period An Aboriginal Focus Group (AFG) was held to discuss the assessment methodology which all RAPs were invited to attend Proposed assessment methodology was revised following RAPs feedback. A copy of the updated draft assessment methodology was subsequently forwarded to all RAPs with additional minimum 28 day review period All RAPs were provided the opportunity to nominate cultural knowledge holders from the community to participate in a cultural values assessment. Ten cultural knowledge holders participated in the assessment Issue of a draft ACHAR, to all RAPs for their review and comment, with minimum 28 day review period A second AFG on to discuss the draft ACHAR. All RAPs were invited to attend. Comment period for draft ACHAR extended by a week Issue of final ACHAR report which details the above consultation in full. Refer Appendix E.
Stage 4	Implement environmental impact assessment recommendations This stage will be implemented after project approval and approval of an AHIP.

5.4 ISEPP consultation

Consultation with councils and other public authorities is provided for by Clause 13 to 16 of the ISEPP, which applies to development carried out by or on behalf of a public authority that may be carried out without consent. Consultation is required in relation to development that impacts on:

- Council related infrastructure or services (Clause 13)
- Local heritage (Clause 14)
- Flood liable land (Clause 15)
- With public authorities other than councils (Clause 16).

Singleton Council has been consulted about the proposal as per the requirements of clause 13, 14 and 15 of the ISEPP. Singleton Council provided a response on 11 May 2018. Issues that have been raised by Singleton Council in relation to impacts to Council infrastructure, local heritage and flood liable land, and

subsequent responses are outlined below in Table 5-3. Other comments raised by Singleton Council not relating to ISEPP matters are addressed in Table 5-4.

The NSW State Emergency Services (SES) has also been consulted about the proposal as per the requirement of clause 15AA for development with impacts on flood liable land. No response was received from the SES for inclusion in the REF.

Appendix F contains an ISEPP consultation checklist that documents how ISEPP consultation requirements have been considered.

Table 5-3: Issues raised through ISEPP consultation

Agency	Issue raised	Response / where addressed in REF
Singleton Council	 Impact of the proposal on flooding levels, particularly within the Doughboy and Glenridding areas. Council requested the following information in the REF: How the impacts of the flood modelling will be addressed, particularly in relation to flooding levels within the Doughboy and Glenridding areas. 	Section 6.2 – Surface water, hydrology and flooding and Appendix J
	What factors will be put in place that address livestock evacuation.	Potential impacts to access during construction and operation are described in Section 6.11.
		Livestock would utilise the temporary access arrangements during construction and restored or new permanent access arrangements during operation in the event that evacuation is required.
Singleton Council	Council queried the location of potential connections on the proposed bypass route, and requested the following: • A full interchange at Putty Road	Section 3.2.3 Major Design Features The Putty Road connection would include a southbound exit ramp and northbound entry ramp. There are no southbound entry and northbound exit ramps proposed for this location. Traffic modelling confirmed that traffic demand for these ramps is low (refer to Section 6.5).
	A northbound exit and southbound entry at the southern end of the bypass	Section 3.2.3 Major Design Features The southern connection would include a northbound exit ramp and southbound entry ramp.
	A northbound entry and southbound exit at Magpie Street	Section 3.2.3 Major Design Features The northern connection would include a southbound exit ramp, a southbound entry ramp and a northbound entry ramp.
	The Gowrie Gates exit is not	Section 3.2.3 Major Design Features

Agency	Issue raised	Response / where addressed in REF	
	essential and could be removed from the concept design, with the Magpie Street exit being sufficient to service the locality.	The connection with the New England Highway at Gowrie Gates would include a southbound entry ramp and a northbound exit ramp.	
Singleton Council	Council requested that the REF details the impacts that the proposal would have on water infrastructure, with specific reference to the large mains that connect across west and east sides of the Hunter River and assets including Water Works Lane Depot, Army Camp Water Pump Station and Control Valve 2.	Section 3.5 Public utility adjustment Consultation has commenced with Singleton Council regarding impacts on water infrastructure. This consultation is ongoing.	

5.5 Government agency and stakeholder involvement

Various government agencies and stakeholders have been consulted about the proposal, including:

- AAPT/PowerTel
- Australia Rail Track Corporation (ARTC)
- Ausgrid
- NSW Department of Primary Industries Fisheries, DPIE
- Environmental Protection Authority
- Hunter Freight Group
- Local Land Services Hunter
- Jemena
- Subsidence Advisory NSW

- NBN Co.
- Crown Land, DPIE
- Water group, DPIE
- Resources Regulator, DPIE
- Heritage Division, Department of Premier & Cabinet
- Singleton Business Chamber
- Singleton Council
- Telstra
- NSW SES.

A letter was sent to each agency on 16 April 2018. A summary of the issues that have been raised as a result of consultation with these agencies and stakeholders are outlined below in Table 5-4. A copy of the responses received is provided in Appendix G.

Table 5-4: Issues raised through agency and stakeholder consultation

Agency	Response received	Issue raised	Response / where addressed in REF	
Singleton Council	11 May 2018	Council requested that the REF detail the following:		
		How the impacts of the flooding will be addressed?	Section 6.2.4.	
		addressed:	A flood response management plan will be prepared as part of the CEMP.	
		What factors will be put in place that address livestock evacuation during flood events?	Section 6.2.3.	
			Flood behaviour within and surrounding the proposal area is well understood, with adequate advance flood warning available to evacuate equipment and protect the work prior to inundation.	
			The infrastructure for the proposal would also provide additional flood evacuation routes in the event of an early-warning flood evacuation for Singleton.	
		Which properties have been impacted by the preferred route?	Section 3.6 – Property acquisition (Table 3-8)	
		What are the proposed impacts of the preferred route on those identified properties?	Section 3.6 (Table 3-8)Section 6.11.2Section 6.12.3.	
		Full details in regard to how those impacts will be addressed	Section 6.11.3Section 6.12.4.	
		What will be the impacts on property values?	Many aspects influence property values such as location and use. Landowners are encouraged to contact the project team to discuss their circumstances and property impacts, including the process of acquisition. Directly affected landowners are being consulted where property acquisition is required. Appropriate compensation would be negotiated	

Agency	Response received	Issue raised	Response / where addressed in REF
			in line with the Land Acquisition Information Guide (Roads and Maritime 2014c) and the Land Acquisition (Just Terms Compensation) Act 1991.
		Priorities for a full the interchange at Putty Road and southbound and northbound entry and exits at the northern and southern connections and Gowrie Gates.	Section 3.2.3. The requirement for entry and exit ramps at each connection point has been determined by traffic modelling.
		Impacts that the proposal would have on agriculture and farming and what measures would be put in place to mitigate/address these issues	Section 6.12.3
		Impact of the proposal on business and trade loss impacts.	Section 6.12.3
		Impact of the proposal on water infrastructure.	Section 3.5
NSW Department of Primary Industries – Fisheries, DPIE	11 May 2018	NSW Department of Primary Industries – Fisheries, DPIE was satisfied that the most pressing issues for the department were addressed. The department noted that if the location or design of the proposal change, DPI Fisheries will need to re-assess the proposal prior to obtaining owners consent on these amendments from Crown lands.	Noted
Environmental Protection Authority	25 May 2018	The Environment Protection Authority identified key adequate description and assessment of:	information requirements for the proposal, including an
		Impacts on water quality and site water management, with specific reference to potential impacts on the Hunter River and an assessment of background water quality.	 Section 6.2 Section 6.3. Available water quality monitoring data for the Hunter River

Agency	Response received	Issue raised	Response / where addressed in REF
			is limited to electrical conductivity. However, available monitoring data from the nearest upstream waterways has been used provide further context regarding local water quality.
	Potential noise impacts due to construction and operation with specific reference to proposed community consultation and management measures during the construction phase.	Section 6.6.	
		The Environment Protection Authority also provided an attachment which included recommended REF requirements and requested Roads and Maritime refer to the relevant guidelines in that attachment. The attachment included guidelines for: • Environmental impacts of the proposal • Licencing requirements • The proposal and premises • Air issues • Noise and Vibration • Water and Soils • Waste • Dangerous goods, chemical storage and bunding • Monitoring programs.	Roads and Maritime has reviewed the attachment and the requirements relevant to this proposal have been addressed in this REF.

Agency	Response received	Issue raised	Response / where addressed in REF
Heritage Division, Department of Premier & Cabinet	11 May 2018	The Heritage Division provided an attachment which included recommended REF requirements and noted that some recommendations may not be relevant to the proposal. The attachment included guidelines for: The proposal Environmental impacts of the proposal Aboriginal cultural heritage Biodiversity DPIE estate Water and soils Flooding Coastal hazards Historic heritage.	Roads and Maritime has reviewed the attachment and the requirements relevant to this proposal have been addressed in this REF.
Singleton Business Chamber	9 May 2018	Noted that five members provided feedback, of which three members were in favour of a bypass of Singleton	Noted
		One member questioned the impact of the proposal on businesses within Singleton	Section 6.12.
		One member requested Roads and Maritime consider implementing clearway arrangements on George Street / New England Highway, Singleton as an alternative to the construction of a bypass	The implementation of clearway arrangements within the proposal corridor would not achieve the proposal objectives as identified within Section 2.3.1.
		Two members questioned the proposed single lane in each direction on the bypass, specifically identifying safety concerns and traffic congestion with two lanes merging into one on the New England Highway.	Section 6.5.2.

5.6 Consultation during the public display of the REF

Roads and Maritime is committed to continue the engagement of the community and stakeholders throughout the development of the proposal. The REF will be placed on public display and comments invited. Consultation activities during this display period would include:

- Briefings with Singleton Council and other relevant stakeholders
- Community information sessions
- Advertisement in local newspapers
- An online community engagement portal and update to the webpage
- Project updates distributed to the community and stakeholders inviting feedback on the proposal.

5.7 Consultation following public display of the REF

Following the public display of the REF, Roads and Maritime would prepare a submissions report which would summarise and provide a response to submissions received for the proposal. The submissions report would include a summary of any changes to the proposal in response to the submissions and other feedback during the display period.

The community would continue to be informed during the development and construction of the proposal. Roads and Maritime would also continue to consult with Singleton Council as well as other relevant stakeholders and government agencies as the proposal develops.

6. Environmental assessment

6.1 Biodiversity

This section addresses the potential terrestrial and aquatic biodiversity impacts associated with the proposal and details the management measures proposed to mitigate these impacts.

6.1.1 Methodology

The methodology for the terrestrial and aquatic flora and fauna assessment is described below.

Background research

A desktop biodiversity assessment was carried out and included a review of relevant and publicly available literature and background information to identify threatened and migratory species, endangered populations and threatened ecological communities (TECs) (or their habitats) that had previously been recorded within, or near to, the proposal area. The following searches were conducted:

- Office of Environment and Heritage (OEH) Atlas of NSW Wildlife Database within a 10 kilometre radius of the proposal, in February 2018 and June 2019
- NSW Department of Primary Industries (DPI) Fisheries Fish Records Viewer, in February 2018
- Department of the Environment and Energy (DoEE) Protected Matters Search Tool (PMST) for known/predicted EPBC Act listed TECs within a 10 kilometre radius of the proposal, in February 2018
- Commonwealth critical habitat register, in February 2018
- The federal Bureau of Meteorology's Atlas of Groundwater Dependent Ecosystems (GDE), in February 2018
- DoEE directory of important wetlands, in February 2018
- DPI database for aquatic TECs, in February 2018
- DPI Key Fish Habitat mapping, in February 2018.

The following additional resources were also reviewed:

- OEH vegetation information system (VIS) database, in June 2019
- The Vegetation of the Central Hunter Valley, NSW (Peake 2006)
- Greater Hunter Native Vegetation Mapping (Sivertsen et al. 2011)
- State Vegetation Type Map: Upper Hunter
- Digital imagery (aerial photography) of the proposal area
- Atlas of NSW Wildlife Database within a 10 kilometre radius of the proposal, in September 2019
- DoEE PMST search in September 2019.

Habitat assessment

A desktop habitat assessment of likelihood of occurrence of threatened species was undertaken using the results of the background research and field surveys. The likelihood of occurrence of these species and TECs within the proposal area was assessed based on the categories provided in Table 6-1.

Table 6-1: Likelihood of occurrence criteria

Likelihood	Criteria	
Recorded	Threatened species was observed during the current survey	
High	It is highly likely that a threatened species inhabits the proposal area and is dependent on identified suitable habitat	
Moderate	Potential habitat is present in the proposal area.	
Low	It is unlikely that threatened species inhabits the study area and has not been recorded recently in the locality (10km).	
None	Suitable habitat is absent from the proposal area.	

The likelihood of occurrence table is located in Appendix B of Appendix I.

Field survey

Vegetation surveys

Field surveys of the proposal area were conducted using a combination of vegetation integrity plots, rapid vegetation assessment points, random meander and targeted searches for threatened species was used to survey the proposal area and to map vegetation communities.

All vascular plants recorded or collected within vegetation integrity plots and rapid vegetation assessment points were identified using keys and Harden (1992, 1993, 2000 and 2002). Updated taxonomy has been derived from PlantNET (Botanic Gardens Trust 2019).

Habitat surveys

Habitat surveys were undertaken where all trees were visually inspects from the ground to identify possible hollows. A search for evidence of owls was also carried out during the hollow-bearing tree (HBT) survey.

Fauna surveys

A range of fauna surveys were undertaken across the proposal area, including:

- Diurnal bird surveys
- Call-playback
- Spotlighting
- Motion-sensing cameras
- Ultrasonic recordings
- Dusk watch for bats
- Harp trapping.

Aquatic surveys

The habitat value of the Hunter River was assessed to inform characterisation of habitat sensitivity and waterway classification. An aquatic habitat assessment was carried out at the proposed bridge crossing location of the Hunter River. The assessment included a visual inspection of the river at the crossing site and 100 metres upstream and downstream, to identify the aquatic habitat features present.

Field survey methods and effort are summarised in Table 6-2.

Table 6-2: Targeted species survey details

Method	Target species	Effort per site	Replication	Total survey effort
Diurnal bird survey	regent honeyeater, grey- crowned babbler, speckled warbler, little lorikeet, little eagle, scarlet robin, hooded robin, painted honeyeater, white-bellied sea-eagle, varied sittella, brown treecreeper, spotted harrier, flame robin, diamond firetail	20 minutes with 2 observers	7 sites	4.6 person-hours
Call-playback	masked owl, powerful owl, bush stone-curlew	30-minute listen/broadcast/sea rch event per site with 2 observers in suitable habitat	2 sites per night on 8 nights	16 call-playback sessions over 8 separate nights
Spotlighting	squirrel glider, brush-tailed phascogale, masked owl, powerful owl, bush stone- curlew, grey-headed flying- fox	At least 1 hour with 2 observers, combination of walking and driving	8 nights	16 person-hours
Motion-sensing cameras (arboreal)	squirrel glider, brush-tailed phascogale	15 nights at 5 sites; 27 nights at 3 sites	8 sites	156 trap nights
Motion-sensing cameras (ground)	spotted-tailed quoll	15 nights at 2 sites; 27 nights at 2 sites	4 sites	84 trap nights
Ultrasonic recording	eastern cave bat, yellow- bellied sheathtail-bat, Corben's long-eared bat, southern myotis, eastern coastal freetailed-bat, large bentwing-bat, little bentwing-bat, eastern false	Units were set to record from 2000 to 0500 hrs each night. For each site call data was analysed for two nights.	5 sites	10 trap nights
Dusk watch for bats	pipistrelle	1 observer at each entrance for 30 mins before, and 1 hour after dusk	2 sites	2 dusk watches
Harp trapping		1 trap over culvert during emergence	1 site	1 emergence survey
Meandering transects	Threatened flora, including Cymbidium canaliculatum	N/A	N/A	ELA: 16, 29, 30 October and 6, 7 December 2018 Umwelt: 21, 24, 25, 27 June 2019

6.1.2 Existing environment

Plant community types

The total extent of plant community types recorded in the proposal area based on verified and regional vegetation mapping is shown in Table 6-3 below.

Table 6-3 Extent of plant community types within the proposal area

Plant community type (PCT)	Condition	Area (ha) in proposal area	Area (ha) in impact area	
Verified Vegetation Mapping	Verified Vegetation Mapping			
1598 Forest Red Gum Grassy Open Forest on Floodplains of the Lower Hunter	Moderate/Good	0.47	-	
1598 Forest Red Gum Grassy Open Forest on Floodplains of the Lower Hunter	Derived Native Grassland (DNG)	0.22	-	
1604 Narrow-leaved Ironbark - Grey Box - Spotted Gum Shrub - Grass Woodland of the Central and Lower Hunter	Moderate/Good	19.45	5.34	
1604 Narrow-leaved Ironbark - Grey Box - Spotted Gum Shrub - Grass Woodland of the Central and Lower Hunter	Thinned Canopy	11.46	6.35	
1604 Narrow-leaved Ironbark - Grey Box - Spotted Gum Shrub - Grass Woodland of the Central and Lower Hunter	DNG	50.16	14.21	
1604 Narrow-leaved Ironbark - Grey Box - Spotted Gum Shrub - Grass Woodland of the Central and Lower Hunter	African Olive Infestation	1.14	-	
-	Exotic Grassland	0.84	0.33	
-	Cleared Land, Dam and Swamp Oak Plantings	2.84	1.50	
Total		86.57	27.73	
Regional Vegetation Mapping				
42 River Red Gum / River Oak riparian woodland wetland in the Hunter Valley	-	3.83	1.22	
1600 Spotted Gum - Red Ironbark - Narrow- leaved Ironbark - Grey Box shrub-grass open forest of the lower Hunter	-	4.36	2.21	
1600 Spotted Gum - Red Ironbark - Narrow- leaved Ironbark - Grey Box shrub-grass open forest of the lower Hunter	DNG	2.44	2.44	
1601 Spotted Gum - Narrow-leaved Ironbark- Red Ironbark shrub - grass open forest of the central and lower Hunter	-	4.15	0.08	

Plant community type (PCT)	Condition	Area (ha) in proposal area	Area (ha) in impact area
1603 Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest of the central and lower Hunter	-	0.15	-
1604 Narrow-leaved Ironbark - Grey Box - Spotted Gum shrub - grass woodland of the central and lower Hunter	-	0.02	-
1731 Swamp Oak - Weeping Grass grassy riparian forest of the Hunter Valley	-	-	0.08
Non-native	-	156.11	75.92
Total		171.14	81.95
Overall Total		257.73	109.69

Threatened ecological communities

The threatened ecological communities listed under the BC Act and EPBC Act that were mapped to be within the proposal area are listed below and shown on Figure 6-1 and Figure 6-2:

- Hunter Lowland Redgum Forest in the Sydney Basin and NSW North Coast Bioregions EEC (BC Act)
- Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions EEC (BC Act)
- Central Hunter Ironbark Spotted Gum Grey Box Forest in the NSW North Coast and Sydney Basin Bioregions EEC (BC Act)
- Central Hunter Grey Box—Ironbark Woodland in the New South Wales North Coast and Sydney Basin Bioregions EEC (BC Act)
- Central Hunter Valley Eucalypt Forest and Woodland CEEC (EPBC Act).

Threatened flora species and populations

Three individual river red gum (*Eucalyptus camaldulensis*) were recorded within the proposal area. These individuals are part an endangered flora population (BC Act).

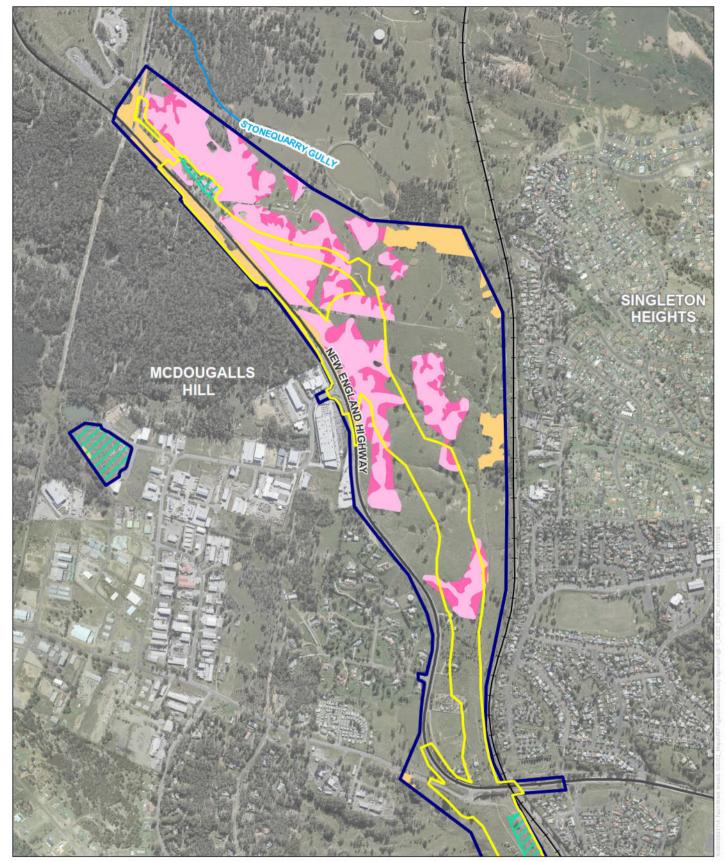


FIG. 6-1 Critically endangered ecological communities (EPBC Act)





Legend

Proposal features

- Proposal area
- Disturbance area
- Construction ancillary facilities

Other features

- State roads
 Watercom -Watercourse
- Main North railway line

CEEC

- Central Hunter Valley Eucalypt Forest and Woodland CEEC

 Central Hunter Valley Eucalypt Forest and Woodland CEEC Derived Native Grassland Form

PCT's likely to be equivalent to the Central Hunter Valley Eucalpyt Forest and Woodland CEEC

— Central Hunter Valley Eucalypt Forest and Woodland CEEC

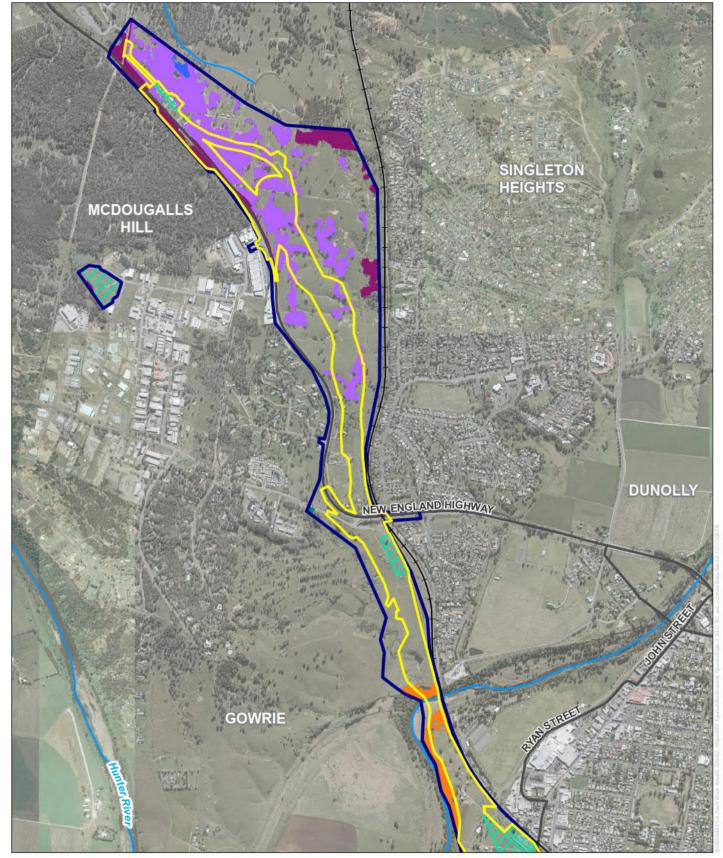


FIG. 6-2 Endangered ecological communities (BC Act)

Legend

Proposal features
Proposal area
Disturbance area

Construction a
Other features

State roads

Watercourse
 Main North railway line
EEC

Central Hunter Grey Box—Ironbark Woodland in the New South Wales North Coast and Sydney Basin Bioregions EEC

Central Hunter Ironbark — Spotted Gum — Grey Box Forest in the NSW North Coast and Sydney Basin Bioregions EEC

Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions EEC

PCT's likely equivalent to BC Act TEC's

Central Hunter Ironbark-Spotted Gum-Grey Box Forest in the NSW North Coast and Sydney Basin Bioregions EEC
Hunter Lowland Redgum Forest in the Sydney Basin and NSW North Coast Bioregions EEC



Threatened fauna species and populations

Nine threatened fauna species were recorded as present, and four threatened species as potentially present, during fauna surveys (refer to Table 6-4).

Table 6-4 Habitat assessment and survey results

Scientific name Common Name		Status	
		BC Act	EPBC Act
Birds			
Hieraaetus morphnoides	little eagle	V	-
Pomatostomus temporalis	grey-crowned babbler	V	-
Tyto novaehollandiae	masked owl	V	-
Mammals			
Falsistrellus tasmaniensis	eastern false pipistrelle	V	-
Micronomus norfolkensis	eastern coastal free-tailed bat	V	-
Miniopterus australis	little bent-winged bat	V	-
Miniopterus orianae oceanensis	large bent-winged bat	V	-
Myotis macropus	southern myotis	V	-
Petaurus norfolcensis	squirrel glider	V	-
Phascogale tapoatafa	brush-tailed phascogale	V	-
Pteropus poliocephalus	grey-headed flying-fox	V	V
Scoteanax rueppellii	greater broad-nosed bat	V	-
Vespadelus troughtoni	eastern cave bat	V	-

Habitat for threatened species which occur in the proposal area are shown below in Figure 6-3 and include:

- A total of 32.1 hectares of native vegetation, comprised of 16.0 hectares of grassland habitat and 14.5 hectares of woodland and forest vegetation that contains 239 hollow-bearing trees
- One known and five potential microbat roost sites in existing sandstone block culverts
- Key fish habitat in the Hunter River.

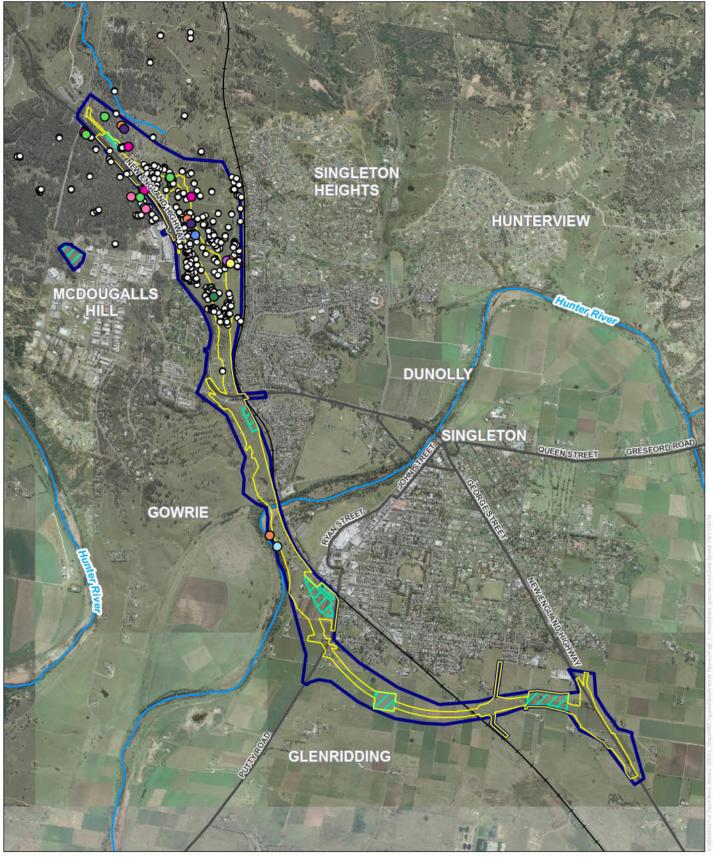


FIG. 6-3 Threatened fauna species and key habitat features



Legend

Proposal features

- Proposal area
- Disturbance area
 Construction ancillary facilities
- Other features
- -State roads Watercourse
- Main North railway line
- Habitat feature
- O Hollow-bearing tree

Threatened species

- Brush-tailed Phascogale

 Eastern Bentwing Bat

 Eastern Coastal Free-tailed Bat

 Grey-crowned Babbler

 Little Bentwing Bat

 Little Eagle

 Masked Owl (potential record)

- Eucalyptus camaldulensis population in the Hunter catchment Microbat Roost

 Southern Myotis
- Squirrel Glider

Aquatic results

The Hunter River is mapped as key fish habitat under the NSW DPI Key Fish Habitat mapping for the Singleton LGA, and forms part of the known distribution for the threatened southern purple-spotted gudgeon (Mogurnda adspersa). The nearest known population of the southern purple-spotted gudgeon occurs about 20 kilometres north of Singleton in a tributary of Glennies Creek.

Within the proposal area the Hunter River has been classified as Type 1 highly sensitive fish habitat and Class 1 major key fish habitat area (refer to Appendix I for clarification).

Critical habitat and Areas of Outstanding Biodiversity Values

No critical habitat listed under the FM Act was identified within the proposal area and no declared Areas of Outstanding Biodiversity Values listed under the BC Act occur within the proposal area.

Wildlife connectivity corridors

Wildlife corridors are largely limited to those occurring along the Hunter River and remnant vegetation north of the Hunter River between the New England Highway and the Main North railway line. An area of remnant vegetation about 250 hectares in size occurs to the west of the New England Highway between Maison Dieu Road and Rixs Creek.

Groundwater dependent ecosystem

A review of the Bureau of Meteorology's Atlas of Groundwater Dependent Ecosystems identified the Hunter River as a high potential aquatic Groundwater Dependent Ecosystem (GDE). It is considered to be reliant on groundwater in addition to rainfall in the Hunter River channel.

6.1.3 Potential impacts

Construction

Native vegetation communities

During construction, 32.1 hectares of native vegetation including 91 hollow-bearing trees would require removal, consisting of:

- Around 1.22 hectares of Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions EEC (BC Act)
- Around 13.98 hectares of Central Hunter Ironbark Spotted Gum Grey Box Forest in the NSW North Coast and Sydney Basin Bioregions EEC (BC Act)
- Around 16.89 hectares of Central Hunter Valley Eucalypt Forest and Woodland CEEC (EPBC Act).

Threatened flora

Based on field survey results, three individual River red gum (Eucalyptus camaldulensis) which are part of the endangered flora populations in the Hunter catchment have been recorded within the study area but outside of the proposal disturbance area.

Fauna habitat

Native vegetation provides potential foraging and/or breeding habitat for numerous threatened fauna species. The proposal would result in the removal of 91 hollow-bearing trees, many of which contain multiple hollows and seven of which are stags. Together, these hollow-bearing trees include:

- 183 hollows less than five centimetres wide (80 trees)
- 147 hollows five to 10 centimetres wide (67 trees)
- 60 hollows 10 to 20 centimetres wide (45 trees)
- 13 hollows 20 to 30 centimetres wide (12 trees)
- Three hollows greater than 30 centimetres wide (three trees).

Six culverts which provide potential habitat for microbats, including the Southern myotis (*Myotis macropus*) which was recorded during surveys, occur within the proposal area. Four of these would not be disturbed by the proposal, however two of the culverts could be indirectly impacted by the work through increased noise, light and vibration impacts.

Aquatic

Construction of the temporary instream structures in the Hunter River has the potential to result in alteration of fish passage during construction. The proposal includes construction of five piers and abutments, including four piers on the southern bank of the river and one pier in the river channel.

Temporary access ramps, crane pads, sheet piling and a temporary rock platform in the river would impact on aquatic habitat values during construction. The rock platform would not block the main river channel. The banks would be protected by geotextile material with rock overlay, or similar, to protect them from tracked equipment including cranes required to access the instream platform to lift the bridge girders into place. A silt curtain would be installed around the rock platform to protect water quality. The platform would be designed to ensure that flow of the main river channel and fish passage is maintained even during low flow periods.

During the proposal there would be the potential for impacts on water quality through fuel spills and leaks from machinery, and from runoff of soils and materials into the waterway. If not controlled, this could lead to a degraded aquatic environment, increased turbidity and contamination of the waterway which could reduce the habitat quality for aquatic species. The implementation of the mitigation measures listed in Section 6.1.4 would reduce the likelihood for an incident to occur.

The proposal would not degrade native riparian vegetation.

Key threatening processes

A threatening process is considered a key threatening process (KTP) under the BC Act if:

- (a) It adversely affects threatened species or ecological communities, or
- (b) It could cause species or ecological communities that are not threatened to become threatened.

There are four known and six potential KTPs under the BC Act, and one known KTP under the FM Act relevant to the proposal (see Table 6-5).

Table 6-5 KTPs relevant to the proposal

Key threatening process	Type of Threat	Relevance to proposal		
Known				
Clearing of native vegetation (BC Act)	Habitat loss/change	During construction, 32.1 hectares of native vegetation would require removal.		
Loss of hollow-bearing trees (BC Act)	Habitat loss/change	The proposal would result in the direct removal of 91 hollow-bearing trees.		
Removal of dead wood and dead trees (BC Act)	Habitat loss/change	The proposal would result in the removal of dead wood and dead trees as part of vegetation clearing.		
Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands (BC Act)	Habitat loss/change	The proposal would result in temporary instream structures in the Hunter River.		
Installation and operation of instream structures and other mechanism that alter natural flow regimes of rivers and streams (FM Act)	Habitat change	The proposal would result in temporary instream structures in the Hunter River.		
Potential				
Invasion of native plant communities by exotic perennial grasses (BC Act)	Weed	Exotic perennial grasses are present in the proposal area, particularly along roadsides. Weed management required to avoid/reduce impact of this KTP.		
Invasion of native plant communities by African olive <i>Olea europaea</i> subsp. <i>cuspidata</i> (Wall. ex G. Don) Cif. (BC Act)	Weed	African Olive is present in proposal area. Weed management required to avoid/reduce impact of this KTP.		
Low Potential				
Competition and grazing by the feral European rabbit (BC Act)	Pest animal	European rabbit is present in the proposal area.		
Predation and hybridisation by Feral Dogs, Canis lupus familiaris (BC Act)	Pest animal	Feral dogs are potentially present in the proposal area.		
Predation by feral cats (BC Act)	Pest animal	Feral cats are present in the proposal area.		
Predation by the European red fox (BC Act)	Pest animal	European red fox is present in the proposal area.		

Noise, light and vibration

The proposal would result in an increase of noise, light and vibration impacts during the construction and operation phases. These impacts have the potential to adversely affect fauna species through disturbance of roosting and foraging behaviour and reducing the occupancy of areas of suitable habitat. As the proposal area occurs adjacent to the urban centres of Singleton and Singleton Heights, which are already subject to noise, light and vibration impacts from the adjacent railway and the existing New England Highway and Main North railway line, it is not expected that the proposal would significantly affect the behaviour of fauna in the surrounding area during construction.

Operation

Long-term effects associated with the proposal include fragmentation of fauna habitat and resulting loss of wildlife connectivity corridors in the area. Invasion and spread of weeds, pests and pathogens, and changes to surface hydrology may occur as a result of the changed landscape.

Fish passage would be altered during construction however, upon completion, the bridge across the Hunter River is not expected to alter natural flows or block passage for any aquatic species or foraging micro-bats. Following the completion of bridge construction, the rock platform would be removed, and stabilised.

The proposal would result in an overall change to a small percentage of each of the relevant catchments of the first and second order watercourses within the proposal area, north of the Gowrie Gates, and is likely to have minor impacts. The third order watercourse that flows into the Hunter River from the north would be diverted as part of the proposal.

Assessments of Significance

Assessments of Significance were carried out for 19 threatened fauna species, one endangered flora population, and two TECs listed under the BC Act, and five threatened fauna species and one TEC and migratory species under the EPBC Act. An Assessment of Significance under the FM Act was also carried out for the southern purple-spotted gudgeon (*Mogurnda adspersa*). These assessments found that the proposal would likely significantly impact the Central Hunter Valley Eucalypt Forest and Woodland CEEC (EPBC Act). No other threatened species, populations or ecological communities known or predicted to occur are likely to be significantly impacted by the proposal.

The Assessments of Significance for threatened species can be found in Appendix F of Appendix I.

Conclusion on significance of impacts

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.

The proposal is likely to significantly impact threatened species, ecological communities or migratory species, within the meaning of the *Environment Protection and Biodiversity Conservation Act* 1999.

Where a significant impact is likely to threatened species, ecological communities or migratory species within the meaning of the *Environment Protection and Biodiversity Conservation Act 1999:*

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	Yes
abatement plans, conservation advices and guidelines provided by	
the Australian Government been considered?	
Can suitable offsets be secured?	Yes

6.1.4Safeguards and management measures

Mitigation measures provided in Table 6-6 would be implemented to minimise potential impacts biodiversity.

Table 6-6: Summary of mitigation measures to minimise impacts to biodiversity

Impact	Environmental safeguards	Responsibility	Timing
Biodiversity	A Flora and Fauna Management Plan will be prepared and implemented as part of the CEMP. It will address terrestrial and aquatic matters and will include, but not necessarily be limited to: (a) plans for the construction site and adjoining	Construction contractor	Pre- construction and construction
	area showing native vegetation, flora and fauna habitat, threatened species and threatened ecological communities;		
	(b) plans showing areas to be cleared and areas to be protected, including exclusion zones and protected habitat features (e.g. hollow-bearing trees), and areas for rehabilitation or re- establishment of native vegetation. The limits of clearing within the construction site and protected habitat features will be clearly delineated using appropriate signage, barriers, fencing or markings;		
	(c) requirements set out in the Landscape Design Guideline (RMS 2018);		
	 (d) procedures addressing relevant matters specified in the Biodiversity Guidelines - Protecting and managing biodiversity on RTA projects (RTA 2011) including but not limited to: 		
	 pre-clearing, including the outcomes of final flora and fauna species checks, establishment of exclusion zones and on- ground identification of specific habitat features to be retained (such as hollow- bearing trees) 		
	 vegetation clearing and bushrock removal, including staged habitat removal and any specified seasonal limits on clearing activities 		
	 fauna handling and unexpected threatened species finds 		
	 rehabilitation, revegetation, re-use of soils, woody debris and bushrock, and other habitat management actions weed, pathogen and pest management 		
	(e) procedures addressing relevant matters specified in the NSW DPI (Fisheries) Policy and guidelines for fish habitat conservation and management.		
	(f) monitoring during construction and post- construction		

Impact	Environmental safeguards	Responsibility	Timing
	(g) adaptive management measures to be applied if monitoring indicates unexpected adverse impacts.		
Biodiversity	Measures to further avoid and minimise the construction footprint and native vegetation or habitat removal will be considered during the detailed design stage and implemented where practicable and feasible. Measures to avoid and minimise impacts should be prioritised in the following order: (a) critical habitat (b) threatened species, endangered ecological communities, groundwater dependent ecosystems or their habitat (c) native vegetation and habitat supporting flora and fauna connectivity and/or that supports other environmental objectives such as protecting water quality, hydrology or erosion and sediment controls (d) native vegetation of higher quality condition (e) other native vegetation	Construction contractor	Pre-construction and construction
Biodiversity	Consistent with the Biodiversity Guidelines - Protecting and managing biodiversity on RTA projects (RTA 2011), and any specific requirements of the approved Flora and Fauna Management Plan, management arrangements will be implemented to ensure unavoidable vegetation and bushrock removal minimises biodiversity impacts as far as practicable. As a minimum that will include: (a) no vegetation clearing or bushrock removal beyond limits identified in this (b) avoiding identified exclusion zones and protected habitat features. (c) avoiding mixing of topsoil with woody debris materials (d) separation of woody vegetation suitable for re- use during construction and rehabilitation or revegetation works (e) implementation of staged clearing (f) trimming and pruning to be undertaken in accordance with relevant Australian Standards (g) in riparian zones: avoiding clearing during likely flood periods; ensuring cleared vegetation does not enter the waterway; installation of suitable sedimentation and erosion control; retaining roots and stumps to maintain bank stability; applying the hierarchy for snag management set out in the Guidelines.	Construction contractor	Pre-construction and construction

Impact	Environmental safeguards	Responsibility	Timing
Biodiversity	 Prior to the commencement of construction, carry out: Targeted surveys to confirm the presence of the following along the Hunter River and unnamed tributary to the north of the Hunter River within the area to be impacted by the proposal River red gum (<i>Eucalyptus camaldulensis</i>) (endangered population - BC Act) Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions (EEC – BC Act) Threatened flora survey, fauna habitat assessments and ground-truthing of vegetation mapping, between the Hunter River and the southern extent of the area surveyed by Umwelt (2019), north of the New England Highway near Gowrie Gates, within the area to be impacted by the proposal Ground truthing surveys of the regional vegetation mapping within the McDougalls Hill ancillary facility to confirm presence of:	Construction contractor	Pre-construction
Biodiversity	The unexpected species find procedure is to be followed under <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011) if threatened ecological communities, not assessed in the biodiversity assessment, are identified in the proposal site.	Construction contractor	Construction
Biodiversity	A nest box strategy would be developed and implemented during the detailed design stage in accordance with <i>Guide 5: Re-use of woody debris and bushrock</i> and <i>Guide 8: Nest boxes of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011). The strategy is to include: (a) a trial of artificial hollow creations. (b) reinstallation of suitable hollows removed by	Construction contractor	Detailed design

Impact	Environmental safeguards	Responsibility	Timing
	the proposal. (c) installation of nest boxes in the event that there are not sufficient trees for artificial hollow creation and hollows for reinstallation.		
Biodiversity	Prior to the commencement of construction, carry out monitoring to determine the presence of threatened microbats in the culverts that are part of the former Great Northern Railway. If threatened microbats are identified, collect the following information: (a) Species present. (b) Total number of individuals and groups per occupied roost site. (c) Description of occupied roost sites. (d) Breeding status of the colony, including approximate adult to juvenile ratios.	Construction contractor	Pre-construction
Biodiversity	If roosting threatened microbats are found during pre-construction monitoring, a Bat Management Plan is to be developed and implemented. The Bat Management Plan is to be prepared by a microbat specialist and include the following: (a) A monitoring program for both during and outside of breeding periods. (b) Details of construction activities to be monitored that may affect microbat habitat, particularly light, noise, vibration, alteration of drainage into culverts. (c) Mitigation measures to be implemented during construction, including regular inspections of impacts from sedimentation and weed encroachment to culvert entrances, consider timing and nature of immediately adjacent works in relation to known breeding period of relevant threatened microbats. (d) Adaptive management measures to be implemented if monitoring indicates a decline in bat numbers or if bats are observed leaving the roost during construction activities. (e) A process for evaluating the effectiveness of management measures.	Construction contractor	Pre-construction/construction/post construction
Biodiversity	In accordance with Section 199 of the FM Act, Roads and Maritime would notify DPI Fisheries in writing of any proposed dredging or reclamation in the Hunter River and its tributary. Roads and Maritime would consider any matters raised by the Minister.	Roads and Maritime	Pre- construction

Impact	Environmental safeguards	Responsibility	Timing
Biodiversity	In accordance with Section 219 of the FM Act, Roads and Maritime would seek a permit from DPI Fisheries for any temporary blockage of fish passage. Roads and Maritime would consider any matters raised by the Minister.	Roads and Maritime	Pre- construction
Biodiversity	Instream silt curtains would be implemented and maintained for construction in the Hunter River. Silt curtains would be installed such that they do not block fish passage.	Construction contractor	Construction
Biodiversity	Changes to existing surface water flows would be minimised through detailed design. Any rock platform required to be constructed within the Hunter River bridge would be designed and constructed to prevent blocking the main river channel. The platform would be designed to ensure that flow of the main river channel and fish passage is maintained even during low flow periods. The Department of Primary Industry (DPI) would be consulted on the final design.	Construction contractor	Detailed design
Biodiversity	A wildlife connectivity strategy would be finalised and implemented during the detailed design stage in accordance with the draft Roads and Maritime Wildlife Connectivity Guidelines (RMS 2011). The strategy is to focus on maintaining connectivity in the northern extent of the proposal and is to include, but not be limited to: (a) provision for a rope crossing with an indicative location between chainages 8450 and 8725 (b) identification of trees suitable for retention in the northern connection and tie in to facilitate glider crossings (c) consideration of additional gliding crossing structures where the width of disturbance is greater than 50 metres (d) type and extent of any associated landscaping or structures such as fencing or fauna infrastructure	Construction contractor	Detailed design

6.1.5 Biodiversity offsets

The Roads and Maritime Guideline for Biodiversity Offsets requires consideration of biodiversity offsets when threatened ecological communities or threatened species habitat is impacted above specified thresholds, as detailed in Table 6-7 below.

Table 6-7 Offsetting Thresholds for REFs (Roads and maritime 2016)

Description of Activity or Impact	Consider Offsets or Supplementary Measures
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
Works involving clearing of nationally listed threatened ecological community (TEC) or nationally listed threatened species habitat	Where clearing greater than one hectare of a TEC or habitat in moderate to good condition
Works involving clearing of NSW endangered or vulnerable ecological community	Where clearing greater than five hectares or where the ecological community is subject to an SIS
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 (TSPD)	Where clearing greater than one hectare or where the species is the subject of an SIS
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 (TSPD)	Where clearing greater than five hectares or where the species is the subject of an SIS
Type 1 or Type 2 key fish habitats (as defined by NSW Fisheries)	Where there is any net loss of habitat

The proposal triggers the offsetting thresholds for the following matters:

- Clearing of 16.89 hectares of EPBC Act listed Central Hunter Valley Eucalypt Forest and Woodland CEEC
- Clearing of 13.98 hectares of BC Act listed Central Hunter Ironbark Spotted Gum Grey Box Forest in the NSW North Coast and Sydney Basin Bioregions EEC
- Clearing of greater than one hectare of BC Act listed threatened species credit species habitat.
 - Southern myotis 11.2 hectares (includes all woodland and forest habitat within 200 metres of dams, sandstone culverts and hunter river)
 - Squirrel glider 13.2 hectares (includes all woodland and forest habitat, excluding the riparian vegetation along the Hunter River)
 - o Brush-tailed phascogale 13.2 hectares (includes all woodland and forest habitat, excluding the riparian vegetation along the Hunter River).

A preliminary Biodiversity Assessment Methodology credit calculator assessment determined the following credit requirements, as detailed in Table 6-8.

Table 6-8 Preliminary Biodiversity Credit Requirements according to the BAM (Roads and Maritime 2016)

Threatened Ecological Community/Threatened Species	Biodiversity Credits Required
Central Hunter Valley Eucalypt Forest and Woodland CEEC (EPBC Act)*	Overall Ecosystem credits = 466 CEEC component = 452
Central Hunter Ironbark – Spotted Gum – Grey Box Forest in the NSW North Coast and Sydney Basin Bioregions EEC (BC Act)*	Overall Ecosystem credits = 466 EEC component = 419

Threatened Ecological Community/Threatened Species	Biodiversity Credits Required
Southern myotis	377
Squirrel glider	419
Brush-tailed phascogale	419

^{*}note that the ecosystem credits requirements for the Central Hunter Valley Eucalypt Forest and Woodland CEEC (EPBC Act) and Central Hunter Ironbark – Spotted Gum – Grey Box Forest in the NSW North Coast and Sydney Basin Bioregions EEC (BC Act) largely overlap.

Under an agreement with DoEE, Roads and Maritime must carry out a Strategic Assessment of the impacts on 'Specified Protected Matters'. The proposal is likely to have a significant impact on the Central Hunter Valley Eucalypt Forest and Woodland CEEC which is identified as a 'Specified Protected Matter'.

In keeping with the strategic assessment agreement, Roads and Maritime would, as part of detailed design, reduce impacts where possible to this Specified Protected Matter and consult with DoEE regarding the activity.

Residual impacts to the CEEC would be offset through the retirement of biodiversity credits.

Fulfilling offset requirements under the BC Act may be achieved by Roads and Maritime using one or more of the following offset strategies:

- In-perpetuity conservation through the establishment of a Stewardship site and the retirement of credits
- Securing required credits through the open credit market
- Payments to the Biodiversity Conservation Fund.

6.2 Surface water, hydrology and flooding

This section summarises the results of the surface water, hydrology and flooding assessment that was completed for the proposal. The detailed assessment is provided in Appendix J.

6.2.1 Methodology

The surface water assessment adopted the following methodology:

- Review of available water quality, flooding data and existing conditions to obtain background information on catchment history and land use and define the existing environment
- Identification of the potential impact of construction and operational activities and potential cumulative impact on water quality with reference to the ANZECC/ARMCANZ (2000) water quality guidelines and NSW Water Quality Objectives (WQOs) for protection of the relevant environmental values
- Development of water quality treatment measures to mitigate the impact of construction on water quality, following the principles of the *Managing Urban Stormwater: Soils and Construction*, Volume 1 (Landcom 2004) and Volume 2D (DECC 2008)
- Development of water quality treatment measures to mitigate the impact of the operation of the proposal on water quality following the principle of *Procedure for Selecting Treatment Strategies to* Control Road Runoff (RTA 2003) and Roads and Maritime Water Policy (RTA 1997)
- Development of any additional measures to manage potential cumulative impact resulting from the proposal.

The flooding assessment adopted the following methodology:

- Review of available flooding data and previous flooding assessments
- Preparation of flood modelling for a number of flooding scenarios for the proposal design as part of a flooding modelling report (BMT WBM, 2019)
- Assessment of the impact of construction and operational activities for the proposal on flooding
- Identification of measures to manage potential flooding impacts.

6.2.2 Existing environment

Surface water features

Singleton is situated to the north and south of the Hunter River. The Hunter River begins on the western slopes of the Mount Royal Range, part of the Great Dividing Range, east of Murrurundi, and flows generally south-west and then south-east before flowing into the Pacific Ocean at Newcastle. Around Singleton the Hunter River has a catchment area of roughly 16,000 square kilometres. At Singleton, the Hunter River bed has eroded below the level of the floodplain to create a deep incised channel. The incised channel is about 80 to 90 metres wide at the top of the bank.

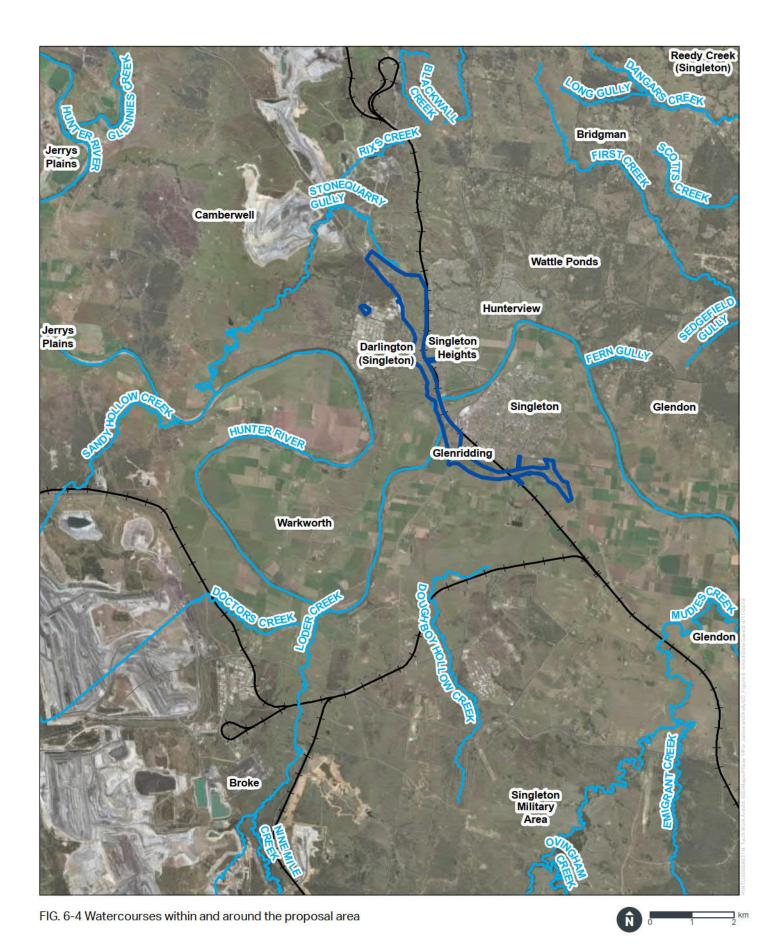
Other key surface water features include the Doughboy Hollow and Glenridding floodway (refer below for further detail). The proposal would traverse the Hunter River, the Doughboy Hollow and Glenridding floodway and a number of unnamed watercourses. The unnamed watercourses are located:

- North of the Hunter River crossing, flowing south from Maison Dieu Road, capturing flows from McDougalls Hill and the approved Gowrie subdivisions
- North of Gowrie Gates where crossings of tributaries to an unnamed watercourses drain to the east towards Lachlan Avenue in Singleton Heights.

A number of other watercourses are located near the proposal area, but are not traversed by the proposal:

- Mudies Creek, south-east of the southern connection
- Doughboy Hollow Creek, south of Glenridding
- Stone Quarry Gully, north of the northern connection.

Figure 6-4 shows the watercourses within and surrounding the proposal area.



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Water quality

Upstream of the proposal, mining and agriculture are key influences on the water quality in the Hunter River catchment. The receiving waterways near to the proposal area are regarded as moderately disturbed.

Electrical conductivity (a measure of the salinity of water) in the Hunter River has been measured regularly since 1993 at gauging station 'Hunter U/S Singleton'. This station is located about 700 metres upstream of the existing Main North Railway Bridge over the Hunter River.

The release of flows to the Hunter River is regulated upstream which influences water quality downstream at Singleton. Irrigation water is normally released to the Hunter River upstream from Glennies Creek Dam, which assists in keeping electrical conductivity low. When Glennies Creek Dam is not releasing water, the primary influence on salinity is from Glenbawn Dam which is located in the upper reaches of the Hunter River. Flows from Glenbawn Dam are associated with higher levels of salinity and generally increase salinity at the 'Hunter U/S Singleton' to around 800 μ S/cm when Glennies Creek Dam is not releasing water.

Discharges of saline water into the Hunter River catchment is permitted only during periods when the Hunter River is in high flow or flood flow, and only by persons who hold licences that authorise such discharges (discharge licences) under the Hunter River Salinity Trading Scheme.

Water quality monitoring of total suspended solids (TSS) and pH is carried out at Rixs Creek Mine and Bulga Coal Complex. The water monitoring data is summarised in Table 3-2 of Appendix J. The results indicated variable levels of TSS and pH, including elevated levels for both parameters (indicating a more alkaline water quality with higher amounts of suspended solid) which are likely a result of nearby mining and agricultural activities.

The water source at Singleton is part of the Water Sharing Plan for the Hunter unregulated and alluvial water sources. The report card for the Singleton water source prepared as part of the water sharing plan (NSW Department of Water and Energy, August 2009) identifies the following:

- There is low economic dependence of the local community on water extracted for irrigation
- There is low risk to instream value (from water extraction)
- There is medium relative instream value (within catchment) given:
 - The presence of two threatened bird species, three threatened amphibian species and one endangered ecological community
 - Moderate fish community integrity
 - Moderate ecology value for invertebrates.

Given the outcomes from the report card for the Singleton water source, the trigger values for physical and chemical stressors for 'South-East Australian slightly to moderately disturbed lowland rivers' (ANZECC, 2000) have been applied to the assessment of potential impacts to water quality in the proposal area and are summarised in Table 6-9. Existing water quality within the proposal area is generally considered to be below or within the trigger values in Table 6-9.

Table 6-9: Proposal water quality objectives trigger values and associated indicators

Trigger	Trigger value
Chlorophyll-a	3 μg/L
Total Phosphorus (TP)	25 μg/L
Total Nitrogen (TN)	350 μg/L
Dissolved Oxygen	Aquatic ecosystems (Lowland rivers): 85% saturation Drinking water: greater than 80% saturation

Trigger	Trigger value
рН	6.5-8.0
Electrical conductivity	125-2200 μS/cm
Turbidity	Aquatic ecosystems (lowland rivers): 6-50 NTU
Temperature	Aquatic ecosystems: greater than 80 percentile less than 20 percentile Primary contact recreation (eg swimming): 15-35°C
Chemical contaminants	Refer to Appendix J for detail regarding trigger values for chemical contaminants
Faecal coliforms	Drinking water: 0 colony forming units (cfu) per 100 mL Irrigation water: Less than 100 cfu per 100 mL Primary contact recreation: Less than 150 cfu per 100 mL Secondary contact recreation (eg fishing): Less than 1000 cfu per 100mL, with 4 out of 5 samples less than 4000 cfu per 100 mL
Algae and blue green algae	Drinking water: Less than 2000 algal cells per 100 mL Livestock water: Less than 11,500 algal cells per 100 mL Secondary contact recreation and primary contact recreation: Less than 15,000 cells per mL
Visual clarity and colour	Natural visual clarity not reduced more than 20%
Enterococci	Primary contact recreation: 35 cfu per 100 mL Secondary contact recreation: Less than 230 enterococci per 100 mL
Protozoans	Absent

Flooding

During a major flood event, flows at Singleton follow two primary flow path:

- The Hunter River channel and adjacent floodplain flowing around the northern side of Singleton
- Doughboy Hollow floodplain, which breaks away from the Hunter River at Glenridding (east of the proposal area) and flows around the southern side of Singleton, before combining with the Hunter River floodplain again at Whittingham (west of the proposal area).

The Rose Point floodway is also an important local flow path within and adjacent to the proposal area, which conveys floodwaters from the Hunter River west of the Putty Road connection, through culverts under the Main North railway line to Rose Point Park in the east.

Parts of Singleton are protected from flooding by a 2.7 kilometre long levee system. Included in this levee is a 330 metre long reinforced concrete retaining wall.

The Main North railway line and existing New England Highway cross the natural path of major flood flows conveyed through Glenridding and the Doughboy Hollow floodplains.

The Singleton Flood Study prepared by WBM in 2003 found that the township of Singleton has a relatively high exposure to flood risk. The existing levee system has a limited level of protection and substantial parts of the township would be inundated in major flood events including a one per cent Annual Exceedance Probability (AEP) event.

Flood modelling of existing conditions indicates that the Singleton flood levee along the Hunter River bank is not overtopped by floods up to and including the one per cent AEP event. However, modelling indicates that the one per cent AEP event would overtop the Main North railway line in the vicinity of John Street and the railway station, resulting in extensive inundation of residential properties.

The Main North railway line embankment and local topography create a damming effect during flooding which results in flooding in the Doughboy Hollow floodplain. The damming effect increases the likelihood of overtopping of the Main North railway line from the west to the east and subsequent flooding of the township.

Flood modelling identified that the New England Highway south of Singleton is inundated for a flooding event greater than the 10 per cent AEP event.

6.2.3 Potential impacts

Construction

Surface water quality

Construction activities represent a risk to surface water quality within local receiving waters. During runoff events or flood conditions, sediment laden waters, chemicals stored on site, and construction waste have the potential to mobilise and enter watercourses.

Generation of sediment laden waters and offsite transport can occur during activities such as:

- Clearing and grubbing
- Stockpiling of materials
- General earthworks
- Temporary works i.e. access roads, compounds, laydown areas and pads
- Construction of bridge piers and abutments
- Instream drainage works
- Placement of fill for embankments.

Sediment laden waters pose a potential risk to downstream surface water quality. Water quality impact includes (but not limited to) increased turbidity, elevated concentration of nutrients and other pollutants, such as heavy metals and organic chemicals. The mitigation measures in Section 6.2.4 would minimise the potential for impacts.

Other potential sources that may impact surface water quality during construction include:

- Fuel or oils used by construction plant and equipment
- Waste and litter from building activities and personnel
- Release of nutrients from fertilisers, herbicides and pesticides (eg used in site landscaping)
- Paint and paint wastes
- Acids from acid-based washes
- Disturbance of contaminated soils and/or acid sulfate soils, which may adversely affect water chemistry including pH and dissolved solids.

The outcome of the assessment of potential construction water quality impacts to environmental values and associated indicators of the NSW WQOs is summarised in Table 1-1 and provided in full in Appendix J. The assessment in Table 6-10 considers the application of the mitigation measures outlined in Section 6.2.4.

Table 6-10: Summary of assessment of the impact of Singleton bypass on environmental values and associated indicators of the NSW WQOs

Key indicator	Likelihood of impact	Discussion
Chlorophyll-a	Negligible	Chlorophyll-a is not expected to be present in site runoff as a result of the construction activities.
Total Phosphorus (TP)	Low	The majority of TP is expected to be available in topsoil. Local erosion and sedimentation controls would be provided for topsoil stockpiles (eg cover crops and bunds).
Total Nitrogen (TN)	Low	The majority of TN is expected to be available in topsoil. Local erosion and sedimentation controls would be provided for topsoil stockpiles (eg cover crops and bunds).
Dissolved Oxygen	Low	No substantial change is expected in DO concentrations from proposed site runoff or sediment basin discharges compared to receiving waters.
pH	Low	Based on the geological properties and soil landscape of the study area and preliminary sampling and available monitoring data which indicates generally more alkaline pH levels in water, the site has a low probability of encountering potential acid sulphate soil (PASS) materials.
Electrical Conductivity	Low	The electrical conductivity of site runoff and sediment basin discharges is likely to be consistent with the range of salinity historically observed in the Hunter River.
Turbidity	Low	Existing TSS levels are generally elevated in nearby waterways. Notwithstanding, construction activities have the potential to increase turbidity and TSS in local waterways. Appropriate erosion and sediment controls would be implemented for the construction of the proposal.
Temperature	Negligible	Temperature of stormwater runoff or discharge would be similar to that in nearby waterways.
Chemical contaminants	Low	Spill occurrences would be readily cleaned up as part of routine construction activities and addressed by the proposed sediment basin discharge limits (pH criteria and visible oils and grease).
Faecal coliforms	Low	There is a low likelihood of environmental impact due to faecal coliforms in surface water from construction activities.
Algae and blue green algae	Low	The potential for the construction of the proposal to contribute algal blooms in receiving waters downstream is minor in the context of the Hunter River catchment.
Visual clarity and colour	Low	Appropriate erosion and sediment controls would be implemented for the construction of the proposal.
Enterococci	Low	There is a very low likelihood of environmental impact due to enterococci in surface water from construction activities.
Protozoans	Low	There is a very low likelihood of environmental impact due to protozoans in surface water from construction activities.

Flooding

The construction of a road embankment across a floodplain can potentially increase flood levels, redistribute flows, increase inundation times and increase velocities BMT (July 2019). Potential impacts could occur where temporary access tracks and raised working platforms occur within areas subject to inundation during a flood event, leading to changes in flood patterns or redistributing flows. However, flood behaviour within and surrounding the proposal area is well understood, with adequate advance flood warning available to evacuate equipment and protect the work prior to inundation.

Ancillary facilities such as construction compounds, laydown areas and stockpiles are located outside of areas where they have the potential to impact on major natural flow paths or exacerbate flood conditions.

Operation

Surface water quality

The primary potential risk to surface water quality during the operation of the proposal would include pollutants and contaminants from the surface of the road to receiving waters. Contaminants could include litter, sediment and suspended solids, nutrients, heavy metals, toxic organics, oils and surfactants. Potential sources are:

- Exhaust particles from vehicle engines
- Wear products from brakes, tyres and other mechanical parts
- Minor discharges from vehicle engines, including fluids, lubricants and other similar materials
- Minor discharges from leaking or damaged loads
- Litter or other waste
- Loss of goods and other materials due to vehicle incidents.

The implementation of the mitigation measures provided in Section 6.2.4 would minimise potential impact to surface water quality.

Spill containment

The principal source of chemical spills during operation would be from the transport of chemical liquids during operation of the proposal and could occur due to a crash or incident.

The probability of a spill is considered to be low for the following reasons:

- The bypass provides a higher standard of road design when compared to the existing route the
 bypass alignment could be considered to reduce the potential risk of traffic incidents occurring, so the
 need for spill containment could be reduced compared with the current route
- Legislative controls on the transport of dangerous goods require that safeguards are installed on vehicles transporting hazardous liquids.

The proposal passes through areas that are environmentally sensitive. While the likelihood of a chemical spill is low, if an incident occurred there would be potential for environmental damage.

The Hunter River is a sensitive receiving environment, and the road either side of the river drains toward it. If a spill occurred in this immediate area the spill could enter the river. Spill containment, in the form of containment basins near the outlet of the drainage system, would reduce this risk to the river. Two spill containment basins north and south of the river, with a minimum volume of 25,000 Litres, would be provided to contain flows prior to discharge to the Hunter River. The basins should be capable of retaining the liquid so that it can be pumped out and treated appropriately. The location of the basins would be subject to detailed design.

Should a spill occur further from the river such as over the Hunter River or Doughboy Hollow floodplains, the gently sloping land should provide enough time and storage for the spill to be contained and treated through normal emergency response procedures. It would not therefore be able to reach the Hunter River.

Likewise if a spill were to occur north of Gowrie Gates, there is sufficient storage in the drainage system to delay flow of a spill and it could be treated through standard emergency response procedures. Therefore, there is a low probability of flows reaching the Hunter River.

Flooding - changes in peak flood level

The flooding assessment considered the impact of the proposal to peak flood levels for a range of flood events. A summary of the impacts to the modelled peak flood level as a result of the operation of the proposal for each event is provided in Table 6-11. The impact to peak flood levels for the five and one per cent AEP events is shown in Figure 6-5 and Figure 6-6 respectively.

Flood modelling indicates that the proposal would increase and decrease the peak flood level in different locations. While the proposal would not substantially decrease peak flood levels in any location, the infrastructure for the proposal would provide an additional flood evacuation routes in the event of an early-warning flood evacuation for Singleton. The proposal would also improve local accessibility during a flood event.

Table 6-11: Impacts to modelled peak flood level

Flood event	Summary of impact
20% AEP	No impact to modelled peak flood levels.
10% AEP	Impacts are limited to minor and localised impacts at the Putty Road connection. Impacts to existing private property around the connection would be unlikely.
5% AEP	Impacts would include an increase to the modelled peak flood levels at the Putty Road connection. It is unlikely that nearby dwellings would be impacted by more than a 0.02 metre increase in flood depths.
	Reduced peak flood levels of 0.07 metres are anticipated through Glenridding.
2% AEP	Impacts would include an increase in peak flood level extent and magnitude at the Putty Road connection compared to the five per cent AEP event. Peak flood levels at existing dwellings would be increased by around 0.04 meters.
	Reduced peak flood levels of 0.06 metres are anticipated through Glenridding.
	For this flood event, some localised flood impact is anticipated at the southern connection. However, the impacts are localised and limited to rural property, with no impact anticipated for existing dwellings.
1% AEP	The flooding impact near the Putty Road connection and the southern connection generally increases in extent and magnitude with increased flood event rarity.
	The modelled peak flood level impacts at dwelling locations remote from the bypass would be up to a 0.05 metre increase.
	Reduced peak flood levels of 0.1 metres are anticipated through much of Singleton and Glenridding.
0.5% AEP	The modelled peak flood level impacts at dwelling locations remote from the bypass would increase by up to 0.07 metres.

Flood event	Summary of impact
	Reduced peak flood levels of 0.1 metres are anticipated through much of Singleton and Glenridding.
0.2% AEP	Peak flood level impacts upstream of the southern connection are anticipated to increase by 0.5 metres. However, the impacts are localised and limited to rural property.
	The modelled peak flood level impacts at dwelling locations remote from the bypass would be up to a 0.08 metre increase.
	Reduced peak flood levels are anticipated through Glenridding but generally balanced through Singleton, with some localised reduction of up to around 0.1 metre.

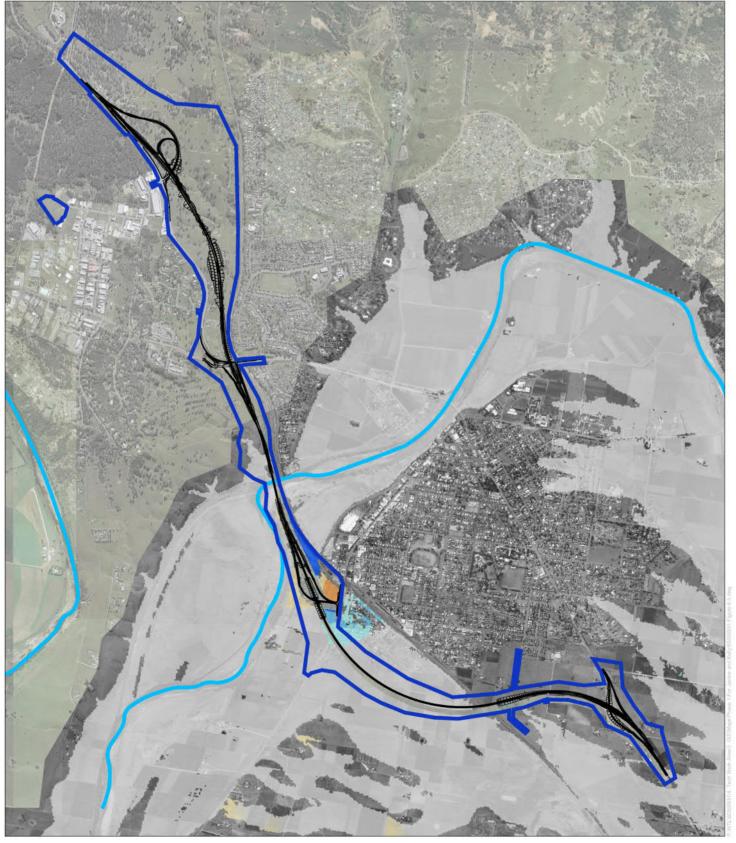
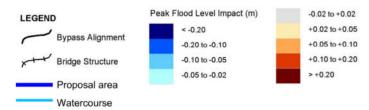


Fig. 6-5 Flood extents for the 5 per cent AEP



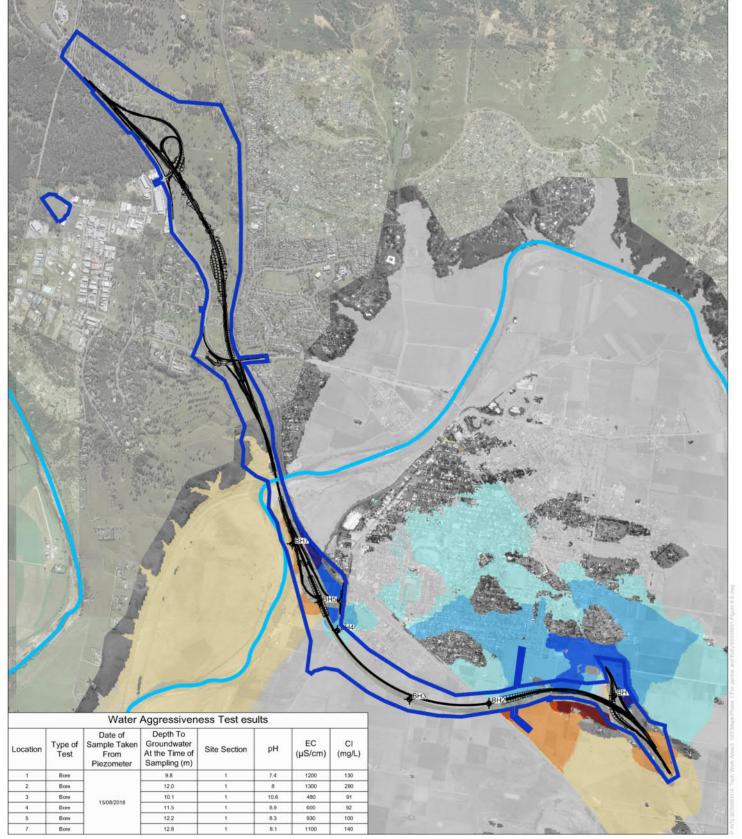


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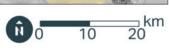
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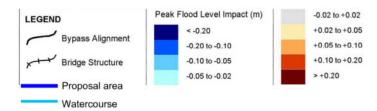
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FilG.6-6 Modelled flood extents for the 1 per cent AEP





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Changes in peak flood velocity

The flooding assessment considered the impact of the proposal to peak flood velocity for a range of flood events. A summary of the impacts to peak flood velocity and scour potential as a result of the operation of the proposal for each event is provided in Table 6-12.

In general, the changes in floodplain velocity distribution are relatively localised at the following locations as a result of the proposal:

- Around the Putty Road connection including:
 - o The Rose Point floodway upstream (west) of the Main North railway line culverts
 - The Main North railway line culverts
 - The Rose Point floodway downstream (east) of the Main North railway line culverts
 - o The northern abutment of the bridge over the floodplain.
- Around the southern connection including:
 - o The southern abutment of the bridge over the floodplain
 - o South of the embankment which connects the bridge over the floodplain to the southern connection.

The detailed design of the proposal would consider scour protection to ensure that impacts to road or other infrastructure are minimised.

Table 6-12: Impacts to peak flood velocity and scour potential from the proposal

Flood event	Summary of impact					
	Putty Road connection			Southern connection		
	Rose Point floodway (upstream)	Main North railway line culverts	Rose Point floodway (downstream)	Northern abutment of bridge over the floodplain	Southern abutment of bridge over the floodplain	South of embankment
20% AEP	No impact.				No impact.	
10% AEP	Road connection velocities due to the proposal. Peak flood veloc waters along the	Minor impacts on the modelled peak flood velocities at the Putty Road connection. The impacts would generally be reduced elocities due to the presence of the proposed embankments for the proposal. Peak flood velocities would be locally increased where flood waters along the Rose Point floodway overtop the entry ramp and exit ramp at the Putty Road connection.		reduced abankments for where flood	Negligible chang velocity.	ges to flood
5% AEP	Increase from around 0.7 to 1.0 metres per second.	Decrease from around 1.6 to 1.2 metres per second.	Decrease from around 0.9 to 0.7 metres per second.	Increase from around 0.6 to 0.8 metres per second.	3 3	
2% AEP	Increase from around 0.8 to 1.3 metres per second.	Decrease from around 2.2 to 1.5 metres per second.	Decrease from around 1.5 to 1.0 metres per second.	Increase from around 1.0 to 1.4 metres per second.	Negligible chang velocity.	ges to flood

Flood event	Summary of in	mpact				
1% AEP	Increase from around 0.8 to 1.6 metres per second.	Decrease from around 2.6 to 2.0 metres per second.	Decrease from around 1.1 to 0.8 metres per second.	Increase from around 1.1 to 1.7 metres per second.	Increase from around 0.5 to 1.0 metres per second.	Localised increase from around 0.6 to 1.1 metres per second. General increase of around 0.4 to 0.6 metres per second.
0.5% AEP	Increase from around 0.9 to 1.7 metres per second.	Decrease from around 3.0 to 2.5 metres per second.	Decrease from around 1.8 to 1.2 metres per second.	Increase from around 1.3 to 2.1 metres per second.	Increase from 0.7 to 1.2 metres per second.	Increase from around 0.9 to 1.2 metres per second.
0.2% AEP	Increase from around 1.1 to 1.9 metres per second.	Decrease from around 3.6 to 3.0 metres per second.	Decrease from around 2.1 to 1.4 metres per second.	Increase from around 1.4 to 2.1 metres per second.	Increase from 1.1 to 1.6 metres per second.	Increase from around 1.2 to 1.4 metres per second.

6.2.4 Safeguards and management measures

Mitigation measures provided in Table 6-13 would be implemented to minimise potential impacts to surface water and flooding.

Table 6-13: Summary of mitigation measures to minimise impacts to surface water and flooding

Impact	Environmental safeguards	Responsibility	Timing
Surface water and flooding	A Soil and Water Management Plan will be prepared in accordance with QA Specification G38 and implemented as part of the CEMP. The Plan will identify all reasonably foreseeable risks relating to soil erosion and water pollution associated with undertaking the activity, and describe how these risks will be managed and minimised during construction. That will include arrangements for managing pollution risks associated with spillage or contamination on the site and adjoining areas, and monitoring during and post-construction.	Construction Contractor	Pre-construction/construction
Surface water and flooding	 A flood response management plan will be prepared as part of the CEMP. The Flood Risk Management Plan will address, but not necessarily be limited to: Processes for monitoring and mitigation flood risk Steps to be taken in the event of a 	Construction contractor	Construction

Impact	Environmental safeguards	Responsibility	Timing
	flood warning including removal or securing of loose material, equipment, fuels and chemicals.		
Surface water and flooding	A site specific Erosion and Sediment Control Plan(s) will be prepared and implemented and included in the Soil and Water Management Plan. The Plan(s) will identify detailed measures and controls to be applied to minimise erosion and sediment control risks including, but not necessarily limited to: runoff, diversion and drainage points; sediment basins and sumps; scour protection; stabilising disturbed areas as soon as possible, check dams, fencing and swales; and staged implementation arrangements. The Plan will also include arrangements for managing wet weather events, including monitoring of potential high risk events (such as storms) and specific controls and follow-up measures to be applied in the event of wet weather.	Construction Contractor	Construction
Surface water and flooding	Stockpiles will be designed, established, operated and decommissioned in accordance with the RTA Stockpile Site Management Guideline 2011.	Construction Contractor	Construction
Surface water and flooding	 The rehabilitation of disturbed areas will be undertaken progressively as construction stages are completed, and in accordance with: Landcom's Managing Urban Stormwater: Soils and Construction series RTA Landscape Guideline RMS Guideline for Batter Stabilisation using Vegetation (2015) 	Construction Contractor	Construction
Surface water and flooding	Consistent with any specific requirements of the approved Soil and Water Management, control measures will be implemented to minimise risks associated with erosion and sedimentation and entry of materials to drainage lines and waterways. That will include, but not necessarily be limited to: Sediment management devices, such as fencing, hay bales or sand bags Measures to divert or capture and filter water prior to discharge, such as drainage channels and first flush and sediment basins	Construction Contractor	Construction

Impact	Environmental safeguards	Responsibility	Timing
	 Scour protection and energy dissipaters at locations of high erosion risk Installation of measures at work entry and exit points to minimise movement of material onto adjoining roads, such as rumble grids or wheel wash bays Appropriate location and storage of construction materials, fuels and chemicals, including bunding where appropriate. 		
Surface water and flooding	Batters will be designed and constructed to minimise risk of exposure, instability and erosion, and to support long-term, on-going best practice management, in accordance with Roads and Maritime 'Guideline for Batter Surface Stabilisation using vegetation' (2015).	Roads and Maritime / Construction Contractor	Detailed design/ construction
Surface water and flooding	Two spill containment basins with a minimum volume of 25,000 litres are to be provided on the north and south side of the Hunter River.	Roads and Maritime / Construction Contractor	Detailed design/ Pre- construction/co nstruction
Surface water and flooding	 A Spill Management Plan will be prepared and implemented as part of the CEMP to minimise the risk of pollution arising from spillage or contamination on the site and adjoining areas. The Spill Management Plan will address, but not necessarily be limited to: Management of chemicals and potentially polluting materials Any bunding requirements Maintenance of plant and equipment Emergency management, including notification, response and clean-up procedures. 	Construction Contractor	Pre-construction/construction
Surface water and flooding	A water quality monitoring program would be developed and implemented as part of the Soil and Water Management Plan in accordance with Roads and Maritime Guideline for Construction Water Quality Monitoring (Roads and Maritime, 2003). The monitoring program is to include • Visual monitoring of local water quality • Up and down stream water quality monitoring of the Hunter River prior to the start of construction • Monthly up and down stream water quality monitoring for the duration of working within and over the Hunter River.	Construction Contractor	Construction

Impact	Environmental safeguards	Responsibility	Timing
Surface wa and flooding	, ,	Construction Contractor	Detailed design/ Construction

6.3 Ground water

This section summarises the results of the groundwater assessment that was completed for the proposal. The detailed assessment is provided in Appendix J.

6.3.1 Methodology

The groundwater assessment adopted the following methodology:

- Review of available groundwater quality data, proposal geotechnical borehole data (Douglas Partners, 2019) and background information on catchment history and land use to define the existing environment
- Collation of registered bores from the NSW Department of Industry Water Division groundwater database
- Collation of groundwater dependent ecosystems (GDE) from the National Atlas of Groundwater Dependent Ecosystems (Australian Bureau of Meteorology (BoM))
- Assessment of construction and operational impacts to groundwater users, groundwater quality and groundwater dependent ecosystems
- Provision of a consolidated list of measures to be applied during the construction and operational phase to mitigate potential impact to groundwater.

6.3.2 Existing environment

Regional and local hydrogeology

The hydrogeology of the Upper Hunter Valley is dominated by two aquifers: a superficial aquifer hosted by alluvial deposits of Quaternary age and a bedrock aquifer hosted by consolidated sedimentary rocks and coal measures of Permian age.

Within the proposal area the superficial alluvial aquifer is present mainly south of the Hunter River beneath low-lying areas at depths ranging from 5.3 metres to 12.8 metres below the surface. The aquifer comprises sandy gravel and gravel deposits ranging between 3.2 metres and 9.0 metres in thickness. The water table is between nine and 12.7 metres below ground surface. Groundwater quality is moderately alkaline with the groundwater pH ranging from 7.4 to 10.6 and has electrical conductivity levels of 480 to 1300 µS/cm.

Within the proposal area the weathered and/or fractured bedrock aquifer is present north of the Hunter River and comprises fractured, slightly to moderately weathered siltstone and claystone.

Groundwater users

There are nine registered bores/wells located within the proposal area which are all located south of the Hunter River. Three bores are licensed for town water use by Singleton Council. The remaining six bores are licensed for irrigation, stock and domestic uses.

There are three additional bores within the proposal area which are not licensed and have been abandoned and backfilled after being drilled.

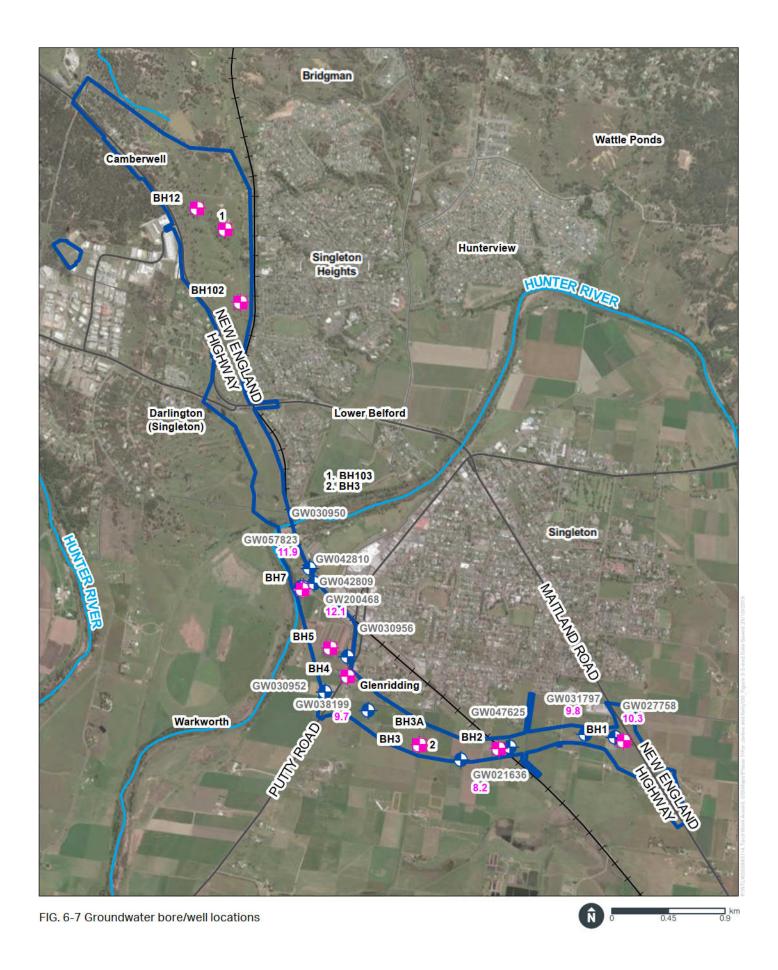
The location of groundwater bores is shown in Figure 6-7.

Groundwater dependant ecosystems

GDEs identified in the National Atlas of Groundwater Dependent Ecosystems that may be present within the proposal area include the following terrestrial GDEs:

- Hunter-Macleay dry sclerophyll forests
- Coastal swamp forests
- Eastern riverine forests.

No aquatic or subterranean GDEs have been identified in the proposal area.





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6.3.3 Potential impacts

Construction

Interaction with groundwater is anticipated during the construction of bridge piles and piers for the proposal at the following locations:

- Southern connection
- Bridge over the floodplain
- Putty Road northbound entry ramp
- Bridge over Rose Point floodway
- Hunter River.

The pile holes for the bridge over the Hunter River would intersect the superficial alluvial aquifer on the southern side of the river and weathered and fractured bedrock on the northern side of the river.

To minimise the potential of encountering groundwater, the pile holes would be installed by advancing steel casing into the ground as they are drilled. The steel casing will pass through one to two metres of gravel below the existing water table. Once the casing has been advanced to the bedrock, groundwater is generally not expected to be encountered.

While geotechnical investigations did not identify groundwater north of the Hunter River, deep excavations for the proposal at the McDougalls Hill (including around the northern connection) may intersect minor groundwater flows from the base of the weathered and fractured bedrock interval at 10 to 15 metres depth once it is exposed.

Groundwater users

Potential direct impacts to groundwater users are limited to three private groundwater bores used for irrigation. These bores may need to be relocated as they are within the impact area of the proposal. Potential impacts to other groundwater users are likely to be avoided.

No earthworks south of the Hunter River would extend to the water table and therefore dewatering and drawdown-related impacts to groundwater users are considered to be unlikely.

Groundwater quality

During construction there is a risk that groundwater could be contaminated during the construction program from activities including:

- Leaks or spills of fuels, oils and lubricating fluids used by construction machinery
- Seepage from spoil areas containing soils derived from below the water table (from excavated pile holes and deep excavations that expose fresh bedrock) that may contain unstable sulphide minerals.

Potential impacts associated with seepage are considered to be low. The proposal's risk to groundwater from acid sulphate soils is considered to be low given geotechnical investigations (Douglas Partners, 2019) identified that the water table is below the planned depth of excavation within the proposal area. Activities that may disturb materials potentially containing unstable sulphide minerals are limited to pile holes for the bridge over the floodplain and bridge across and south of the Hunter River, and excavations at McDougalls Hill.

Groundwater dependant ecosystems

There is the potential for GDEs to be impacted by the construction of the proposal at the bridge across the Hunter River due to pile construction and for the excavations at McDougalls Hill.

The Hunter River GDE is not expected to be disturbed by installation of the bridge's pile foundations. Each pile hole would be cased-off with steel piping to avoid the need to dewater the superficial alluvial aquifer that supports nearby GDEs. The aquifer has a high level of permeability (ie groundwater can easily flow through the aquifer) and therefore any minor inflows to the pile holes are unlikely to result in a measurable change to the water table.

Potential impacts to nearby GDEs located west of the excavations at McDougalls Hill to the west of the New England Highway outside of the proposal area is not expected because:

- The GDEs are up gradient and therefore the excavations would not affect the amount of groundwater recharging the local water table aquifer where the GDEs are located
- The minor amounts of groundwater that may be drained during excavations would not result in an area of groundwater drawdown that would extend to these GDEs.

Operation

Groundwater users

Minor changes to groundwater flows due to the presence of operational infrastructure for the proposal would be quickly balanced within the local groundwater system due to the high permeability of the aquifer south of the Hunter River. The operation of the proposal would not result in substantial changes to the recharge of groundwater within the proposal area and therefore no ongoing impact to groundwater users is anticipated.

Groundwater quality

There is the potential for groundwater to be contaminated in the event of an accidental spill on the road surface that is not managed and is conveyed to the groundwater system. The proposal includes the provisions for two spill containment basins north and south of the Hunter River, with a minimum volume of 25,000 Litres, to contain flows for treatment. In other areas sufficient storage is provided in the road catchment and drainage system to allow for the spill to be contained and treated through normal emergency response procedures.

Groundwater dependant ecosystems

The area of the pile foundations would be very small relative to the extent of the aquifer that supports the GDEs at the bridge over the Hunter River. Changes to groundwater flows and potential impacts to GDEs for the operation of the proposal in this area would therefore be negligible.

In the event that groundwater is intercepted during excavations at McDougalls Hill, the GDEs located west of the New England Highway are not anticipated to be impacted during operation of the proposal by the ongoing interception of groundwater flows due to the low permeability of this aquifer.

6.3.4 Safeguards and management measures

Mitigation measures provided in Section 6.2.4 would be implemented to minimise potential impacts to water quality.

6.4 Soils

This section summarises the results of a desktop investigation of the soils and geology underlying the proposal area, as well as a Contaminated Soils Phase 1 Assessment which is provided in Appendix K.

6.4.1 Methodology

The desktop investigation of soils included a review of publicly available information to obtain an understanding of the geological formations and soils landscapes within the proposal area. The Contaminated Soils Phase 1 Assessment was prepared (refer to Appendix K) in order to identify potential sources of contamination within or in proximity to the proposal area.

The methodology for the Contaminated Soils Phase 1 Assessment included:

- A review of the land use history of the proposal area through the review of publicly available information including historic aerial photography
- A review of geotechnical investigations for the proposal (Douglas Partners, 2019)
- Development of a conceptual site model to describe potential sources of contamination, pathways by which contaminants may be transmitted through the environment and the receivers that may be exposed to the contaminants
- A qualitative risk assessment based on the conceptual site model
- Identification of environmental safeguards to manage potential contamination impacts.

6.4.2 Existing environment

Soils and geology

Reference to the 1:250 000 scale Singleton Geological Sheet SI/56-01 (Rasmus et al 1969), indicates the proposal is underlain by a number of different rock types including a series of faulted folded sedimentary deposits of the Permian age, generally assigned to the Maitland Group.

The Maitland Group consists of the following identified geological units (in descending geological age):

- Quaternary Sediments gravel, sand, silt clay
- Mulbring Sandstone siltstone and sandstone
- Muree Sandstone sandstone and conglomerate
- Branxton Formation mudstone, sandstone and conglomerate.

To the north-west of the proposal area, the Singleton Coal Measures overlies the Maitland Group and comprises sandstone, shale, mudstone, conglomerate and coal seams, the latter of which has been historically mined. The Quaternary Sediments are associated with the southern section of the proposal area near the Hunter River as it traverses through Singleton.

The 1:250 000 scale Singleton Soil Landscape Map (DLWC 1991) shows that soils in the southern section of the proposal area are part of the Hunter Soil Landscape and are generally fertile alluvial soils, brown clays, black earths and red podzolic soils. The fertile alluvial soils are well suited to cropping and grazing (DPI, 2013). The northern section of the proposal that intercepts McDougalls Hill is associated with the Sedgefield Soil Landscape and is characterised by yellow soloths, black soloths and yellow solodic soils.

Acid sulphate soils are not identified in the proposal area by publically available acid sulphate soils mapping including the Singleton LEP. The results of the geotechnical investigations for the proposal (Douglas Partners (2019)) identified:

- The soils and groundwater below the water table are not acidic
- The bedrock at the bridge over the floodplain and deep excavations at McDougalls Hill presents a low risk as a potential acid sulphate soil source as indicated by the low sulphur and net acid generation test results, and excess acid neutralising capacity
- The bedrock beneath the southern end of the proposal presents a higher risk of potential acid sulphate soil materials being present due to the high total sulphur contents and low pH.

Salinity

Dryland salinity has been observed in the Upper Hunter area, however no salinity hazard maps are listed in the Singleton LEP. The Salinity hazard report for Catchment Action Plan upgrade – Hunter-Central Rivers CMA (Nicholson et al., 2012) identified a high hazard risk of salinity around the township of Singleton, with land along the New England Highway identified as being of a very high salinity hazard.

Contamination

The Contaminated Soils Phase 1 Assessment identified the following potential contamination sources within or in proximity to the proposal area:

- Rix's Creek Mine to the north of the proposal area
- Heavy machinery and equipment maintenance businesses potentially storing fuels and chemicals adjacent to the proposal area in the north and west, including Maitland Diesel Service and Complete Parts and Equipment Solutions
- Motor vehicle servicing and sales businesses potentially storing fuels and chemicals adjacent to the proposal area in the north west and south east, including Singleton Toyota and Lancaster Motor Group
- Caltex Service Station storing fuel adjacent to the proposal area in the north-west
- New England Highway and additional collector roads which connect throughout the proposal area
- Main North railway line which traverses the southern portion of the proposal area and the eastern boundary of the proposal area
- Fill containing potential asbestos containing material and a water main lined with potential asbestos, within the rail corridor in the north-east section of the proposal area
- Mines Rescue Station located to the east of the northern section of the proposal area
- Concrete batch plant adjacent to the proposal area to the east
- The former Singleton Gasworks which is an EPA listed site declared for remediation and is located to the east of proposal area on John Street
- Roads and Maritime Singleton Maintenance Depot located to the west of the proposal area which stores fuels and chemicals and may potentially store waste spoil stockpiles
- Market Gardens within the proposal area, north of Putty Road which may potentially store chemicals and fuels from machinery refuelling and maintenance
- Excess nutrient and microbial loading in the subsurface environment from evaporation ponds within Singleton Sewerage Treatment Plant located south of the proposal area
- Historical storage and use of unknown chemicals/fuels in the operational Singleton Sewerage Treatment Plant
- Agricultural land use, including pastoral land
- Houses and buildings within the proposal area potentially containing asbestos.

The potential contamination sources are shown in Appendix K.

The proposal area includes the following sensitive receptors:

- Human receptors within and adjacent to the proposal area including:
 - Construction workers for the proposal
 - Commuters using the existing New England Highway, surrounding public roads, Singleton Train
 Station and the proposal during operation
 - o Recreational users of Rose Point Park, the Hunter River and nearby public recreation areas
 - o Workers within the commercial and industrial areas of Singleton and McDougalls Hill
 - o Agricultural industry utilising land adjacent to the proposal area for market gardens and pastoral use
 - Groundwater users
 - Residents in the surrounding areas.
- · Ecological receptors within and adjacent to the proposal area including:
 - o Surface water (e.g. Hunter River)
 - Groundwater
 - Native vegetation and wildlife
 - o Agricultural land.

6.4.3 Potential impacts

Construction

Erosion and sedimentation

The proposal would involve removal of top soil, earthworks associated with filling for the new road and stockpiling of spoil for construction. If not adequately managed, earthworks, stockpiling and transportation of spoil could potentially have the following impacts:

- Erosion of exposed soil and stockpiled materials
- An increase in sediment loads entering nearby watercourses.

With the implementation of erosion and sedimentation control outlined in Section 6.3.4, potential construction related erosion and sedimentation impacts would be appropriately managed and would be minor.

There is a low risk of encountering acid sulphate soils during construction of the proposed works given that excavations would be carried out to a maximum depth of 15 metres and the probability of acid sulphate soils in the area is low.

Salinity

The construction of the proposal has the potential to exacerbate dryland salinity in the proposal area where the groundwater table is impacted by construction works. Given impacts to the groundwater table are anticipated to be minor as described in Section 6.4.3, the proposal is unlikely to contribute to dryland salinity.

Contamination

Existing contamination present within soils or groundwater in the proposal area has the potential to be exposed or disturbed during construction activities. The demolishment of existing houses, buildings and the former rail corridor has the potential to disturb asbestos containing material. The Contaminated Soils Phase 1 Assessment identified that overall there is a moderate risk of contamination from a range of potential contaminants and sources within and adjacent to the proposal area that may present an unacceptable risk

to human health and/or the environment. Contamination risks would be managed in accordance with the environmental safeguards provided in Section 6.4.4.

Soil contamination could occur as a result of any accidental spills or leaks of fuels, oils and other chemicals from equipment and vehicles during construction. To avoid this potential impact, fuels and chemicals would be managed in accordance with the management measures provided in Section 6.4.3.

Operation

During the operation of the proposal, the risk of soil erosion would be minor as all areas impacted during construction would be sealed or rehabilitated and landscaped to prevent soil erosion from occurring.

There are minor contamination risks associated with the operation of the proposal which would be limited to:

- Spills from industrial heavy vehicles such as oil tankers
- Accidents from general motorists causing oil and petrol spills.

Spills and other contamination sources during operation would be appropriately managed by implementing standard emergency spill environmental safeguards.

6.4.4 Safeguards and management measures

Environmental safeguards provided in Table 6-13 would be implemented to minimise potential impacts related to soils and contamination.

Measures to manage erosion and sedimentation are listed in Section 6.4.3.

Table 6-14: Summary of environmental safeguards to minimise impacts to soils and contamination

Impact	Environmental safeguards	Responsibility	Timing
Contamination	The CEMP will include an unexpected finds protocol for potentially contaminated material encountered during construction work.	Construction contractor	Construction
Contamination	If contaminated areas are encountered during construction, appropriate control measures will be implemented to manage the immediate risks of contamination. This may include but not be limited to: • Diversion of surface runoff • Capture of any contaminated runoff • Temporary capping. All other works that may impact on the contaminated area will cease until the nature and extent of the contamination has been confirmed and any necessary site-specific controls or further actions identified in consultation with the Roads and Maritime Environment Manager and/or the EPA.	Construction contractor	Construction
Contamination	An Asbestos Management Plan will be developed and implemented to manage asbestos and asbestos containing material if encountered during the construction. The plan	Construction contractor	Construction

Impact	Environmental safeguards	Responsibility	Timing
	 will include: Identification of potential asbestos on site Procedures to manage and handle any asbestos Mitigation measures if asbestos is encountered during construction Procedures for disposal of asbestos in accordance with NSW EPA guidelines, Australian Standards and relevant industry codes of practice. 		
Soils	An Acid Sulfate Materials Management Plan will be prepared and implemented as part of the CEMP. The Plan will be prepared in accordance with the RTA Guidelines for the Management of Acid Sulfate Materials.	Construction contractor	Construction

6.5 Traffic and transport

6.5.1 Existing environment

Existing road network

The New England Highway is a key strategic road forming part of the Sydney to Brisbane corridor of the National Land Transport Network. It is a major freight and commuter route between Newcastle and the Upper Hunter with about 15 per cent of traffic movements being heavy vehicles.

The New England Highway passes through Singleton providing links to Muswellbrook to the north and Maitland to the south. Between 18,000 and 28,000 vehicles per day (two-way) travel on the highway through Singleton.

With planned future developments in Singleton and the continual growth in regional freight movements, the resulting traffic growth is likely to impact on the functionality of the New England Highway in this area.

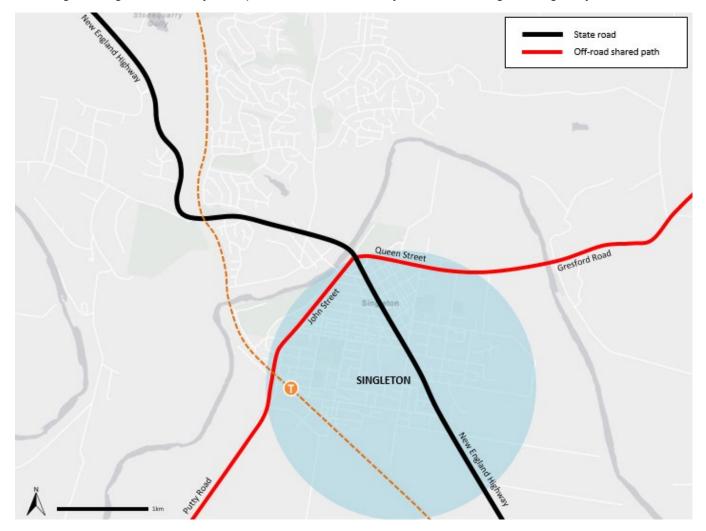


Figure 6-8: Existing road network for the Singleton area

Key roads within and around the proposal area are illustrated in Figure 6-8, and include:

- The New England Highway is a state road and classified as a highway. It is a major north-south route
 passing through Singleton. As the road passes through Singleton, it is generally one lane in each
 direction, with an on-street parking lane provided on both sides. It has a posted speed limit of 50
 kilometres per hour to 60 kilometres per hour within the proposal area
- Gresford Road is a regional road and classified as a main road. It is an east-west route providing
 access to rural areas east of Singleton. The undivided road is one lane in each direction with a posted
 speed limit of 60 kilometres per hour
- Putty Road is a regional road and classified as a main road. It is a north-south route providing access
 to rural areas south-west of Singleton. The undivided road is one lane in each direction with a posted
 speed limit of 60 kilometres per hour
- Queen Street and John Street are regional roads and both classified as main roads. These two roads
 provide an east-west link through Singleton linking with Putty Road and Gresford Road. These
 undivided roads have one lane in each direction with an on-street parking lane on both sides. There
 are posted speed limits of 50 kilometres per hour to 60 kilometres per hour, within the proposal area. A
 school zone operates on Queen Street between Combo Lane and Boundary Street.

The roads described above are considered to be key roads as they form the primary north-south and east-west traffic routes to and from Singleton.

Key intersections

Key intersections along the New England Highway through Singleton provide connectivity to residential streets and regional roads and include:

- New England Highway / Magpie Street (signals)
- New England Highway / Bridgman Road (signals)
- New England Highway / Boundary Street / York Street (signals)
- New England Highway / Orchard Avenue / Howe Street (signals)
- John Street / Hunter Street / Ryan Avenue (signals)
- Putty Road / Ryan Avenue (signals)
- John Street / Newton Street / Campbell Street (roundabout).

As the New England Highway passes through Singleton, there are a number of priority controlled intersections, the majority of which are T-intersections. At priority controlled intersections, the side road(s) has either a 'give way' or a 'stop' sign.

Parking facilities

On-street kerbside parking (parallel) is provided on both sides of New England Highway as it passes through Singleton. The majority of the on-street kerbside parking is unrestricted with some timed restrictions in place for retail uses, such as the pharmacy and bakery along New England Highway.

Heavy vehicles

The New England Highway is a major freight route between Newcastle, Maitland and the Upper Hunter. It is classified as a B-double route for trucks up to 25/26 metres in length, as shown in Figure 6-9.

Putty Road and Gresford Road are also classified as B-double routes, with some time-of-day restrictions on certain sections on the approach to and through Singleton.

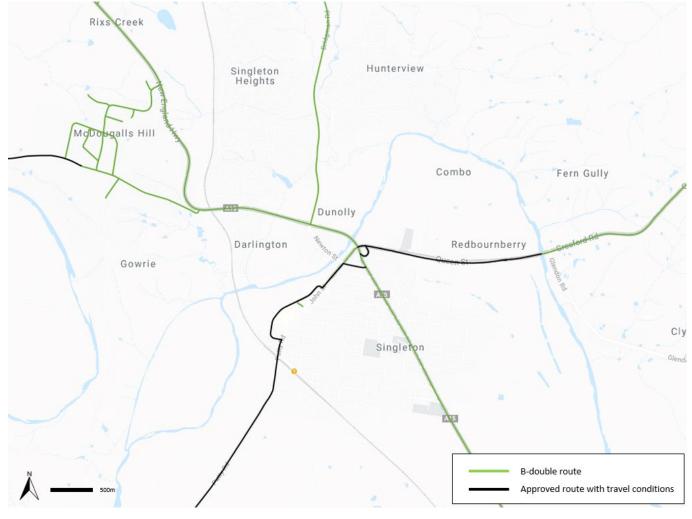


Figure 6-9: B-double routes

Existing traffic volumes

Roads and Maritime has a permanent classifier station located on the New England Highway about 200 metres north of Rixs Creek Lane at Rixs Creek. This station provides historical annual average daily traffic (AADT) data, which is presented in Table 6-15.

The AADT data for the New England Highway shows traffic volumes have steadily increased at an annual rate of about 2.6 per cent between 2015 and 2018.

Table 6-15: Roads and Maritime Services AADT data for New England Highway

ID	Station	Two-way traffic volumes (vehicles)				
		2015	2016*	2017	2018	Growth per annum
6153	200m north of Rixs Creek Lane, Rixs Creek	13,245	-	13,796	14,284	2.6%

^{* 2016} data has been excluded from the table as southbound traffic was only recorded

Mid-block traffic counts were also collected between 1 March and 19 March 2018, as summarised in Table 6-16. These surveys show the New England Highway (at Hunter River Bridge) carries up to 28,000 vehicles per weekday (two-way).

Table 6-16: 2018 traffic volumes

Road	Location	Direction	Weekday average (vehicles)
New England	North of Rixs Creek Lane	NB	7879
Highway		SB	8028
	West of Hunter River / Hunter River Bridge	EB	14,017
		WB	13,922
	South of Cambridge Street	NB	11,389
		SB	10,721
	South of Waddells Road	NB	10,504
		SB	10,689
	South of Haggartys Lane	NB	10,478
		SB	10,809
John Street	South of Campbell Street	NB	7166
		SB	7875
Putty Road	South of Carrington Street	NB	2649
		SB	2576
Queen Street	East of Raworth Street West of Civic Avenue	EB	2385
		WB	2318
		EB	3835
		WB	3763

Note: NB = northbound, SB = southbound, EB = eastbound, WB = westbound

Figure 6-10 shows the daily traffic volume profile on the New England Highway at Hunter River Bridge. There are two distinct morning peaks, one between 5.30am and 6.30am and the other between 8.30am and 9.30am. The evening peak hour was identified to occur between 4pm and 5pm, which has the highest cumulative two-way traffic volume.

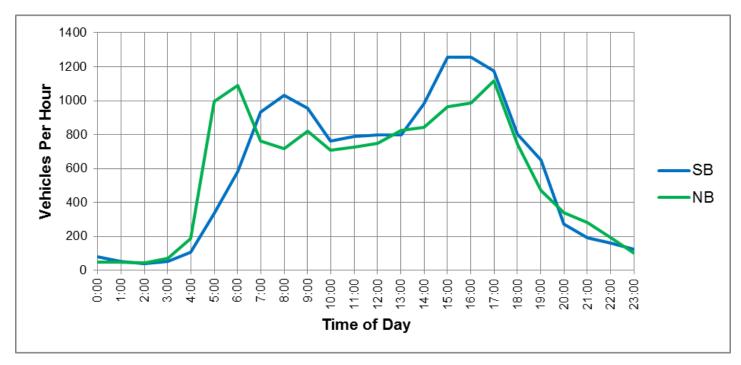


Figure 6-10: Daily traffic profile on New England Highway at Hunter River Bridge

A vehicle origin and destination (OD) survey was carried out in Singleton by Austraffic on Wednesday 28 February 2018. The data was collected in 15 minute intervals between 5am and 9:30am and between 3pm and 7pm.

Analysis of the OD survey data indicated:

- During the morning period, up to 44 per cent of trips originating south of Singleton (south of White Falls Lane) were through (northbound) trips along the New England Highway
- During the morning period, up to 54 per cent of trips originating north of Singleton (north of Magpie Street) were through (southbound) trips along the New England Highway
- During the evening period, up to 36 per cent of trips originating south of Singleton (south of White Falls Lane) were through (northbound) trips along the New England Highway
- During the evening period, up to 51 per cent of trips originating north of Singleton (north of Magpie Street) were through (southbound) trips along the New England Highway.

Intersection performance

Level of service (LoS) is the standard measure used to assess the operational performance of intersections. There are six levels of service, ranging from LoS A (the best) to LoS F (the worst). LoS D or better is considered to be an acceptable level of service.

An Aimsun traffic model was developed to assist with the operational traffic impact assessment of the proposal (see Appendix L for further details). The traffic model was calibrated and validated using 2018 traffic survey data. Table 6-17 summarises the intersection performance of key intersections, which shows most of the intersections operate satisfactorily except for the New England Highway and Bridgman Road intersection.

Table 6-17: 2018 intersection performance

Intersection	AM peak (5.30-6.30am)		AM peak (8.30-9.30am)		PM peak (4-5pm)	
intersection	Avg. delay (s)	LoS	Avg. delay (s)	LoS	Avg. delay (s)	LoS
New England Highway / Bridgman Road	88	F	44	D	58	E
New England Highway / Orchard Avenue / Howe Street	9	Α	20	В	16	В
New England Highway / Boundary Street / York Street	7	Α	20	В	28	С
Putty Road / Ryan Avenue	13	Α	14	В	13	Α
John Street / Hunter Street / Ryan Avenue	10	Α	26	В	24	В
John Street / Newton Street	2	Α	12	Α	19	В
Queen Street / New England Highway Ramp	3	Α	7	Α	6	Α

Crash data

Figure 6-11 and Table 6-18 summarise crash data between January 2013 and December 2017 along the New England Highway within the proposal area. A total of 86 crashes were recorded, which involved 64 casualties. No fatalities were recorded during this period.

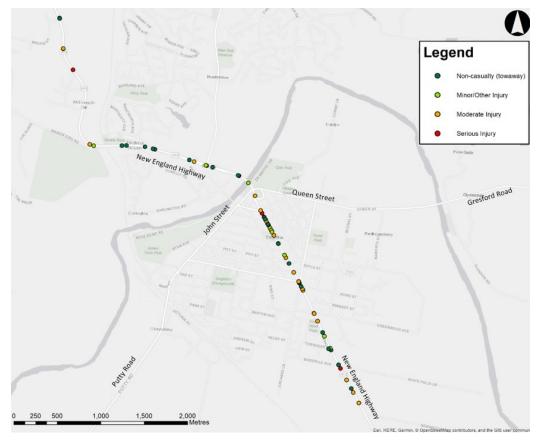


Figure 6-11: Crash location and types between 2013 and 2017

Source: Roads and Maritime, 2019

Table 6-18: Crash data summary between January 2013 and December 2017

Туре	Crashes	Casualties
Fatal	0	0
Serious injury	9	9
Moderate injury	24	38
Minor/other injury	14	17
Non-casualty	39	-
Total	86	64

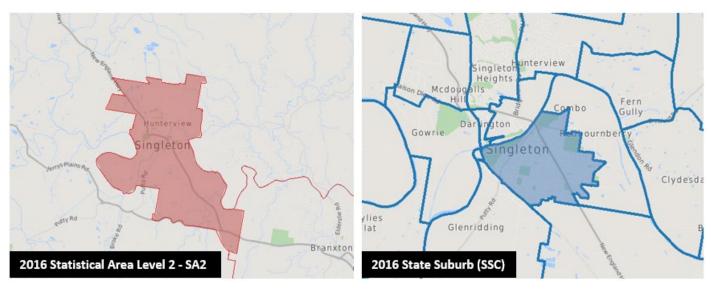
Source: Roads and Maritime, 2019

Analysis of the crash data indicated the following:

- About 90 per cent of crashes involved multiple vehicles
- About 44 per cent of crashes were rear-ends
- About 54 per cent of crashes occurred at an intersection
- Current trends indicate fewer crashes are occurring with 27 crashes recorded in 2013 and 14 crashes in 2017.

Mode of travel

Travel characteristics for Singleton were based on 2016 Census data. This data provides details on the mode of transport by which residents travelled to work on the day of the Census. The assessment of traffic and transport impacts related to the proposal considers the traffic environment within the boundary of Singleton (state suburb) that is located within the broader statistical area of Singleton (SA2). The mode of travel shared for these two key areas are summarised in Table 6-19.



Private vehicles are the predominant mode of transport for travel to work in Singleton, accounting for about 80 per cent of commute trips. This could be attributed to the limited public transport services to key employment areas, which is reflected by the low reliance on public transport, accounting for less than one per cent of commute trips.

Table 6-19: Method of travel to work (2016 Census)

Boundary	Car – driver or passenger	Public transport	Walked	Other
Singleton (SA2)	78%	<1%	4%	17%
Singleton (state suburb)	79%	<1%	4%	16%

Public transport services

Rail services

Singleton Station, which is served by the Hunter Line and North Western NSW Line, both operated by NSW TrainLink, is adjacent to the proposal area:

- The Hunter Line through Singleton provides an intercity service between Newcastle and Scone
- The North Western NSW Line is a regional service through the Hunter, New England and North West Slopes & Plains regions.

Table 6-20 summarises the number of train services at Singleton Station.

Table 6-20: Rail services at Singleton Station

Rail service	Description	No. of weekday services	No. of weekend services
Hunter Line	Scone to Newcastle	4	2
	Newcastle to Scone	4	2
North Western NSW Line	Central to Armidale	1	1
	Armidale to Central	1	1

Bus services

Hunter Valley Buses provides the following bus services to the Singleton area:

- 180: Singleton Heights to Stockland Green Hills
- 180X: Singleton Heights to Stockland Green Hills (express)
- 401: Singleton town Service
- 402: Singleton to Darlington and Hunterview
- 403: Singleton to Singleton Heights
- 404: Singleton to Singleton Heights.

The bus routes serving Singleton and surrounding areas, provide a mixture of regional and local connections, as shown in Figure 6-12 and summarised in Table 6-21.

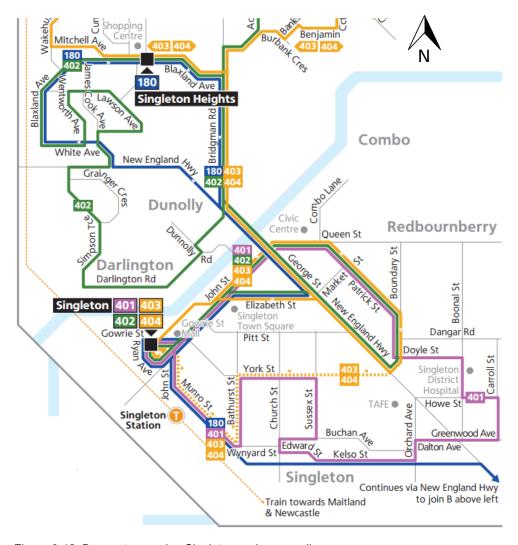


Figure 6-12: Bus routes serving Singleton and surrounding areas

Table 6-21: Bus services at Singleton

Route	Description	No. of weekday services	No. of Saturday services	No. of Sunday & Public Holiday services
180	Singleton Heights to Stockland Green Hills	4	3	0
	Stockland Green Hills to Singleton Heights	4	3	0
180X	Singleton to Maitland (Express Service)	2	0	0
	Maitland to Singleton (Express Service)	2	0	0
401	Singleton town Service (loop)	8	6	5
402	Singleton to Darlington and Hunterview (loop)	3	0	0
403	Singleton to Singleton Heights (loop)	5	4	2
404	Singleton to Singleton Heights (loop)	5	4	3

Walking and cycling facilities

Pedestrian footpaths are provided on both sides of the New England Highway (George Street and Maitland Road) as it passes through Singleton. Along the New England Highway, marked (signalised) pedestrian crossings are provided south of Market Street and Elizabeth Street and at the Maitland Road / York Street and Orchard Avenue Road / Howe Street intersections.

On the New England Highway to the north of the Hunter River, there is a shared footpath on the north side of the highway between Bridgman Road and Simpson Terrace, as well as a signalised pedestrian crossing at the Bridgman Road intersection.

Cycle routes are provided in select locations close to the New England Highway as shown in Figure 6-13:

- On-road cycle routes along Bourke Street and High Street provide a north-south link through the Singleton town centre. Both on-road cycle routes link to the off-road shared path along Queen Street
- A network of off-road shared path connections is provided for the suburbs of Hunterview, Singleton Heights and Darlington, which are located to the north of Hunter River.



Figure 6-13: Bicycle network near Singleton

6.5.2 Potential impacts

Construction impacts

A qualitative construction traffic impact assessment has been completed. The results of the assessment are summarised below.

Construction footprint and construction site locations

The construction footprint for the proposal is shown in Figure 3-2 to Figure 3-6 in Chapter 3 of this REF. As indicated on these figures, construction compounds and facilities are planned at the following locations:

- Southern connection laydown area located west of New England Highway, between White Falls Lane and Newington Lane
- Army Camp Road laydown area located west of Army Camp Road
- Waterworks Lane construction compound located in the area both sides of Waterworks Lane, between the Main North railway line to the east and the Putty Road connection to the west
- Gowrie Gates construction compound located south of the existing Main North railway line bridge over the New England Highway
- Northern connection construction compound located east of the existing New England Highway west of the Main North railway line
- McDougalls Hill facility located within an area of vacant land in the McDougalls Hill industrial area
 west of the New England Highway near the proposed northern connection.

Traffic impacts

Construction vehicles would access the site via arterial roads wherever possible. Indicative construction traffic access points are shown on Figure 3-9 in Chapter 3 and would generally be via the New England Highway.

Indicative heavy vehicle haulage routes have been identified for the movement of spoil between different areas of the proposal. The routes to and from the New England Highway are also shown on Figure 3-9 in Chapter 3. The haulage routes have been designed to avoid use of local roads, where possible. As shown in Figure 6-9, both the New England Highway and Putty Road are classified as B-double routes, with the relevant section of Putty Road having a restriction of 25 to 26 metre B-double trucks only being able to travel northbound between 3am and 5am Monday to Friday.

The number of construction vehicle movements has been estimated to be up to 80 light and 140 heavy vehicles per day (up to 12 per hour) during peak construction periods across all ancillary facilities.

Heavy vehicle movements, which are likely to have the largest impact, would mainly be related to earthworks or spoil movement, but would also include other movements including girder delivery and plant delivery. The estimated 140 heavy vehicle movements described above includes movements associated with girder delivery and plant delivery, which are anticipated to be limited to around 10 per cent (14 movements per day) of the total daily heavy vehicle movements.

As noted, heavy vehicles would only access construction sites from approved heavy vehicle routes, primarily the New England Highway. Existing traffic flows on the New England Highway are substantially greater than the proposed construction traffic numbers. The existing traffic flows are over 1000 heavy vehicles from 7am to 10pm and over 300 heavy vehicles from 10pm to 7am each day. Therefore, construction traffic, including earthworks truck movement, is likely to have a minor impact on existing traffic operations.

Most construction works would be carried out separate to the existing road network, during standard working hours and so would be unlikely to impact traffic operations. It is expected that some works, including tie-in works would be undertaken outside of standard working hours under a Road Occupancy Licence (ROL) to avoid impacts during peak traffic periods.

Impacts to traffic on the New England Highway during construction would be temporary in nature. Traffic impacts would occur due to the movement of construction and service vehicles along New England Highway and access roads, for the haulage of construction materials. As described above, construction sites would be primarily accessed via approved heavy vehicle routes.

Potential traffic impacts caused by the construction of the proposal include:

- Increased travel time due to reduced speed limits around construction sites
- Increased travel time due to increased truck and construction machinery movements
- Temporary partial or complete closure of roads and altered property accesses during construction. Property access would be maintained as far as practicable throughout construction.

Measures to manage potential construction traffic impacts are listed in Section 6.5.3.

Public transport

The proposal is not expected to disrupt public transport. All existing bus and train services would be maintained during construction, with potential for minor delays on bus services due to construction speed limits or detours. Through the implementation of the community engagement plan, the community, including public transport operators, would be informed of upcoming activities that may affect the operation of public transport.

Walking and cycling facilities

A separated shared pedestrian and cyclist path is located next to the New England Highway where the New England Highway passes beneath the Main North railway line, providing connectivity under the rail bridge. This shared path, west of the Main North railway bridge, would be temporarily impacted during activities required for the construction of the bridge over the New England Highway and southern entry ramp at Gowrie Gates. Connectivity would be maintained through localised diversions where feasible, however temporary diversion of the shared path into the road shoulder, with temporary concrete barriers for protection, may be required.

There is an informal pedestrian access to the Hunter River beneath the Main North railway line near Rose Point Road. The informal access is used primarily to access the Hunter River for recreational activities. This access would be closed during the construction of the proposal due to the work required for the bridge over the Hunter River.

Recreational users of the Hunter River would continue to have the option to use an existing access to the river east of the proposal area, to the north of Rose Point Park.

It is anticipated that construction works would be carried out in a manner to ensure that public access routes are maintained and pedestrian diversions are minimised. This would be documented in the Construction Traffic Management Plan (CTMP) that would be developed for the proposal.

Operational impacts

Traffic impacts

The traffic assessment modelled the impact of the proposal. Modelling was undertaken for an assumed opening year of 2026 and future years of 2036 and 2046. The following future scenarios were modelled:

 Base: The future Base scenarios assume no changes or upgrades to the current road and public transport networks

- Do Minimum: The future Do Minimum scenario assumes the proposal has not been built. It is called Do
 Minimum rather than Do Nothing as it assumes ongoing improvements would be made to the broader
 road and public transport network including some new infrastructure and intersection improvements to
 improve capacity and cater for traffic growth
- **Design**: The future Design scenarios assume the proposal is complete and open to traffic. Two Design options were assessed as shown in Figure 6-14 with and without south facing ramps from Putty Road.

To understand the impacts of the proposal, the modelling outcomes for 2036 (10 years after the proposed opening) are summarised in this chapter. The full traffic assessment is contained in Appendix L.

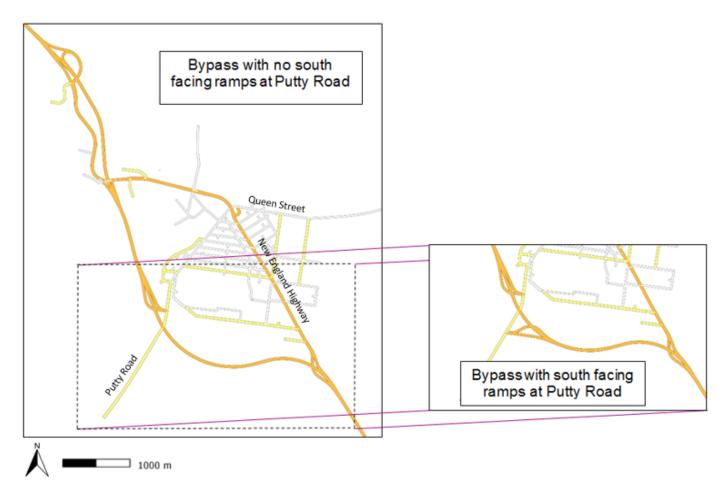


Figure 6-14: Bypass options with and without south facing ramps at Putty Road

In 2036, the introduction of the proposal (with and without Putty Road ramps) is forecast to remove:

- AM peak hour (5.30am to 6.30am):
 - Up to 1500 vehicles per hour (two-way) from the New England Highway through Singleton when compared to the Do Minimum scenario
 - Up to 300 vehicles per hour (two-way) in the Town Centre along John Street compared to the Do Minimum scenario.
- AM peak hour (8.30am to 9.30am):
 - Up to 1000 vehicles per hour (two-way) from the New England Highway through Singleton when compared to the Do Minimum scenario
 - Up to 450 vehicles per hour (two-way) in the Town Centre along John Street compared to the Do Minimum scenario.

- PM peak hour (4pm to 5pm):
 - Up to 1250 vehicles per hour (two-way) from the New England Highway through Singleton when compared to the Do Minimum scenario
 - Up to 400 vehicles per hour (two-way) in the Town Centre along John Street compared to the Do Minimum scenario.

The shift of these vehicles from the road network within Singleton to the bypass should provide additional capacity for vehicles undertaking more local trips and the reduction should provide greater amenity within the Town Centre.

Future intersection performance

The modelling indicates that with the proposal an overall improvement in the performance of key intersections is forecast in 2036, with most forecast to operate at LoS C or better during the peak periods assessed, except for the New England Highway / Bridgman Road intersection.

The performance of the New England Highway / Bridgman Road intersection is forecast to decrease slightly during the 2036 AM peak hour (5.30am to 6.30am) compared to the 2036 Do Minimum scenario. This performance is comparable to the 2036 Base scenario during the AM peak hour (5.30am to 6.30am). Improvements during the AM peak hour (8:30am to 9.30am) and PM peak hour (4pm to 5pm) are forecast.

Travel times

With the bypass proposed to be posted for 100 kilometres per hour, the travel time savings for through traffic that switch from the New England Highway to the bypass are forecast to range from about 6 minutes to 9 minutes in 2026 and 2036, respectively.

In addition, improvements in travel time in the local area (along John Street / Queen Street) are forecast as a result of the bypass, with savings of about 4 minutes forecast for northbound traffic on John Street in 2036.

On-street parking

The operation of the proposal would not impact on-street parking.

Public transport

There are no anticipated impacts on local public transport because of the proposal. No dedicated bus facilities would be removed or provided by the proposal.

Some bus services could experience travel time improvements due to the reduction in traffic volumes along the New England Highway.

Pedestrian and cycling facilities

There are minor impacts on existing pedestrian and cyclist facilities because of the proposal would modify the shared path west of the Main North railway bridge, adjacent to the New England Highway, to pass beneath the southern entry ramp to the bypass at Gowrie Gates.

The reduction of traffic along the New England Highway through Singleton could improve traffic conditions for cyclists, potentially allowing this section of the New England Highway to form part of the on-road cycle route. Cyclists would be able to use the road shoulders on the bypass.

Road user safety

The safety of all road users including pedestrians, cyclists and motorists would be expected to improve once the bypass is operational. The diversion of traffic, in particular heavy vehicles, to the bypass would reduce the volume of traffic through Singleton and this in turn is expected to reduce the number of crashes.

Property access

All properties would be provided with access, including properties that may be subdivided or had access altered because of acquisition. Impacts would be limited to changes to the location and length of access routes for some properties compared to existing access arrangements.

Council access to the water pump station infrastructure in its altered location would be provided.

6.5.3 Safeguards and management measures

Table 6-22 provides management measures to be implemented to minimise potential impacts on traffic and transport.

Table 6-22: Summary of potential impacts and environmental safeguards – traffic and transport

Impact	Environmental management measures	Responsibility	Timing
Traffic and transport	Disruptions to property access and traffic will be notified to landowners at least five days prior in accordance with the relevant community consultation processes outlined in the TMP	Roads and Maritime	Detailed design
Traffic and transport	Where any legal access to property is permanently affected, arrangements for appropriate alternative access will be determined in consultation with the affected landowner and local road authority.	Construction contractor and Roads and Maritime	Detailed design
Traffic and transport	Access to properties will be maintained during construction. Where that is not feasible or necessary, temporary alternative access arrangements will be provided following consultation with affected landowners and the relevant local road authority.	Construction contractor and Roads and Maritime	Construction
Traffic and transport	A detailed construction traffic management plan will be prepared in accordance with <i>Traffic Control at Work Sites Manual Version 4</i> (RTA, 2010) and <i>Specification G10 - Control of Traffic.</i> The plan will be approved by Roads and Maritime before implementation to provide a comprehensive and objective approach to minimise any potential impacts on road network operations during construction. The plan will include:	Construction contractor	Pre- construction
	 Access and haulage routes Measures to maintain access to local roads and properties Site specific traffic control measures (including signage) to manage and regulate traffic movement Measures to maintain pedestrian and cyclist access Requirements and methods to consult and inform the local community of impacts on the local road network Access to construction sites including entry and exit locations and measures to prevent 		

	 construction vehicles queuing on public roads. A response plan for any construction traffic incident Consideration of other developments that may be under construction to minimise traffic conflict and congestion that may occur due to the cumulative increase in construction vehicle traffic Monitoring, review and amendment mechanisms. 		
Traffic and transport	Where practical, heavy vehicle movements would be outside the traffic peak hours to minimise impacts on the existing road network operation during construction.	Construction contractor	Construction
Traffic and transport	Preparation of pre-construction and post construction road condition reports for local roads likely to be used during construction. Any damage resulting from construction (not normal wear and tear) will be repaired unless alternative arrangements are made with the relevant road authority. Copies of road condition reports will be provided to the local roads authority	Construction contractor	Pre and post construction
Traffic and transport	Pedestrian and cyclist access will be maintained throughout construction. Where that is not feasible or necessary, temporary alternative access arrangements will be provided following consultation with affected landowners and the local road authority.	Construction contractor	Construction

6.6 Noise and vibration

This section summarises the results of the noise and vibration technical report prepared for the proposal which is provided in Appendix M.

6.6.1 Methodology

The assessment involved a quantitative assessment of construction noise and vibration and operational noise, prepared with consideration of the following key guidelines:

- Construction Noise and Vibration Guidelines (CNVG) (Roads and Maritime 2016)
- Interim Construction Noise Guideline (ICNG) (DECC 2009)
- Assessing Vibration: a technical guideline (NSW Department of Environment and Conservation (DEC) 2006a)
- DIN 4150:Part 2-1999 Structural vibration Effects of vibration on structures (Deutsches Institut für Normung 1999)
- DIN 4150:Part 3-1999 Structural vibration Effects of vibration on structures (Deutsches Institut für Normung 1999)
- Evaluation and Measurement for Vibration in Buildings Part 2, (British Standard (BS) 7385:Part 2-1993)
 (BS 7385).
- NSW Road Noise Policy (RNP) (DECCW 2011)
- Noise Criteria Guideline (NCG) (Roads and Maritime 2015a)
- Noise Mitigation Guideline (NMG) (Roads and Maritime 2015b)
- Noise Model Validation Guideline (Roads and Maritime 2018)
- Application Notes Noise Criteria Guideline (Roads and Maritime 2015a)
- Environmental Noise Management Manual (ENMM) (Roads and Maritime 2001)
- Procedure for Preparing an Operational Noise and Vibration Assessment (Roads and Maritime 2011b)
- Draft At-Receiver Treatment Guideline (ARTG) (Roads and Maritime 2017).
- NSW Road Noise Policy (RNP) (DECCW 2011)
- Noise Policy for Industry (NPfl) (NSW Environment Protection Authority (NSW EPA) 2017).

The assessment involved:

- Identification of sensitive receivers
- Monitoring of background noise levels including traffic counts for background road traffic noise
- Establishment of noise and vibration assessment criteria
- Prediction of potential construction noise and vibration and operational noise
- · Assessment of potential noise and vibration impacts by comparing predictions against relevant criteria
- Providing mitigation, where required.

6.6.2 Existing environment

Sensitive receivers

Noise sensitive receivers to the proposal have been identified. Construction noise sensitive receivers have been grouped into noise catchment areas (NCAs). Receivers within each NCA are expected to experience

similar existing background noise levels based on the results of site observations and background noise monitoring. The NCAs are described in Table 6-23 and shown in Figure 6-15.

The existing noise environment in NCA 1 and NCA 5 at the southern and northern extent of the proposal is generally influenced by the operation of the nearby New England Highway and Main North railway line. Mining activities contribute to the existing noise environment in the north for NCA 5. The noise environment in NCA 2, NCA 3 and NCA 4 is generally characteristic of a rural/suburban environment. The primary sources of noise in this area include local traffic and rail movements on the Main North railway line.

Non-residential receivers sensitive to the proposal are identified in Table 6-24 and shown in Figure 6-15

Table 6-23: Noise catchment areas

Noise catchment area	Description
NCA 1	NCA 1 is located around the southern connection and includes suburban residential properties in the northern section of the NCA and semi-rural properties in the south.
NCA 2	NCA 2 is located north and south of the Main North railway line around Putty Road and includes suburban and semi-rural residential properties to the north and south of the Main North railway line respectively.
NCA 3	NCA 3 is located to directly to the east of the Main North railway line at Singleton Heights and includes suburban residential properties.
NCA 4	NCA 4 is located east of the New England Highway around McDougalls Hill and includes suburban residential properties.
NCA 5	NCA is located around the northern connection at Rixs Creek and includes semi-rural residential properties located to the east of the New England Highway.

Table 6-24: Non-residential receivers

Receiver	Receiver type ¹	Address
Australian Christian College – Singleton (including Rainbows Early Learning Centre)	School	109-219 Kelso Street, Singleton
Wyland Caravan Park Singleton	Passive recreation	20 Carrington Street, Glenridding
Country Acres Caravan Park	Passive recreation	58 Maison Dieu Road, McDougalls Hill
Majestic Cinemas Singleton	Commercial property	21 Ryan Avenue, Singleton
Charbonnier Motor Inn Singleton	Commercial property	44 Maitland Road, Singleton

Table note 1: As defined in the ICNG

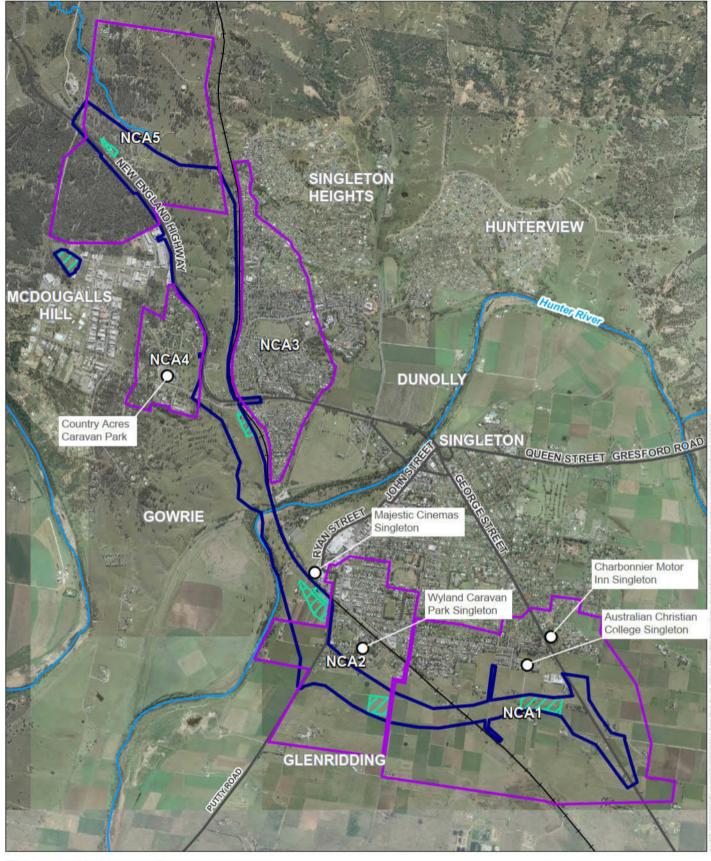


FIG. 6-15 Noise catchment areas

Legend

Proposal features

Proposal area

OModelled representative non-residental receivers

✓ Construction ancillary facilities

NCA

Other features

- -State roads
- --- Watercourse
- -+ Main North railway line



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Background noise levels

Noise monitoring was carried out for each NCA to measure the existing the background and ambient noise and road traffic noise in the vicinity of the proposal area. Noise monitoring was carried out at seven locations considered to be representative of the local noise environment. Noise logger locations are show in Figure 6-15. The monitoring was carried out between 2 and 15 March 2018.

A summary of background noise levels is provided in Table 6-25 and indicate that the noise environment at the measurement locations are typical of those located along major transport corridors in rural/suburban areas.

Table 6-25: Background noise levels

Noise	Background noise level L _{A90, 15min} dB(A)			
catchment area	Day (7am-6pm)	Evening (6pm-10pm)	Night (10pm-7am)	
NCA 1	34	34	34	
NCA 2	35	35	30	
NCA 3	36	36	32	
NCA 4	36	36	32	
NCA 5	39	39	31	

Table 6-26: Measured road traffic noise levels

Noise logger	Road traffic noise level dB(A)		
	Day (7am-10pm) L _{Aeq, 15hr}	Night (10pm to 7am) L _{Aeq, 9hr}	
1	71	67	
5	64	63	
6	50	48	
7	62	60	

6.6.3 Criteria

Construction noise

Construction noise criteria were developed in accordance with the ICNG for each noise catchment area. Standard construction hours defined in the ICNG are:

- 7am to 6pm Monday to Friday
- 8am to 1pm on Saturday
- No work on Sundays or public holidays.

The proposed construction activities are expected to generally occur during standard construction hours, however some activities would be required to be carried out outside of standard hours. Refer to Section 3.3.2 for further information.

Construction noise management levels (NMLs) have been developed for standard construction hours (day) and outside of standard construction hours (evening and night) based on the background noise levels in Table 6-25. The NML represents the point above which there may be some community reaction to noise. The NMLs are summarised in Table 6-27.

A receiver is considered to be highly noise affected where predicted noise levels exceed 75 dB(A). The highly noise affected level represents the point above which there may be strong community reaction to noise.

Table 6-27: Noise management levels

Noise	Construction NML dB(A)			
catchment area	Day (7am-6pm)	Evening (6pm-10pm)	Night (10pm-7am)	
NCA 1	44	39	39	
NCA 2	45	40	35	
NCA 3	46	41	37	
NCA 4	46	41	37	
NCA 5	49	44	36	

The construction noise management levels that apply to other sensitive receivers (when in use) include:

- Schools, hospital and places of worship 45 dB(A) internal noise level
- Active recreation 65 dB(A) external noise level
- Passive recreation 60 dB(A) external noise level
- Industrial properties 75 dBA(A) external noise level
- Commercial properties 70 dB(A) external noise level.

Construction road traffic noise

In accordance with the *Road Noise Policy* a screening test has been carried out to evaluate whether existing road traffic noise levels would increase by more than 2 dB(A) as a result of the construction of the proposal.

Based on the *Road Noise Policy* it is considered that where road traffic noise levels already exceed the assessment criteria, an increase of less than 2 dB(A) represents a minor impact that is barely perceptible to the average person.

Construction vibration

The German Standard Structural Vibration Part 3: Effects of vibration on structures, DIN 4150-3 -1999 (DIN 4150) is the relevant standard for construction vibration and is summarised in Table 6-28. DIN 4159 includes minimum safe levels of vibration at different frequencies for residential, commercial and heritage listed buildings.

Table 6-28: Vibration criteria for structural damage

Type of structure	Vibration velocity in millimetres per second		
	1 – 10 hertz	10 – 50 hertz	50 – 100 hertz
Buildings used for commercial purposes, industrial buildings and buildings of similar design	20	20 to 40	40 to 50
Dwellings and buildings of similar design and/or use	5	5 to 15	15 to 20
Structures that because of their particular sensitivity to vibration, do not correspond to those listed in Lines 1 or 2 and have intrinsic value (e.g. buildings that are under a preservation order)	3	3 to 8	8 to 10

Humans are sensitive to vibration such that they can detect vibration levels well below those required to cause any risk of damage to a building or its contents. Criteria to avoid annoyance for intermittent and continuous vibration are provided in *Assessing Vibration: A Technical Guideline* and detailed discussion regarding criteria for human comfort is provided in Appendix M.

Ground-borne noise

Vibration generated by activities such as piling may enter buildings via the ground. This may cause the floors, walls and ceilings to vibrate and to radiate noise. This noise is commonly referred to as ground-borne noise. Ground-borne noise is typically low frequency and if audible, is perceived as a 'rumble'.

In general, ground-borne noise level values are relevant only where they are higher than the airborne noise, such as where construction works are being carried out within a cutting which would provide shielding to airborne noise. Ground-borne noise from construction would typically be masked by airborne noise associated with construction activities and/or traffic.

The ground-borne noise management levels as outlined in the ICNG are presented in Table 6-29. These levels are applicable during the evening and night-time periods only in residential properties, as the objective is to protect the amenity and sleep of people when they are at home.

Table 6-29: Ground-borne noise goals

Time	Ground-borne noise goals dB(A) L _{Aeq(15 min)}
Evening (6pm-10pm)	40
Night (10pm-7am)	35

Sleep disturbance

Guidance provided in the *Road Noise Policy* for assessing the potential for sleep disturbance recommends that to minimise the risk of sleep disturbance during the night-time period (10pm to 7am), the noise level outside a bedroom window should not exceed the background noise level by more than 15 dB(A). Construction noise sleep disturbance criteria have been developed in accordance with the *Road Noise Policy* and are summarised in Table 6-30.

The *Road Noise Policy* contains a review of research into sleep disturbance which represents NSW EPA advice on the subject of sleep disturbance due to noise events. It concludes that, 'Maximum internal noise levels below 50-55 dB(A) are unlikely to cause awakening reactions'. Therefore, given that a closed window provides around 10 dB(A) in noise attenuation from outside to inside, external noise levels of 60-65 dB(A) are unlikely to result in awakening reactions.

Table 6-30: Summary of environmental safeguards to minimise impacts to soils and contamination

NCA	Sleep disturbance screening criteria – L _{A1(1min)} dB(A)	Sleep disturbance awakening reaction criteria – L _{A1(1min)} dB(A)
NCA 1	49	65
NCA 2	45	65
NCA 3	47	65
NCA 4	47	65
NCA 5	46	65

Operational road traffic noise criteria

Operational road traffic noise criteria are assigned to sensitive receivers using the Roads and Maritime's *Noise Criteria Guideline*. The *Noise Criteria Guideline* provides guidance on how to apply the *Road Noise Policy*. Criteria are based on the road development type which is affecting the residential receiver. The operational criteria for residential land use are summarised in Table 6-31.

In some instances residential receivers may be exposed to noise from both new and redeveloped roads. Where this occurs, the proportion of noise from each road is used to establish transition zone criteria. Noise contours were developed to calculate transition zones in accordance with the *Noise Criteria Guideline* (refer to Appendix E of Appendix M). The contours identified that due to the relatively low level of noise from the new road segment, transition zone criteria do not apply to any sensitive receivers.

Table 6-31: Operational criteria for residential land use

Road category	Road development and land use types	Assessment criteria dB(A)		
		Day (7am-10pm)	Night (10pm-7am)	
Freeway/arterial /sub-arterial	Existing residences affected by noise from new freeways/arterial/sub-arterial road corridors	L _{Aeq(15 hr)} 55 (external)	L _{Aeq(9 hr)} 50 (external)	
	Existing residences affected by noise from redevelopment of existing freeways/arterial/sub-arterial roads	L _{Aeq(15 hr)} 60 (external)	L _{Aeq(9 hr)} 55 (external)	
	Existing residences affected by both new roads and the redevelopment of existing freeway/arterial/sub-arterial roads in a Transition Zone	Between L _{Aeq(15 hr)} 55-60 (external)	Between L _{Aeq(9 hr)} 50-55 (external)	
	Existing residences affected by increases in traffic noise of 12 dB(A) or more from new freeway/arterial/sub-arterial roads	Between L _{Aeq(15 hr)} 42-55 (external)	Between L _{Aeq(15 hr)} 42-50 (external)	

The criteria of non-residential sensitive receivers is summarised in Table 6-32. For schools, places of worship and childcare facilities, the *Noise Criteria Guideline* criteria are based on internal noise levels when in use.

Table 6-32: Operational criteria for non-residential land use

Land use	Assessment criteria		
	Day (7am-10pm)	Night (10pm-7am)	
School classrooms	L _{Aeq(1 hr)} 40 (internal)	n/a	
Hospital wards	L _{Aeq(1 hr)} 35 (internal)	L _{Aeq(1 hr)} 35 (internal)	
Places of worship	L _{Aeq(1 hr)} 40 (internal)	L _{Aeq(1 hr)} 40 (internal)	
Open space (active use)	L _{Aeq(15 hr)} 60	n/a	
Open space (passive use)	L _{Aeq(15 hr)} 55	n/a	
Child care facilities	Sleeping rooms L _{Aeq(1 hr)} 35 Indoor play areas L _{Aeq(1 hr)} 40 (internal) Outdoor play areas L _{Aeq(1 hr)} 55 (external)	n/a	
Aged care facilities	Residential land use noise assessment criteria should be applied to these facilities.		

6.6.4 Potential impacts

Construction noise

Construction activities with the potential to generate noise would be carried out within the ancillary facilities described in Section 3.4 and throughout the proposal area. Noise associated with the following construction scenarios have been considered for the ancillary facilities as relevant:

- Vegetation clearing
- · Establishment of site offices, amenities and temporary infrastructure including fencing
- Laydown, storage and delivery of materials and plant
- Stockpiling
- Demobilisation.

Noise associated with the following construction scenarios have been considered for the construction activities along the proposal area:

- Vegetation clearing
- Earthworks
- Drainage
- Bridge and viaduct construction
- Pavement works
- Finishing works.

For each ancillary facility and along the proposal area, predicted noise levels for each construction scenario have been assessed against the relevant noise criteria. A summary of the results of the assessment is provided below and detailed noise predictions are provided in Section 4 of Appendix M.

Potential noise impacts from construction activities during standard hours include:

- Potential exceedances of NMLs at residential receivers in all NCAs. Activities along the proposal area
 and activities at the Waterworks Lane construction compound are likely to affected the greatest number
 of residential receivers. Receivers closest to the proposal have the highest potential for impact
- NML exceedances are generally less than 10 dB(A). The pavement and earthworks activities along the
 proposal area are likely to cause the largest number of exceedances of the NMLs. During these
 activities exceedances of NMLs by greater than 20 dB(A) are predicted at up to eight receivers in NCA
 1, 14 receivers in NCA 2 and 26 receivers in NCA 3
- Residential receivers in NCA 1 and NCA 2 have the greatest potential for impact. Up to six receivers in NCA 1 are predicted to be highly noise affected during earthworks along the proposal area. Up to eight receivers in NCA 2 are predicted to be highly noise affected during pavement works along the proposal area
- Construction activities are predicted to result in minor exceedances of NMLs at the Australian Christian College – Singleton and Wyland Caravan Park Singleton by 5 dB(A) and 10 dB(A) respectively. No exceedances are predicted at the other non-residential land uses.

Potential noise impacts from construction activities outside of standard hours include:

- Construction activities have the potential to exceed NMLs at residential receivers outside of standard hours in all NCAs. Consistent with the activities during standard hours, activities outside of standard hours along the proposal area and activities at the Waterworks Lane construction compound are likely to affected the greatest number of residential receivers
- NML exceedances are generally less than 15 dB(A), however a number of exceedances of greater than 25 dB(A) are predicted. The pavement and earthworks activities along the proposal area and laydown and storage activities at the Waterworks Lane construction compound are likely to cause the largest number of exceedances of the NMLs
- Construction activities are predicted to result in minor exceedances at Wyland Caravan Park (less than 5 dB(A)). No exceedances are predicted at the other non-residential land uses.

It is important to consider that the predicted noise levels are representative of the worst case 15 minute period of construction activity, while the construction equipment is at the nearest location to each sensitive receiver location. The assessed scenario does not represent the ongoing day to day noise impact at noise sensitive receivers for an extended period of time.

Particularly noisy activities, such as piling and use of concrete saws, would not persist for the entire construction period. In addition, the predictions use the shortest separation distance to each sensitive receiver, however in reality separation distances would vary between plant and sensitive receivers.

For linear works (works that move along the road alignment, rather than works located at a construction ancillary facility) noise exposure at each receiver would reduce due to increases in distance loss as the works progress along the alignment.

The reported maximum noise level is for the highest noise level during that construction scenario. The reported number of receivers where noise levels are expected to exceed the noise management levels is based on the reported maximum noise level. Typically the number of sensitive receivers exceeding the noise management levels will be reduced substantially depending instantaneous operating conditions.

A range of safeguards and management measures would be implemented to manage potential noise impacts during and outside of standard hours. The measures are outlined in Section 0.

Construction sleep disturbance

Exceedances of the sleep disturbance and awakening reaction criteria are predicted at a number of properties in each NCA. The largest numbers of exceedances are associated with bridge and viaduct and pavement works along the proposal area in the vicinity of NCA 1, NCA 2 and NCA 3. Sleep disturbance exceedances are predicted for up to about 1231 properties in total during these activities and awakening reactions are predicted for up to about 184 properties in total.

As described in Section 3.3.2, construction would largely be carried out during standard construction working hours.

A range of safeguards and management measures would be implemented to manage potential sleep disturbance impacts. The measures are outlined in Section 0.

Construction road traffic noise

The numbers of construction vehicle movements have been estimated to be up to 80 light and 140 heavy vehicles per day (up to 12 per hour) during peak construction periods across all ancillary facilities. Vehicles would access the site primarily by the New England Highway. Heavy vehicles would only access the site from approved heavy vehicle routes.

The existing traffic flows on the New England Highway are substantially greater than the proposed construction traffic numbers (there are currently over 1000 heavy vehicles between 7 am and 10 pm and over 300 heavy vehicles between 10pm and 7 am each day on the New England Highway). Therefore the additional traffic would have a minor impact on existing road traffic noise in the area, road traffic noise levels during construction are expected to increase by less than 2 dB(A).

Construction vibration

Construction activities would result in a short-term increase in localised vibration levels. Vibration impacts focus on potential structural damage in close proximity to construction activities. Furthermore, it is possible that local sensitive receivers may perceive construction vibration at times. The level of annoyance, however, will depend on individuals.

Plant and equipment needed for the proposal would be determined during the construction planning phase. Table 6-27 provides safe working buffer distances required to comply with the human comfort, cosmetic damage, standard dwelling and heritage building structural damage criteria for equipment likely to be used for the proposal. Other equipment may be used however it is anticipated that they would produce similar vibration levels. It is considered unlikely that vibration intensive plant would be operated within the minimum safe working distances for heritage structures and cosmetic damage outlined below.

Table 6-33: Recommended minimum working distances for vibration intensive plant

Plant	Rating	Minimum safe wo	rking distance (r	metres)
		Heritage structures ¹	Cosmetic damage	Human response
Vibratory roller	< 50 kN (typically 1-2t)	8	5	15
	< 100 kN (typically 2-4t)	10	6	20
	< 200 kN (typically 4-6t)	20	12	40
	< 300 kN (typically 7-13t)	25	15	100
	> 300 kN (typically 13-18t)	30	20	100
	> 300 kN (>18 t)	38	25	100
Drop hammer	3t enclosed (30kJ per blow assumed)	40	23	100
	5kJ per blow	17	10	35
Vibratory rig	50kJ per cycle	50	30	100
	10kJ per cycle	23	15	100
Pile boring	≤ 800 mm	4	2 nominal	N/A
Jack hammer	Handheld	1 nominal	Avoid contact with structure	Avoid contact with structure

Table note:

Operational road traffic noise

The *Road Noise Policy* requires the assessment of road traffic noise at the year of opening (2026 indicative) and at the design year (2036 indicative) for daytime and night time periods. The operational noise scenarios that have been assessed therefore include:

- 'Do Minimum' (2026 and 2036), which represents the future road network if the proposal was not to be built
- Design (2026 and 2036), which incorporates the proposal design alignment, including the ramps and the future road network.

The relevant 'Do Minimum' and Design scenarios are compared to identify the operational noise impact of the proposal.

A noise barrier assessment has been carried out as part of the operational road traffic noise assessment in accordance with the *Road Noise Policy*. Six noise barriers have been recommended as part of the proposal, subject to detailed design. The dimensions of the barriers are described in full in Section 5.1.5 of

¹ More stringent conditions may apply to heritage or other sensitive structures. Any heritage property would need to be considered on a case by case basis and assessed in accordance with *DIN4150:3 Structural vibration - Effects of vibration on structures*.

Appendix M and outlined in Table 6-34 below. The dimensions would generally be between three and 3.5 metres in height.

Table 6-34: Design noise barrier heights

Location	Height (m)	Length (m)
Bridge over the floodplain (east)	3	700
Bridge over the floodplain (central)	3	880
Bridge over the floodplain (west)	3.5	950
North of the Hunter River	3.5	540
South of Gowrie Gates	3.5	370
North of Gowrie Gates	3.5	720

Operational road traffic noise assessments were completed for scenarios with and without the noise reduction associated with the barriers (refer to Appendix M for further detail). Considering the impacts in both Year 2026 and Year 2036 during the daytime and night-time periods with the noise barriers the impacts are summarised as follows:

- Road traffic noise levels are predicted to exceed the L_{Aeq} noise criterion at a total of 93 sensitive receivers
- Of these 93 noise sensitive receivers:
 - Noise levels are predicted to increase by more than 2 dB(A) at 61 sensitive receivers
 - Noise levels are predicted to exceed the cumulative limit at 6 sensitive receivers. (ie \geq L_{Aeq(15 hr)} or L_{Aeq(9 hr)} noise criterion + 5 dB(A))
 - o Noise levels are predicted to exceed the relative increase criterion at 22 sensitive receivers (the difference between 'no build' and 'build' noise levels is ≥ 12 dB)
 - One receiver is identified as being acute (ie the proposal contributes less than 2.0 dB(A) to the overall level and noise levels are equal to or greater than L_{Aeq(15 hr)} 65 dB(A) or L_{Aeq(9 hr)} 60 dB(A)
- 89 sensitive receivers are considered to be eligible for the consideration of feasible and reasonable noise mitigation measures. A list of these receivers is provided in Table 5-4 of Appendix M.

Summary maps for operational road noise contours for the proposal with the noise barriers are shown in Figure 6-16 to Figure 6-18. Detailed maps are included in Appendix M.

Operational sleep disturbance

The *Road Noise Policy* includes a review of international sleep arousal research and concludes that at the current level of understanding, it is not possible to establish absolute noise level criteria that would correlate to an acceptable level of sleep disturbance.

The *Environmental Noise Management Manual* considers a maximum noise level event to be defined as a vehicle pass-by event for which the L_{A,max} noise level is equal to or greater than 15 dB(A) above the L_{Aeq(1hr)}. Maximum noise level events have been considered at 4294 New England Highway, Whittingham and 4850 New England Highway, McDougalls Hill. These locations are considered to be representative of receivers along the future proposed alignment.

An assessment of maximum noise level events was completed for the proposal and is provided in Section 5.1.7 of Appendix M. The assessment identified that the area is already exposed to maximum noise level events that have the potential for awakening reactions.

One of the main goals of this proposal is to reduce heavy vehicle traffic through Singleton town centre. It is expected that the maximum noise events would decrease in both number and duration due to reduced congestion, better alignments and gradients. Maximum noise events are most likely to occur between Gowrie Gates and the northern connection.

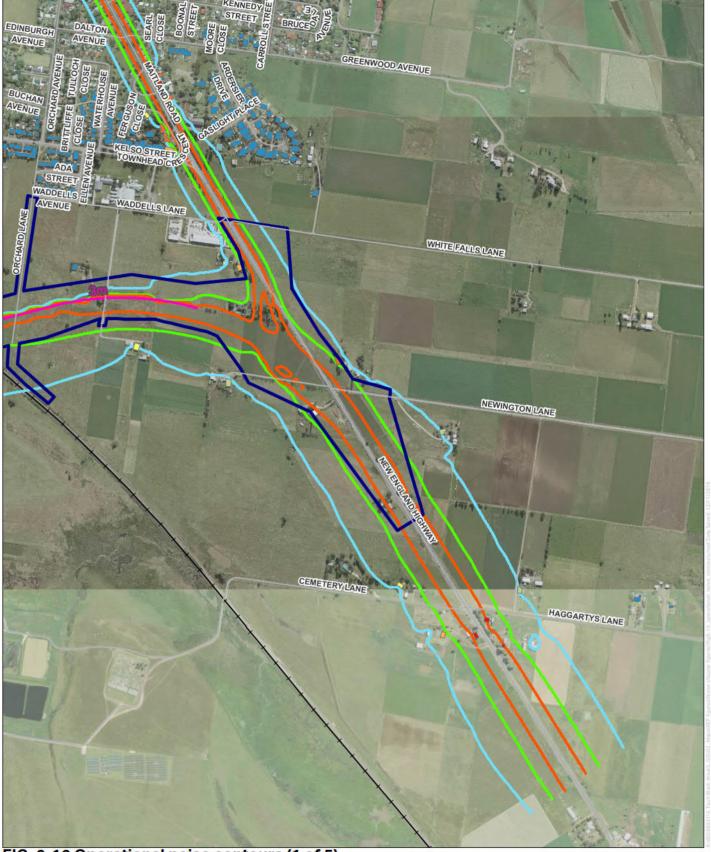


FIG. 6-16 Operational noise contours (1 of 5)

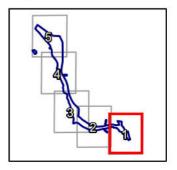
Legend

Proposal features

Proposal area
Other features

Facade corrected sound pressure level, LAeq dBA

Topopopopopopo



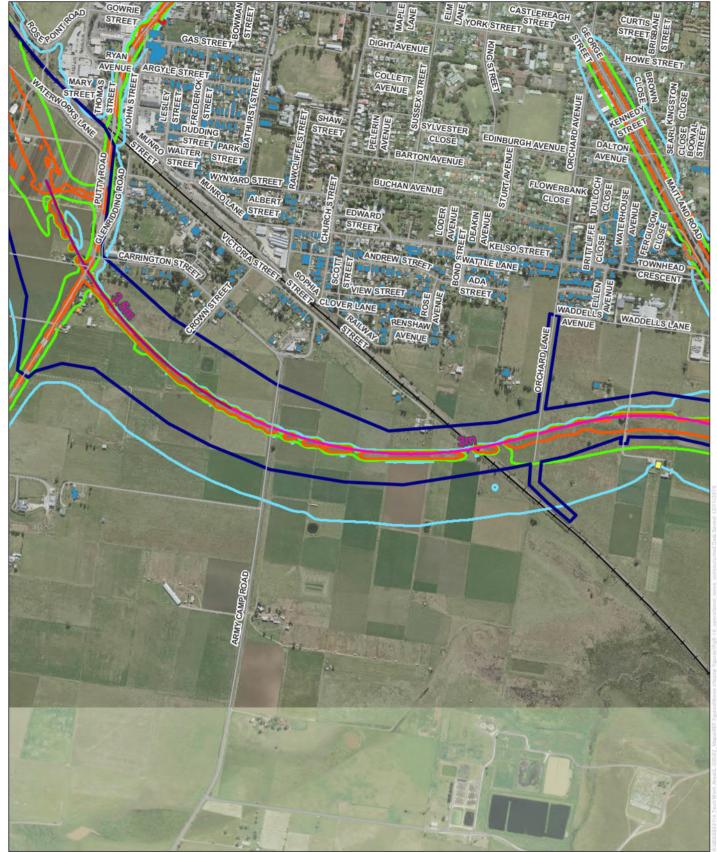


FIG. 6-17 Operational noise contours (2 of 5)

Legend

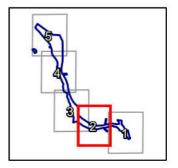
Proposal features

Other features

Main North railway line
 Proposed noise wall height (m)

Free field sound pressure level, LAeq dBA





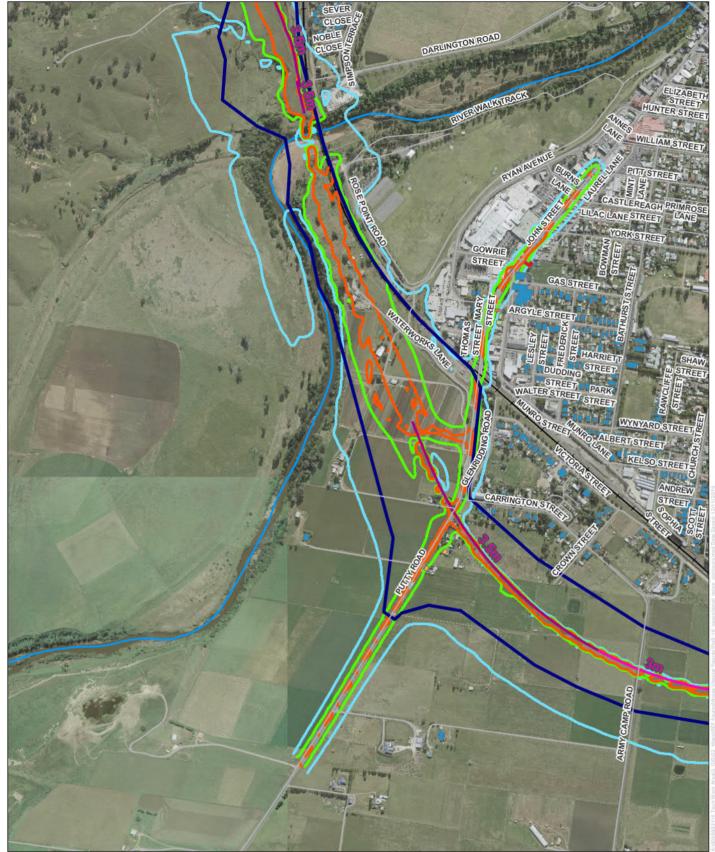


FIG. 6-18 Operational noise contours (3 of 5)

Legend

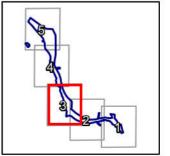
Proposal features

Proposal area
Other features

-- Roads
-- Watercourse
-- Main North railway line
-- Proposed noise wall height (m)
-- 3
-- 3
-- 3.5

Free field sound pressure level, LAeq dBA





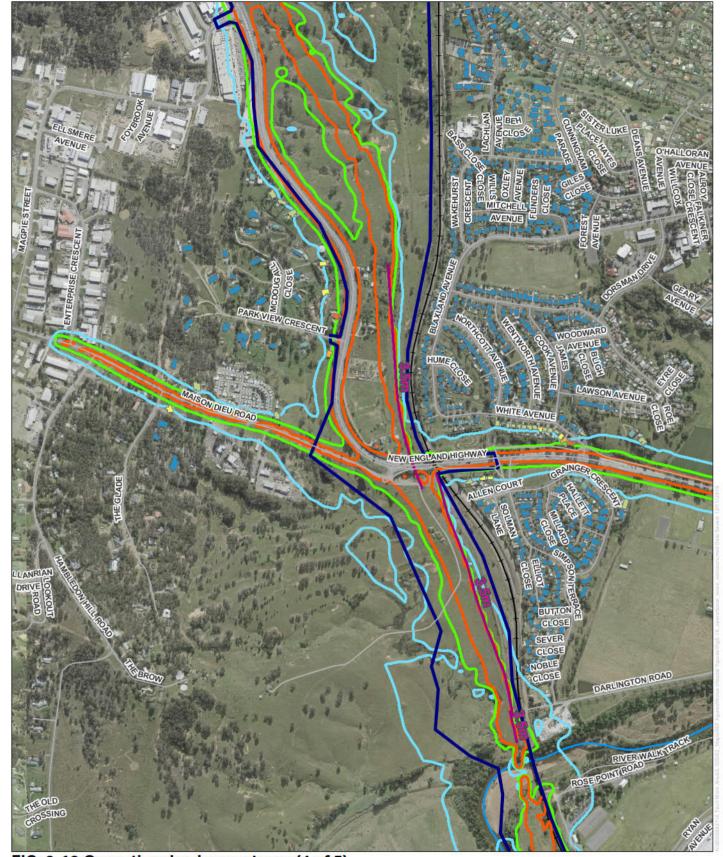


FIG. 6-19 Operational noise contours (4 of 5)

Legend

Proposal features

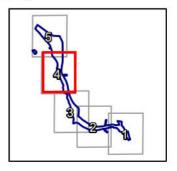
Proposal area
Other features

Roads
Watercourse
Main North railway line
Proposed noise wall height (m)
3

Free field sound pressure level, LAeq dBA

Facade corrected sound pressure level, LAeq dBA





Meters

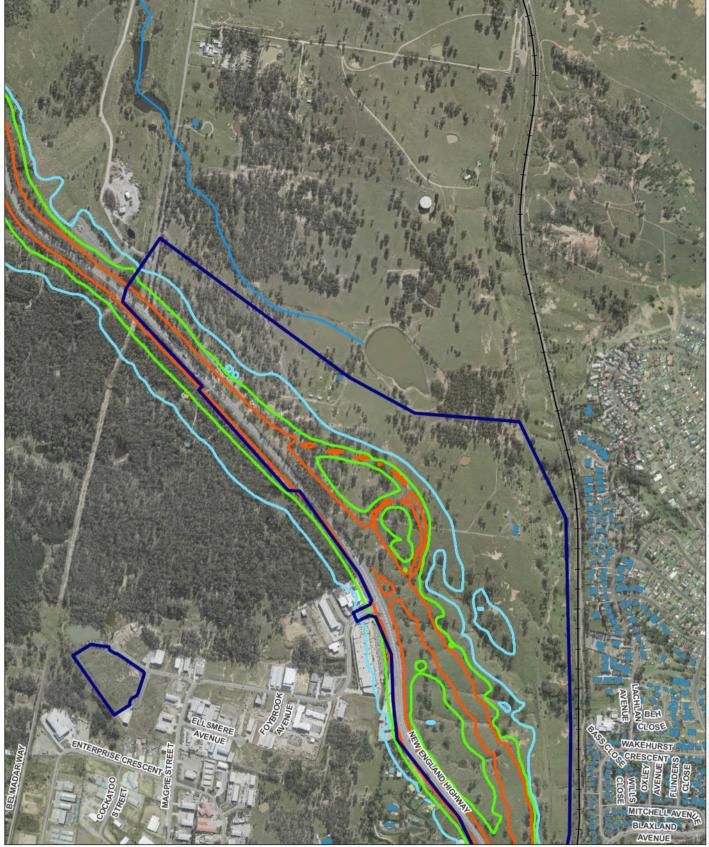


FIG. 6-20 Operational noise contours (5 of 5)

Legend Proposal features

Proposal features

Proposal area
Other features

Roads

Watercourse

Main North railway line
Proposed noise wall height (m)

3

3.5

Free field sound pressure level, LAeq dBA

55

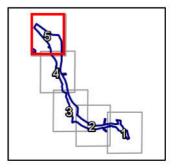
80

65

Facade corrected sound pressure

Facade corrected sound pressure level, LAeq dBA





Ñ

6.6.5 Safeguards and management measures

Environmental safeguards provided in Table 6-13 would be implemented to minimise potential impacts related to noise and vibration. Additional mitigation measures are identified in Section 6.4 of Appendix M.

Table 6-35: Summary of environmental safeguards to minimise impacts to noise and vibration

Impact	Environmental safeguards	Responsibility	Timing
Noise and vibration	 A Construction Noise and Vibration Management Plan (CNVMP) would be prepared as part of the Construction Environmental Management Plan. The CNVMP would identify: all potential significant noise and vibration generating activities associated with the activity noise and vibration sensitive receptors measures to be implemented during construction to minimise noise and vibration impacts, such as restrictions on working hours, staging, placement and operation of work compounds, parking and storage areas, temporary noise barriers, haul road maintenance, and controlling the location and use of vibration generating equipment feasible and reasonable mitigation measures to be implemented, taking into account the Roads and Maritime's Beyond the Pavement urban design policy, process and principles. 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 an out of hours works procedure, including approval process and proposed mitigation measures. 	Contractor	Pre-construction and Construction
Noise and vibration	All sensitive receivers likely to be affected will be notified at least five days prior to commencement of any works associated with the activity that may have an adverse noise or vibration impact. The notification will include details of: • the project • construction period and construction hours • contact information for project management staff • complaint and incident reporting and how to obtain further information	Contractor	Construction
Noise and vibration	 All employees, contractors and subcontractors are to receive an environmental induction. The induction must at least include: All relevant project specific and standard noise and vibration mitigation measures Relevant licence and approval conditions Permissible hours of work any limitations on high noise generating activities Location of nearest sensitive receivers Construction employee parking areas 	Contractor	Construction

Impact	Environmental safeguards	Responsibility	Timing
	 Designated loading/unloading areas and procedures Site opening/closing times (including deliveries) Environmental incident procedures. 		
Noise and vibration	Where feasible and reasonable, construction should be carried out during the standard daytime working hours. Work generating high noise and/or vibration levels should be scheduled during less sensitive time periods. Any variations to the standard construction hours will follow the approach RTA Environmental Facts Sheet - Noise Management and Night Works, including consultation with the affected local community	Contractor	Construction
Noise and vibration	Where reasonable ad feasible, high noise generating activities (75dB(A)L $_{\rm eq}$ at receiver) be used during standard construction hours and in continuance blocks of no more than 3 hours with at least one hour respite between each block of work generating high noise impact, where the location of the work is likely to impact the same receiver.	Contractor	Construction
Noise and vibration	 Where high noise generating activities (75 dB(A) L_{eq} at receiver) are required out of hours the following will be implemented: The equipment will be used prior to 10pm where reasonable and feasible Where the above cannot be achieved the equipment will be used prior to midnight where reasonable and feasible It is not proposed to apply a three hour on and a one hour off respite approach in an effort to ensure that the use of such equipment is completed as early in the night as possible. 	Contractor	Construction
Noise and vibration	Where properties have been identified for architectural treatment and these properties would be impacted by noise from construction works, Roads and Maritime would consult with those property owners on the early installation of treatments to provide noise mitigation during the construction of the proposal.	Roads and Maritime	Pre- Construction
Noise and vibration	 The following will be implemented for deliveries the and from the proposal Loading and unloading of materials/deliveries is to occur as far as possible from sensitive receivers. Dedicated loading/unloading areas to be shielded if close to sensitive receivers. Delivery vehicles to be fitted with straps rather than chains for unloading, wherever possible. Construction sites would be arranged to limit the need for reversing associated with regular/repeatable movements 	Contractor	Construction
Noise and vibration	Non-tonal reversing beepers (or an equivalent mechanism) must be fitted and used on all construction vehicles and mobile plant regularly used on site and for	Contractor	Construction

Impact	Environmental safeguards	Responsibility	Timing
	any out of hours work.		
Noise and vibration	The noise associated with the operation of construction ancillary facilities would primarily result from the operation of fixed and mobile plant and truck movements. Consideration would be given to the layout of the site in order to maximise distance and shielding to nearby receivers.	Contractor	Pre- construction and Construction
Noise and vibration	Where practicable, work should be scheduled to avoid major student examination periods such as before or during Higher School Certificate and at the end of higher education semesters.	Contractor	Construction
Noise and vibration	At compound sites, consider positioning site sheds, earth bunds and hoarding to maximise shielding to residential receivers	Contractor	Construction
Noise and vibration	In circumstances where the noise levels are predicted to exceed construction noise management levels after implementation of the general work practices, additional mitigation measures are required. These measures include the following: Monitoring Notification (letterbox drop or equivalent) Specific notifications Phone calls Individual briefings Respite Offers Respite Periods Duration Respite. Alternative Accommodation	Contractor	Construction
Noise and vibration	Vibration intensive equipment size would be selected to avoid working within the structural damage minimum working distances The use of less vibration intensive methods of construction or equipment would be considered where feasible and reasonable.	Contractor	Construction
Noise and vibration	Where the use of vibration intensive equipment within the relevant minimum working distances cannot be avoided, prior to the commencement of vibration intensive work, a detailed inspection will be carried out and a written and photographic report prepared to document the condition of buildings and structures within the minimum working distances. A copy of the report will be provided to the relevant land owner or land manager.	Contractor	Pre- Construction
Noise and vibration	To confirm that the noise level targets are achieved, a post-construction noise monitoring program be carried out in accordance with the Noise Mitigation Guideline (Roads and Maritime 2014d).	Roads and Maritime	Operation

6.7 Aboriginal heritage

6.7.1 Methodology

Potential impacts to Aboriginal cultural heritage values as a result of the proposal were assessed in accordance with Roads and Maritime's PACHCI (NSW Roads and Maritime Services, 2011), as well as relevant statutory guidelines including the NSW Office of Environment and Heritage's *Guide to Investigation, Assessing and Reporting on Aboriginal Cultural Heritage in NSW* (OEH 2011). The PACHCI outlines a four stage process for investigating potential impacts to Aboriginal cultural heritage values as a result of Roads and Maritime road planning, development, construction and maintenance activities and includes a process of community consultation that aims to ensure that the role, function and views of Aboriginal people are considered and respected in the assessment process. The four stages of the PACHCI are detailed in Section 5.3 of this REF.

In accordance with Stage 2 of PACHCI, an Archaeological survey of the proposal area was carried out over five days (26-29 March and 3 April 2018). The survey team consisted of personnel from AECOM, Roads and Maritime, registered native title claimant group PCWP and Wanaruah LALC.

In late 2018 works in accordance with Stage 3 of the PACHCI were carried out for the proposal, including additional archaeological survey and test excavations. The Stage 3 test excavations were carried out for all sites identified as containing Potential Archaeological Deposit (PAD) and as having potential to be impacted by the proposal. They were carried out over 14 days (19 to 23 and 26 to 30 November, 3 to 6 December 2018). The survey team consisted of personnel from AECOM, Roads and Maritime, OEH and site officers representing multiple Representative Aboriginal Parties (RAPs).

An Aboriginal Cultural Heritage Assessment Report (ACHAR), which details the results of the Aboriginal heritage assessment, has been prepared for the proposal and is included in Appendix E. The ACHAR should be read in conjunction with Aboriginal Archaeological Report (AAR) (AECOM, 2019), and Aboriginal Cultural Values Assessment Report (ACVAR) (Waters Consultancy, 2019) which are appended in the ACHAR.

The Aboriginal cultural heritage assessment included:

- Consultation with Aboriginal stakeholders and the local Aboriginal community
- A review of relevant literature and databases
- Field survey
- Archaeological test excavation
- Provision of mitigation measures based on the results of the investigation and the anticipated impacts
 of the project.

Aboriginal consultation

Aboriginal community consultation was carried out in accordance with OEH's *Aboriginal Cultural Heritage Consultation Requirements for Proponents* (DECCW, 2010a) and Roads and Maritime's PACHCI. Aboriginal consultation that has been carried out to date is detailed in Section 5.3 and Appendix E.

6.7.2 Existing environment

According to Tindale's (1974) tribal map, the proposal area is located within the traditional lands of the Wonnarua people, with surrounding 'tribes' including the Awabakal and Worimi to the east, the Darkinjung to the south, the Geawegal to the north and the Wiradjuri to the west. Historical records indicate that Tindale's division of the Awabakal and Wonnarua into two separate 'tribes' does not adequately capture what was a complex system of social and territorial organisation involving numerous local descent groups (i.e. clans) and bands who spoke the same language. Individual bands would have occupied and used the resources of particular tracts of land within the overall territory of their clan, although the territorial boundaries would have been permeable or elastic in the sense of complex kinship ties.

Available records suggest that residential mobility was generally quite high. Fawcett (1898) notes that the Wonnarua 'had no permanent settlements, but roamed about from place to place within their tribal district, in pursuit of game and fish, which was their chief sustenance, making use periodically of the same camping grounds'. Documented 'ceremonial' activities carried out by the Aboriginal groups occupying the Hunter Valley include corroborees, male initiation ceremonies, marriage, ritual combat and various burial, body adornment and modification practices.

The topography of the proposal area is divided into two broad topographic units, referred to as the 'Hunter River Floodplain' and the 'Northern Hills'. Both topographic units contain landforms amenable to occupation by Aboriginal people in the past.

The proposal area contains parts of several first to greater than fourth order streams. The Hunter River, which bisects the proposal area on an east-west axis, is the primary and only named watercourse, with level to very gently inclined terrain in the southern half of the proposal area comprising part of the river's extensive right bank floodplain.

AHIMS Sites

A search of the Aboriginal Heritage Information Management System (AHIMS) database was completed on 15 January 2019, covering a 20 by 20 kilometre area centred on the proposal area. The search returned 1360 registered sites. Desktop review of these results identified six registered Aboriginal sites located within or immediately adjacent to the proposal area. These include a scarred tree (37-6-0681) and open artefact sites McDougall Hill 2 (37-6-0789), McDougall Hill 3 (37-6-0788), McDougall Hill 4 (37-6-0787), Singleton Golf Course 1 (37-6-1466) and Singleton Golf Course 3 (37-6-1468) (refer to Figure 6-21).

Archaeological Significance

The archaeological field investigations carried out as part of the ACHAR recognised a total of 25 Aboriginal archaeological sites within the proposal area, including 23 open artefact sites, a single area of PAD and a single potential scarred tree. An assessment of scientific significance identified 23 of these sites to be of low scientific significance and the remaining two (Singleton Bypass OAS4 and OAS19) of moderate scientific significance.

Cultural Significance

The cultural values assessment identified one specific site of cultural significance within the proposal area (Cultural Site A: Gathering Place) and two associated sites of cultural significance outside the proposal area (Cultural Site B: Cultural Line of Sight and Cultural Site C: Camping Place). In addition, a number of places of cultural significance have been identified in the surrounding landscape including pathways, a ceremonial ground, camping grounds, resource areas, and high points that provide lines of sight.

Figure 6-21: AHIMS registered sites

6.7.3 Potential impacts

Construction

Proposed ground disturbance activities within the proposal area are anticipated to impact 16 of the 25 Aboriginal archaeological sites, with a total loss of value for 13 sites and partial loss of value for the remaining three sites. Proposal impacts to Aboriginal archaeological sites are detailed in Table 6-36 and shown on Figure 6-22 and Figure 6-23

Proposed ground disturbance activities are also anticipated to impact one of the three sites of cultural significance identified within the proposal area, Cultural Site A: Gathering Place, which would result in a partial loss of value, as detailed in Table 6-37 and shown on Figure 6-24.

Table 6-36: Impact assessment for Aboriginal archaeological sites within the proposal area

Site name	AHIMS ID(s)	Site type	Type of harm	Degree of harm	Consequence of harm	Site area (m²)	Area of Impact (m²)	Total% Harmed
Singleton Bypass OAS1	37-6-3894	Isolated artefact	Will not be harmed	None	No loss of value	1	-	-
Singleton Bypass OAS2	37-6-3895	Isolated artefact	Direct	Total	Total loss of value	1	1	100
Singleton Bypass OAS3	37-6-3896	Artefact scatter	Will not be harmed	None	No loss of value	877	-	-
Singleton Bypass OAS4	37-6-3897	Artefact scatter	Will not be harmed	None	No loss of value	14,156	-	-
Singleton Bypass OAS5	37-6-3890	Artefact scatter	Will not be harmed	None	No loss of value	1003	-	-
Singleton Bypass OAS6	37-6-3893	Artefact scatter	Will not be harmed	None	No loss of value	206	-	-
Singleton Bypass OAS7	37-6-3889	Isolated artefact	Direct	Total	Total loss of value	1	1	100
Singleton Bypass OAS8	37-6-3888	Artefact scatter	Will not be harmed	None	No loss of value	4251	-	-
Singleton Bypass OAS9	37-6-3887	Artefact scatter	Direct	Total	Total loss of value	2	2	100
Singleton Bypass OAS10	37-6-3886	Isolated artefact	Direct	Total	Total loss of value	1	1	100
Singleton Bypass OAS11	37-6-3892	Artefact scatter	Direct	Total	Total loss of value	438	438	100
Singleton Bypass OAS12	37-6-3891	Isolated artefact	Direct	Total	Total loss of value	1	1	100
Singleton Bypass OAS13	37-6-3900	Artefact scatter	Direct	Total	Total loss of value	4	4	100
Singleton Bypass OAS14	37-6-3899	Isolated artefact	Will not be harmed	None	No loss of value	1	-	-
Singleton Bypass OAS15	37-6-3898	Isolated artefact	Direct	Total	Total loss of value	1	1	100
Singleton Bypass OAS16	37-6-3901	Isolated artefact	Will not be harmed	None	No loss of value	1	-	-
Singleton Bypass OAS17	37-6-3905	Isolated artefact	Direct	Total	Total loss of value	1	1	100
Singleton Bypass OAS18	37-6-3904	Artefact scatter	Direct	Partial	Partial loss of value	11,171	4205	37.6
Singleton Bypass OAS19	37-6-3903 37-6-1466 37-6-1468	Artefact scatter	Direct	Partial	Partial loss of value	182,481	162,277	88.9
Singleton Bypass OAS21	37-6-3925	Artefact scatter	Direct	Partial	Partial loss of value	59,497	14,309	24

Site name	AHIMS ID(s)	Site type	Type of harm	Degree of harm	Consequence of harm	Site area (m²)	Area of Impact (m²)	Total% Harmed
Singleton Bypass OAS22	37-6-3927	Artefact scatter	Direct	Total	Total loss of value	1	1	100
McDougall Hill 2	37-6-0789	Artefact scatter	Direct	Total	Total loss of value	741	741	100
McDougall Hill 3	37-6-0788	Artefact scatter	Direct	Total	Total loss of value	1	1	100
Scarred tree	37-6-0681	Artefact scatter	Direct	Total	Total loss of value	N/A	N/A	100
Singleton Bypass PAD3	37-6-3928	PAD	Will not be harmed	None	No loss of value	27,287	-	-

Figure 6-22: Impact assessment - Aboriginal archaeological sites (northern section)

Figure 6-23: Impact assessment - Aboriginal archaeological sites (southern section)

Table 6-37: Impact assessment for identified sites of cultural significance

Site name	Description	Cultural significance	Impact (Yes or No)	Degree of harm	Consequence of harm
Site A: Gathering Place	A culturally significant camping, resource and gathering place.	This place has High Significance to the local Aboriginal community as a traditional and historical camping, resource and gathering place.	Yes	Partial direct harm	Partial loss of value
Site B: Cultural Line of Sight	A high point that provides a cultural line of sight.	The Gowrie line of sight has High Significance to the local Aboriginal community as a traditional location for orienting people within the cultural landscape and making visible the links between significant cultural places in the landscape.	No	None	None
Site C: Camping Place	A traditional and historical camp area associated with seasonal and ritual movement patterns within the wider region.	The Maison Dieu camping place is of Medium Significance to the local Aboriginal community. This cultural significance is a result of the areas use as a traditional and historical camp that was associated with seasonal and ritual patterns of movement across the landscape.	No	None	None

Figure 6-24: Impact assessment - cultural sites

Operation

The proposal is not expected to impact on any items of Aboriginal heritage or cultural values when it is operational.

6.7.4 Safeguards and management measures

Table 6-38: Summary of Aboriginal heritage mitigation measures

Impact	Environmental safeguards	Responsibility	Timing
Aboriginal heritage	A total of 16 Aboriginal archaeological sites, detailed in Table 6-37 will be impacted by the proposal. Roads and Maritime should apply for an 'all of area' AHIP for land to be impacted by the proposal (the 'AHIP area' shown on Figure 38 of Appendix E). This AHIP will allow impacts to these sites.	Roads and Maritime	Detailed design / pre- construction
Aboriginal heritage	Impacted open artefact site Singleton Bypass OAS19 (37-6-3903, 37-6-1466 and 37-6-1468) has been assessed as being of moderate scientific significance and will be partially impacted by the proposal. To mitigate the impact of the proposal on this site, an archaeological salvage program incorporating surface collection and excavation is recommended for the impacted portion of this site. Salvage activities within OAS19 can only occur after an AHIP has been obtained and should be completed in accordance with the research design and methodology provided in Appendix F of AECOM's AAR.	Roads and Maritime	Detailed design
Aboriginal heritage	Impacted open artefact sites Singleton Bypass OAS2 (37-6-3895), OAS7 (37-6-3889), OAS9 (37-6-3887), OAS10 (37-6-3886), OAS11 (37-6-3892), OAS12 (37-6-3891), OAS13 (37-6-3900), OAS15 (37-6-3898), OAS17 (37-6-3905), OAS18 (37-6-3904), McDougall Hill 2 (37-6-0789) and McDougall Hill 3 (37-6-0788) have been assessed as being of low scientific significance. Regardless, in recognition of their cultural significance, community collection is recommended for these sites, with collection to be limited to the impacted portion of each site. Community collection can only occur after an AHIP has been obtained from OEH and should be completed in accordance with research design and methodology provided in Appendix F of AECOM's AAR.	Roads and Maritime	Detailed design
Aboriginal heritage	Impacted subsurface artefact scatter sites Singleton Bypass OAS21 and OAS22 have been assessed as being of low scientific significance. No further management or mitigation actions are recommended for these sites.	Roads and Maritime	Detailed design
Aboriginal heritage	Should the requirement for impacts to AHIMS registered potential Aboriginal scarred tree 37-6-0681 be confirmed during the detailed design or construction phases of the proposal, a qualified arborist should be engaged to undertake a removal/relocation feasibility assessment of the tree. Subsequent mitigation will depend on the results on this assessment, as follows:	Contractor	Detailed design / pre- construction

Impact	Environmental safeguards	Responsibility	Timing
	 Should the engaged arborist determine that 37-6-0681 is not suitable for relocation (i.e., due to the health of the tree and/or other factors), a detailed archival recording of the tree and its associated scars should be undertaken by a qualified archaeologist. A minimum of one RAP field representative will be invited to participate in the archival recording. Should the engaged arborist determine that 37-6-0681 is suitable for removal/relocation, the relocation procedure outlined in Section 10.1 of Appendix E should be employed. All RAPs should be given the opportunity to review and comment on the arborist's relocation assessment report and if required, the removal methodology (including equipment), keeping place and ongoing access arrangements. 		
Aboriginal heritage	Ten Aboriginal archaeological sites, listed in Table 6-37, will not be impacted by the proposal and should be conserved in situ. The protection of these sites to be retained and those sites identified for partial impact will occur in accordance with the measures outlined in the adopted Aboriginal Heritage Management Plan.	Contractor	Detailed design / pre- construction
Aboriginal heritage	Cultural Site A: Gathering Place (Railway Bridge Camps) will be partially impacted by the proposal. Protective fencing should be erected between the zone of construction activity and the un-impacted area(s) of this site prior to any construction activities, with the un-impacted area(s) of the site to be clearly marked on all operational maps as 'no go zones' of environmental and heritage sensitivities. The location of the fencing at Cultural Site A: Gathering Place (Railway Bridge Camps) should be confirmed by a cultural heritage values consultant to ensure that it accurately reflects the mapped site. Fencing should be maintained throughout the duration of works.	Contractor	Pre-construction
Aboriginal heritage	An Aboriginal Heritage Management Plan (AHMP) will be prepared and implemented as part of the CEMP. The AHMP will provide specific guidance on measures and controls to be carried out to avoid and mitigate impacts on Aboriginal cultural heritage during construction. This will include protection measures to be applied during construction, as well as contractor training in general Aboriginal cultural heritage awareness and management of Aboriginal heritage values. Site locations will be identified in the proposal's CEMP and marked as environmentally sensitive areas or no-go zones.	Contractor	Detailed design / pre- construction
Aboriginal heritage	All relevant staff and contractors working on site are to receive training to ensure awareness of the requirements of the AHMP and relevant statutory responsibilities. Sitespecific training is to be given to personnel when working in the vicinity of identified Aboriginal heritage sites.	Contractor	Pre- construction
Aboriginal heritage	In the event that construction works within the study area uncover any unexpected Aboriginal objects, the relevant	Contractor	Pre- construction

Impact	Environmental safeguards	Responsibility	Timing
	provisions of Roads and Maritime's Standard Management Procedure for Unexpected Heritage Items (Roads and Maritime, 2015) should be followed.		
Aboriginal heritage	A project specific Aboriginal cultural heritage interpretation plan will be developed to promote understanding and awareness of the cultural heritage values of the study area. The strategy should be prepared in accordance with Roads and Maritime's draft Heritage Interpretation Guideline (2016) in consultation with the RAPs and identified Aboriginal knowledge holders. The Aboriginal heritage interpretation project plan will include: a. Interpretative signage (or similar) relevant to Cultural Site A: Gathering Place (Railway Bridge Camps) and how it sits within the wider cultural landscape. The content of the signage is to be developed by a cultural heritage specialist in consultation with the identified Aboriginal knowledge holders. b. Opportunities for input into (aesthetic) design elements of the proposal such as noise walls, bridge piers or abutments to include the interpretation of the Aboriginal cultural values of the area. c. Provisions for rehabilitation and revegetation of the impacted portion of Cultural Site A: Gathering Place (Railway Bridge Camps) with local Indigenous plant species. The identification of the plant species should be undertaken in consultation with the identified Aboriginal knowledge holders. Opportunities should be provided to local Aboriginal organisations for involvement and potential engagement in the revegetation and landscaping process.	Roads and Maritime	Detailed design / pre-construction
Aboriginal heritage	An educational booklet (or similar) would be developed by a cultural heritage specialist on the cultural values and historical records relating to the broader cultural landscape of which Cultural Site A: Gathering Place (Railway Bridge Camps) is one element. As part of this process the photographic recording of the cultural landscape should occur prior to any construction impacts. The final content of the booklet (or similar) to be developed in consultation with the RAPs and identified Aboriginal knowledge holders. To assist in the production of the recommended educational booklet, photographic recording of the cultural landscape by a cultural values specialist at Cultural Site A: Gathering Place (Railway Bridge Camps) should occur prior to any construction impacts.	Roads and Maritime	Detailed design / Pre- construction
Aboriginal heritage	In accordance with Requirement 16B of the Code of Practice, all stone artefacts recovered from the proposal area as part of the test excavation program detailed in the AAR is to be stored temporarily at AECOM's head office (Level 8, 420 George Street, Sydney) while options for their long term management are being investigated, as	AECOM / Roads and Maritime	Detailed design / Pre- construction

Impact	Environmental safeguards	Responsibility	Timing
	determined through consultation with RAPs. Requirement 26 of the Code of Practice provides standard procedures for the deposition of stone artefacts dealt with under AHIPs and the Code of Practice. These procedures will be strictly adhered to.		
Aboriginal heritage	Any Aboriginal objects removed from the study area as a result of test excavation and salvage activities authorised by the Code of Practice or an AHIP should be reburied upon completion of all post-excavation analyses, with the location of the reburial to be determined in consultation with RAPs	Roads and Maritime	Construction

Table 6-48: Management recommendations for Aboriginal archaeological and cultural sites located within the proposal area

Site name	AHIMS ID	Site type	Impact	Degree of harm	Management recommendation(s)
Singleton Bypass OAS1	37-6-3894	Isolated artefact	Not impacted	None	Conservation
Singleton Bypass OAS2	37-6-3895	Isolated artefact	Impacted	Total	Salvage (surface collection)
Singleton Bypass OAS3	37-6-3896	Artefact scatter	Not impacted	None	Conservation
Singleton Bypass OAS4	37-6-3897	Artefact scatter	Not impacted	None	Conservation
Singleton Bypass OAS5	37-6-3890	Artefact scatter	Not impacted	None	Conservation
Singleton Bypass OAS6	37-6-3893	Artefact scatter	Not impacted	None	Conservation
Singleton Bypass OAS7	37-6-3889	Isolated artefact	Impacted	Total	Salvage (surface collection)
Singleton Bypass OAS8	37-6-3888	Artefact scatter	Not impacted	None	Conservation
Singleton Bypass OAS9	37-6-3887	Artefact scatter	Impacted	Total	Salvage (surface collection)
Singleton Bypass OAS10	37-6-3886	Isolated artefact	Impacted	Total	Salvage (surface collection)
Singleton Bypass OAS11	37-6-3892	Artefact scatter	Impacted	Total	Salvage (surface collection)
Singleton Bypass OAS12	37-6-3891	Isolated artefact	Impacted	Total	Salvage (surface collection)
Singleton Bypass OAS13	37-6-3900	Artefact scatter	Impacted	Total	Salvage (surface collection)
Singleton Bypass OAS14	37-6-3899	Isolated artefact	Not impacted	None	Conservation
Singleton Bypass OAS15	37-6-3898	Isolated artefact	Impacted	Total	Salvage (surface collection)
Singleton Bypass OAS16	37-6-3901	Isolated artefact	Not impacted	None	Conservation
Singleton Bypass OAS17	37-6-3905	Isolated artefact	Impacted	Total	Salvage (surface collection)
Singleton Bypass OAS18	37-6-3904	Artefact scatter	Impacted	Partial	Impacted portion - salvage (surface collection) Non-impacted portion - conservation
Singleton Bypass OAS19	37-6-3903 37-6-1466 37-6-1468	Artefact scatter	Impacted	Partial	Impacted portion - salvage (surface collection & excavation) Non-impacted portion - conservation
Singleton Bypass OAS21	37-6-3925	Artefact scatter	Impacted	Partial	Impacted portion - no further management / mitigation actions Non-impacted portion - conservation

Site name	AHIMS ID	Site type	Impact	Degree of harm	Management recommendation(s)
Singleton Bypass OAS22	37-6-3927	Artefact scatter	Impacted	Total	No further management / mitigation actions
McDougall Hill 2	37-6-0789	Artefact scatter	Impacted	Total	Salvage (surface collection)
McDougall Hill 3	37-6-0788	Artefact scatter	Impacted	Total	Salvage (surface collection)
Scarred tree	37-6-0681	Scarred tree	Impacted	Total	Arboricultural relocation/removal feasibility assessment. Detailed archival recording or removal/relocation.
Singleton Bypass PAD3	37-6-3928	PAD	Not impacted	None	Conservation
Cultural Site A: Gathering Place (Railway Bridge Camps)	-	Cultural site	Impacted	Partial	Impacted portion - Rehabilitation / revegetation using local Indigenous plant species at completion of construction works; visual documentation of the cultural landscape prior to any construction impacts; interpretative signage Non-impacted portion — conservation (fencing)

6.8 Non-Aboriginal heritage

This section summarises the results of the non-Aboriginal heritage assessment that was completed for the proposal. The detailed assessment is provided in Appendix C.

6.8.1 Methodology

Desktop Research

Heritage database searches were conducted on 22 March 2018 to identify any heritage items located within the proposal area.

Searches of the following were undertaken:

- World Heritage List (World Heritage Committee, UNESCO)
- National Heritage List (Australian Heritage Council)
- Commonwealth Heritage List (Australian Heritage Council)
- NSW State Heritage Register (Heritage, Department of Premier & Cabinet)
- NSW State Heritage Inventory (Heritage, Department of Premier & Cabinet)
- NSW section 170 Heritage and Conservation Registers (hereafter referred to as S170 Registers) compiled by Roads and Maritime, Sydney Water, Sydney Trains and Transport for NSW and other government agencies as relevant
- Singleton Local Environment Plan 2013 (LEP 2013)
- Register of the National Estate (Australian Heritage Council) (non-statutory).

The desktop research also included:

- Review of historic materials to determine the historic context of the proposal area and to recognise any potential for heritage items
- Assessment of mapped historic heritage listings to establish properties within the proposal area with possible direct and indirect impacts during construction and operation of the project.

Field Survey

A field survey of the proposal area was undertaken over six days from 26 to 29 March and on 3 April and 31 October 2018, with the survey team including two archaeologists from AECOM. The survey was conducted on foot with a total of 31 transects, focusing on areas with previously recorded historic heritage sites.

The location of each transect completed during the survey, including start and end points, was recorded using a handheld differential GPS unit, with associated transect data entered directly into the same unit upon the completion of each transect. All known and newly identified historic sites and items found during the survey were recorded and comprehensively photographed.

Significance Assessment

An assessment of significance is undertaken for relevant items in accordance with the guideline *Assessing Heritage Significance*, part of the NSW Heritage Manual (Heritage Branch, Department of Planning 2001), to understand why it is culturally significant. Where an existing assessment was not available, AECOM carried out their own assessment in accordance with the guidelines, which included assessments for the Coke Ovens, Singleton Hunter River Underbridge, the Woolpack Inn, and an updated assessment for Bebeah.

Environmental heritage means those places, buildings, works, relics, moveable objects, and precincts, of state or local heritage significance (Section 4, *Heritage Act 1977*). An item would be considered to be of State (or local) heritage significance if, in the opinion of the Heritage Council of NSW, it meets one or more of the criteria detailed in the NSW Heritage Manual.

Statement of Heritage Impact

Following the identification of heritage items that may be affected by the proposal, a Statement of Heritage Impact (SoHI) was prepared for each identified item. A SoHI provides a structured examination and assessment of the impacts of a proposed development or activity upon known and potential heritage items. The objective of a SoHI is to evaluate and explain how the proposed development, rehabilitation or land use change will affect the value of the heritage item and/or place. The SoHI also addresses how the heritage value of the item/place can be conserved or maintained, or preferably enhanced by the proposed works.

The applicable standards for the presentation of a SoHI are:

- The Burra Charter: the Australia ICOMOS Charter for Places of Cultural Significance (Australia ICOMOS, 2013)
- NSW Heritage Manual (NSW Heritage Office & NSW Department of Urban Affairs and Planning, 1996b)
- Statements of Heritage impact (NSW Heritage Office, 2002).

The NSW Heritage Manual provides a model format for the structure of a SoHI and includes prompts for questions to be addressed within a SoHI. The key components of a SoHI are:

- The identification of the potential heritage resource, which may or may not be listed in statutory instruments
- Assessment of the significance of the item
- Assessment of the impact of the proposed development, work, or activity upon the item
- Recommendations for avoiding or mitigating impacts to the item.

6.8.2 Existing environment

History

The Hunter region was originally identified as an area of rich resources in 1797 when Lieutenant John Shortland found coal at the mouth of the Hunter's River. A convict settlement was established at the mouth of the river in 1801 to gather coal and timber and burn shells for lime. European settlement of the greater Singleton area commenced in late 1820s. At this time, the Singleton area was known as "Saint Patrick's Plains". This was so named because of John Howe's 1820 expedition which reached the Hunter River on 15 March, two days before Saint Patrick's Day (17 March).

While the European settlement of St Patrick's Plains commenced soon after the district's "discovery" by Howe and his team, the present day township of Singleton was founded in 1836, when Benjamin Singleton received the deeds for his 200 acre land grant adjacent to the Hunter River, which was to be called "Singleton". Containing a natural ford over the Hunter River, known locally as "Singleton's Ford", Singleton first took up residence on his grant in 1823, improving it over time through the construction of a residence, an inn and the area's first flour mill.

Known historical industrial developments in the Singleton area were associated with mining and farming. Early land development was associated with wheat cropping, tobacco production, dairy farming and timber cropping. From the 1870's onwards the land was predominantly cleared and has been used since for both mining and grazing activities, which have substantially affected the physical environment of the area (Whitelaw, 1971).

In 1863, the Great Northern Railway was extended from Black Creek (Branxton) to Singleton and the municipality of Singleton was officially proclaimed in 1866. The Great Northern Railway was further extended from Singleton to Muswellbrook in 1869. The informal track used to access the Singleton area from Newcastle developed over time into the Great Northern Road. In August 1928 it was gazetted as part of state highway 9, which was then renamed the New England Highway in 1933.

Results of Desktop Research and Field Survey

Heritage database searches were carried out on 22 March 2018. Table 6-39 summarises the heritage items within the proposal area and Figure 6-25 and Figure 6-26 shows their locations. The search identified a total of five previously recorded sites within the proposal area. An archaeological survey was then undertaken to identify and record any historic sites within the proposal area. The sites recorded during the survey (including those that had been previously registered) are summarised in Table 6-39 and described in detail in the following sections, along with details of their heritage significance.

Table 6-39: Historic sites within the proposal area

Item	Item ID	Listing	Significance
Coke Ovens	145	Singleton LEP 2013	Local
Great Northern Railway section	Unlisted	Not Listed	Local
Singleton Hunter River Underbridge	SRA844	State Rail Authority of NSW Heritage and Conservation Register	Local
Former Pumping Station	I21	Singleton LEP 2013	Local
Bebeah	I120	Singleton LEP 2013	Local
The Woolpack Inn	l151	Singleton LEP 2013	Local

In addition to the historic sites identified in Table 6-39, other observations were made during the survey. Scatters of glass, ceramic and brick material and landscape modification were observed across the proposal area. These findings were not recognised as having heritage significance when examined in relation to the NSW heritage significance criteria.

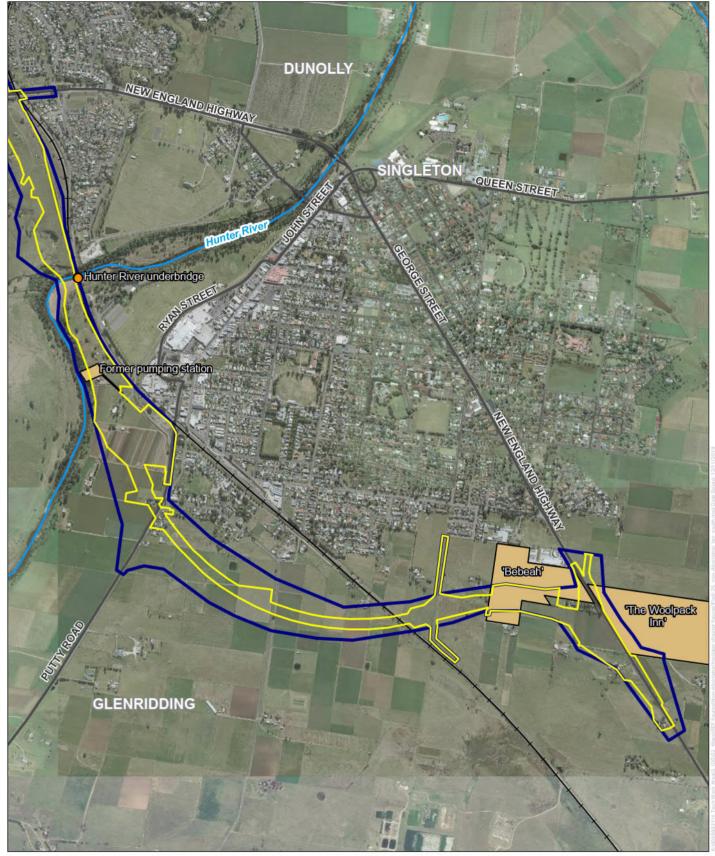


FIG. 6-25 Listed non-Aboriginal heritage items within the proposal area (south)



Legend

Proposal features

Proposal area

Disturbance area

Items listed under State Rail Authority of NSW and Conservation Register

Hundrich Hundrich Hard Bernhalter River underbridge

Items listed under Singleton LEP 2013

Item - General

Other features State roads

-Watercourse

→ Main North railway line

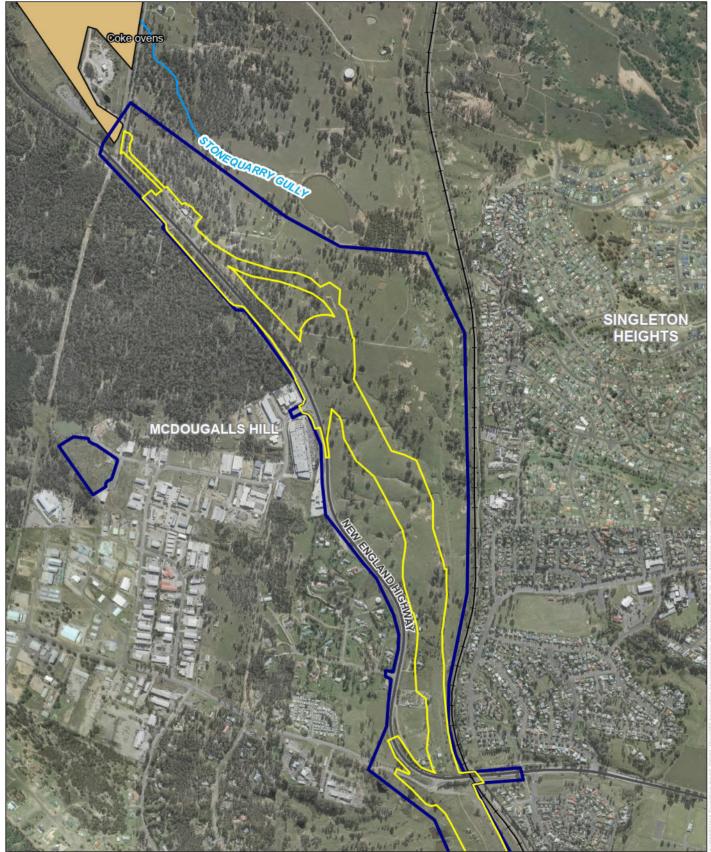


FIG. 6-26 Listed non-Aboriginal heritage items within the proposal area (north)



Legend

Proposal features

-Proposal area

Disturbance area

--- Watercourse

- Main North railway line

Items listed under Singleton LEP 2013

Item - General

Other features

State roads

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Coke Ovens

The item Coke Ovens (I45) is listed on the Singleton LEP 2013 as having local significance. The curtilage for this item is about 48 hectares in size, crossing slightly into the proposal area at its northern extent, but will not be directly impacted by the proposal. A conservation management plan for the ovens was produced in 2007, due to their local heritage significance (Lonergan, 2007). The assessment of significance for this item is presented in full at Section 8.1 of Appendix C.

Great Northern Railway section

During the field survey a linear section of former rail corridor was identified. This was part of the Great Northern Railway corridor that was constructed after the rail line reached Singleton in 1863. It was in active use from around 1869, when the railway was extended to Muswellbrook, up until the Great Northern Railway was deviated in December 1952. The rails have been removed from this original section of rail corridor, however it still contains earth embankments, cuttings and culverts that were all part of the extant physical structure. The former rail corridor has been assessed as one heritage item, inclusive of these multiple elements.

The linear corridor extends from McDougalls Hill in the south (within the proposal area) to Rixs Creek in the north (outside the proposal area), running parallel to the current rail corridor. It passes the disused Rixs Creek Rail Platform and the connection point to the remnant corridor of the Rixs Creek tramway, which connects to the Coke Ovens situated to the west. Approximately two kilometres of the former rail corridor, including the four culverts along with embankments and cuttings, are located within the bounds of the proposal area. The assessment of significance for this item is presented in full at Section 8.2 of Appendix C.

Singleton Hunter River Underbridge

The item 'Singleton Hunter River Underbridge' was listed on the State Rail Authority of NSW in-house Heritage and Conservation Register (SRA844). This item is not listed on the current S170 Heritage and Conservation Register managed by RailCorp.

The bridge is about 150 metres long and 10 metres wide and was originally made of riveted iron and timber, comprising five arches mounted on stone piers. The original bridge was replaced in 1902 by one made of welded deck plate web girders. The original sandstone abutments either side of the Hunter River appear to have been left intact and reused for the replacement underbridge.

An inspection of the bridge and its surrounding area carried out on 28 March 2018 identified two adjacent items that were assessed as being associated with the underbridge. These were a concrete base and timber, brick and metal items. The underbridge was in use and appeared to be in good condition. Graffiti was evident in places. The assessment of significance for this item is presented in full at Section 8.3 of Appendix C.

Former Pumping Station

The Former Pumping Station comprises a twin gabled corrugated steel shed of timber stud construction with pump equipment still in place. Other features present include the battered bank, willow tree plantings and the well. There is the likelihood that archaeological deposits and relics as well as subsurface infrastructure associated with the Former Pumping Station may be present near the existing shed and on its western side (closest to the Hunter River). The area adjacent to the listed curtilage is currently in use as the Singleton Water Depot, demonstrating a continuity of water management activities at this location since 1909.

A site inspection was carried out on 29 March 2018. Only one of the twin gabled sheds clad in corrugated steel mentioned in the listing description was present at the site at the time of inspection. Aerial imagery shows there were originally three sheds abutting each other, however two of these have since been demolished. The remaining shed was observed to be in poor condition exhibiting rust, boarded up and covered sections and graffiti. The assessment of significance for this item is presented in full at Section 8.4 of Appendix C.

Bebeah

The Bebeah residence was built in the Federation Queen Anne style, suggesting construction sometime between 1885 and 1915. The following description of Bebeah has been taken from the Singleton LEP 2013 item entry included under Section 3 of the NSW State Heritage Inventory. This description was last updated 16 August 2010.

"Brick and corrugated steel roof. Seemingly original. Residence. Exterior in seemingly original condition but with replaced roof sheeting" (NSW Office of Environment & Heritage, 2018).

A site inspection was carried out on 3 April 2018. In addition to the residence, which was confirmed to be in good condition, other associated structures and features were also investigated. These included garden plantings, such as fruit trees, two corrugated steel sheds, a brick and corrugated steel shed, a brick structure, three tanks, one silo and enclosures fenced with corrugated steel. The assessment of significance for this item is presented in full at Section 8.5 of Appendix C.

The Woolpack Inn

The Woolpack Inn listed on the Singleton LEP 2013 (I151) is located at 3 Newington Lane, Whittingham. It consists of a building, currently used as a suburban home, located on a rise, with other associated structures. The outlook from the building to the south-west and north-west is across to the New England Highway, across paddocks and on towards Singleton.

The Woolpack Inn was one of several establishments that provided accommodation, food and drink within the Singleton area. The Inn was also used to house other events, such as the auction of furniture and other general merchandise. The assessment of significance for this item is presented in full at Section 8.6 of Appendix C.

6.8.3 Potential impacts

Construction

There are a number of listed heritage items or sites within the proposal area. SoHIs were prepared for the identified items listed in Table 6-39 to assess the impacts of the proposal on the heritage significance of these items. The SoHIs are detailed in Section 8 of Appendix C and summarised in Table 6-40.

It is anticipated that direct impacts during construction may include ground disturbance and indirect impacts may include vibration or ground settlement generated by construction activity. As a result of ground disturbance, one item is anticipated to require complete removal, as discussed below in Table 6-40.

Table 6-40: SoHI summary for historic sites

		Heritage item						
Impact Type	Coke Ovens	Great Northern Railway	Singleton Hunter River underbridge	Former Pumping Station	Bebeah	Woolpack Inn		
Major negative impacts (substantially affects values of state significance)	None	None	None	The proposal would require the removal of the item.	None	None		
Moderate negative impacts (irreversible loss of values of local significance, minor impacts on state significance)	None	The proposal would result in disruption of the linear corridor through destruction of 300 metres of its extent.	None	None	None	None		
Minor negative impacts (reversible loss of local significance or where mitigation retrieves some value)	None	None	None	None	Proposed road works would occur to the south of the property, within the item's curtilage but without impacting on the established public view lines or the fabric of the item.	Proposed road works will occur to the north west of the property, within the item's curtilage but without impacting on the established public view lines or the fabric of the item.		
Negligible or no impacts (does not affect heritage values either negatively or positively)	No direct impacts are proposed within the curtilage of the coke ovens. There will be no impacts to views to or from the heritage item as a result of these works	None	None	None.	None	None		
Minor positive impacts (enhances values of local significance)	None	None	Current view lines from the western side towards the item would be altered. Presently this area is largely limited to private property landowners. If views are left open from the proposed new bridge crossing the Hunter River, the proposal could allow drivers and passengers on the road to view the underbridge from its western side, which is currently largely inaccessible, while retaining the prominent public view lines from the public park area to the east.	None	None	None		
Major positive impacts (enhances values of state significance)	None	None	None	None	None	None		

Consideration of proposed construction activities in relation to the identified historical sites within the proposal area are summarised below in Table 6-41. The consequence of harm refers to impacts that are likely to alter the existing significance level of the item. Construction activities would be guided by a CEMP to ensure construction works are is carried out to Roads and Maritime specifications and the recommendation of this REF.

Table 6-41: Impact summary for historic sites

Item name	ID	Type of harm	Degree of harm	Consequence of harm
Cokes Ovens	145	None	None	No impact to existing heritage significance
Great Northern Railway section	Unlisted	Direct	Moderate	Would impact existing heritage significance
Singleton Hunter River Underbridge	SRA844	Indirect	Low	Unlikely to impact existing heritage significance
Former Pumping Station	I21	Direct	High	Would impact existing heritage significance
Bebeah	I120	Direct	Low	Unlikely to impact existing heritage significance
The Woopack Inn	l151	Direct	Low	Unlikely to impact existing heritage significance

Operation

Potential impacts to non-Aboriginal heritage (either direct or indirect) during the operation of the proposal largely relate to impacts to urban design landscape character and visual amenity. These potential impacts are expected to be minor and would be managed in accordance with the recommended safeguards set out in Section 6.8.4. Operational impacts such as increased noise, vibration or air quality are not considered likely to affect any of the known heritage-listed sites.

6.8.4 Safeguards and management measures

Table 6-42: Summary of non-Aboriginal heritage mitigation measures

Impact	Environmental safeguards	Responsibility	Timing
Non-Aboriginal Heritage	 A heritage management plan should be produced and included with in the Construction and Environment Management Plan measures to manage the identified heritage items in relation to the proposed works, including: Heritage protection measures. An induction program for construction personnel on the management of non-Aboriginal heritage values. Procedures to be implemented if previously unidentified non-Aboriginal relics or heritage items are discovered during construction, in accordance with the Roads and Maritime's Standard Management Procedure - Unexpected 	Contractor	Construction

Impact	Environmental safeguards	Responsibility	Timing
	Archaeological Finds.		
Non-Aboriginal Heritage	 If the use of vibration intensive plant cannot be avoided within the minimum working distance for cosmetic damage the following procedure would occur as a minimum: Notification of the works to the affected residents and community Works would not proceed until attended vibration measurements are undertaken. Vibration monitors are to provide real-time notification of exceedances of levels approaching cosmetic damage criteria. If ongoing works are required a temporary relocatable vibration monitoring system would be installed, to warn operators (via flashing light, audible alarm, short message service (SMS) etc) when vibration levels are approaching the cosmetic damage objective. 	Contractor	Detailed design and Construction
Non-Aboriginal Heritage	Singleton Council should be informed of the proposed impacts to heritage items and their records relating to the corresponding LEP listings should be updated accordingly.	Roads and Maritime	Construction
Non-Aboriginal Heritage	Should any heritage items, archaeological remains or potential relics of Non-Aboriginal origin be encountered, then construction work that might affect or damage the material will cease and notification provided to Roads and Maritime's as per Roads and Maritime Standard Management Procedure - Unexpected Archaeological Finds. Work will only re-commence once the requirements of that Procedure have been satisfied.	Contractor	Construction
Non-Aboriginal Heritage	Roads and Maritime will investigate the need to salvage heritage fabric from listed items removed by the proposal for possible reuse in heritage reinterpretation in consultation with Singleton Council.	Roads and Maritime	Detailed design
Non-Aboriginal Heritage	An archival recording of the Former Pumping Station (I21) will be prepared prior to the removal of the item. The recording will be prepared in accordance with guidelines published by the Heritage Division, Department of Premier & Cabinet.	Contractor	Construction
Heritage impacts	Prior to ground disturbance impacts at the Former Pumping Station (I21), a permit under Section 140 of the <i>Heritage Act 1977</i> would be obtained given the potential for archaeological relics at this location.	Roads and Maritime / contractor	Detailed design and construction

6.9 Air Quality

This chapter presents the methodology and results of the construction and operational air quality impact assessment for the proposal. Further detail regarding the methodology and the results for the assessment is provided in Appendix H.

6.9.1 Methodology

Construction Impacts

A semi-quantitative risk assessment of potential dust impacts on surrounding sensitive receptors was carried out for the construction of the proposal. The assessment was based on the methodology described in the UK Institute of Air Quality Management (IAQM) document, *Guidance on the assessment of dust from demolition and construction*.

The IAQM construction dust risk assessment methodology is commonly used both in NSW and other states of Australia to assess potential dust risks associated with proposed road construction projects. The risk of dust soiling and human health impacts due to particulate matter (PM₁₀) on surrounding areas were determined based on the scale of activities and proximity to sensitive receptors. The IAQM method uses a four-step process to assess dust impacts:

- Step 1: Screening based on distance to nearest sensitive receptors
- Step 2: Assessing the risk of dust impacts from construction activities based on:
 - o Scale and nature of the works, which determines the potential dust emission magnitude
 - Sensitivity of the area
- Step 3: Determining site-specific mitigation for dust-emitting activities
- Step 4: Reassessing the risk of dust impacts after mitigation has been considered.

Operational Impacts

To assess operational air quality impacts, a Level 1 Screening Assessment was undertaken in accordance with the NSW Approved Methods (EPA 2017) using the Tool for Roadside Air Quality (TRAQ) (Version 1.3) developed by Roads and Maritime.

Traffic forecast data from the traffic modelling for the proposal was used to estimate vehicle emissions to enable the quantification of potential air quality impacts attributed to operation of the proposal. Average Annual Daily Traffic (AADT) volumes forecasted for the design opening year (2026) and 10 years after opening (2036) were used as the basis for the estimate of vehicle emissions for daily average traffic (taking into account the traffic volume, traffic mix, speed, number of lanes and road grade).

Details of the construction and operational impacts from the proposal are provided in Section 6.9.3.

6.9.2 Existing environment

Climate and weather

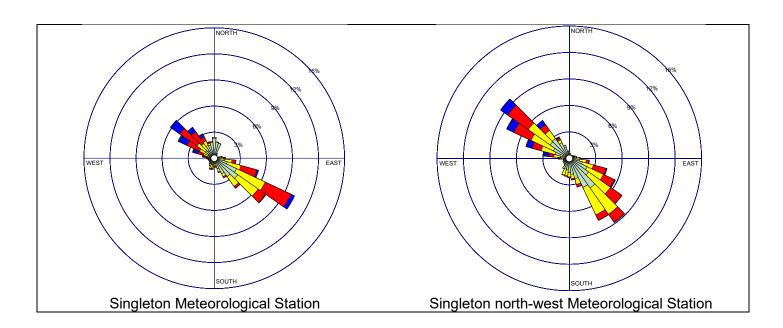
The climate and weather at Singleton are affected by several factors such as terrain and land use. Wind speed and direction are largely affected by topography on a small scale, while factors such as regional scale winds affect wind speed and direction on a larger scale. Wind speed and direction are important variables in assessing potential air quality impacts, as they dictate the direction and distance air pollutants travel.

DPIE operate three ambient air quality monitoring stations in proximity to the proposal area that collect wind speed and wind directional data. DPIE monitoring stations include the:

- Singleton north-west station located approximately 900 metres north-east of the northern end of the proposal area
- Singleton station is approximately 1.9 kilometres east of the centre of the proposal area
- Singleton south station approximately 1.5 kilometres east of the southern end of the proposal area.

Annual average wind roses for 2018 at the Singleton north-west, Singleton and Singleton south DPIE monitoring stations are presented individually in Figure 6-27 and in context with their location in Figure 6-28. Annual average wind patterns shown in Figure 6-28 are relatively similar between the three locations, with predominant wind directions from both the north-west and south-east (which follows the axis of the Hunter Valley). Annual average wind speeds are relatively low at all three stations ranging from 2.1 metres per second at Singleton and 2.9 metres per second at Singleton south.

Given the relatively low wind speeds observed at the monitoring stations, there would be the potential for periods during the year when low wind speeds and calm conditions may result in higher pollution levels (as these conditions commonly correspond to poor dispersion conditions). The screening assessment in Section 6.9.3 adopts a conservative approach through the use of unfavourable weather conditions typically not conducive to rapid dispersion of air pollutants. Weather conditions are based on a wind speed of one metre per second, temperature of 15 degrees Celsius and pascal stability class F (typical of stable night time conditions).



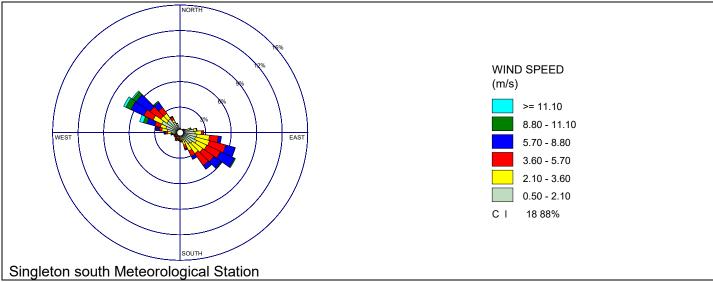


Figure 6-27: Annual 2018 Wind Roses for DPIE Ambient Air Quality Monitoring Stations in the Singleton area (DPIE 2019)

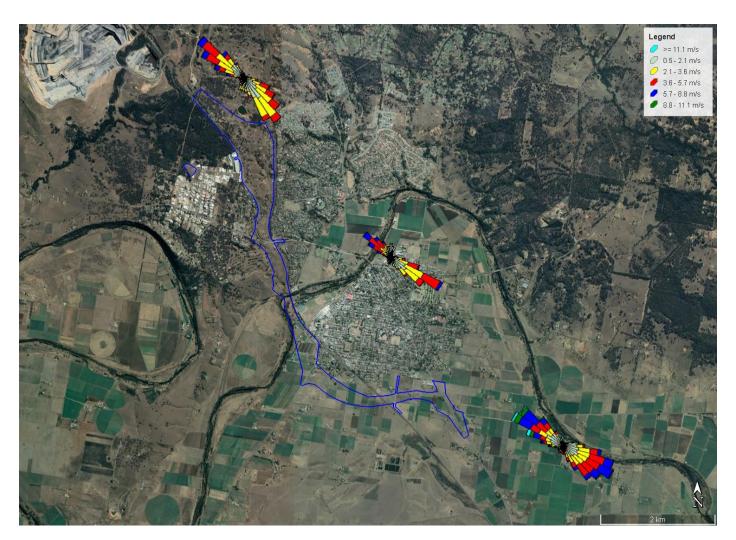


Figure 6-28: Annual 2018 Wind Roses for DPIE Ambient Air Quality Monitoring Stations in the Singleton area (DPIE 2019)

Ambient air quality

Ambient air refers to atmospheric air in its natural state. For ambient air quality within and around the proposal area, pollutants of concern include carbon monoxide (CO), oxides of nitrogen (NO_x) and particulate matter equal to or less than 10 microns in diameter (PM₁₀).

As shown in Figure 6-28 DPIE operates three ambient air quality monitoring stations which all monitor for PM₁₀. Nitrogen dioxide (NO₂) is also monitored at the Singleton monitoring station. Monitoring data for 2018 at each monitoring station is reported in Table 6-43 against the appropriate ambient air quality criteria as stated under the EPAs *NSW Approved Methods for Modelling and Assessment of Air Pollutants* (EPA 2017) for the appropriate averaging periods. Table 6-43 also reports the 90th percentile concentration for NO₂ and PM₁₀ as TRAQ utilises 90th percentile background data to calculate potential cumulative impacts from vehicle emissions and is discussed in Section 6.9.3. In the absence of local CO data at Singleton, default CO background concentrations from the Roads and Maritime TRAQ database have been used in this assessment.

Table 6-43 shows that both the 1-hour maximum and annual average NO₂ concentrations recorded at the Singleton station for 2018 were under the relevant EPA criteria. The PM₁₀ 24 hour maximum concentrations were well above the EPA criterion at all stations in the Singleton area. These concentrations are attributed to dust storms occurring in November 2018, however the 90th percentile concentrations used in TRAQ are below the maximum 24 hour EPA criterion at all stations. Annual average PM₁₀ concentrations for the area were above the criterion at Singleton north-west. This is likely to be attributed to mining activities occurring to the north-west of the monitoring station. Annual average PM₁₀ concentrations recorded at Singleton and Singleton south monitoring stations were just below the criterion.

Table 6-43: 2018 Ambient Air Quality Data at EPA Monitoring Stations at Singleton, NSW (EPA 2019)

Pollutant	Averaging	Co	EPA Criteria		
	Period	Singleton	Singleton north-west	Singleton south	(μg/m³)
NO ₂	1 hour (Maximum)	71.8	No data	No data	246.0
	1 hour (90th Percentile)	34.9	No data	No data	Not applicable
	Annual Average	15.9	No data	No data	68.0
PM ₁₀	24 hour (Maximum)	192.8	195.5	183.3	50.0
	24 hour (90th Percentile)	37.5	46.3	37.0	Not applicable
	Annual Average	24.0	26.8	23.0	25.0

₁ μg/m³ refers to micrograms per cubic metre

The assessment of particulates from the TRAQ model is limited to the assessment of PM_{10} emissions. This excludes an analysis of particulate matter equal to or less than 2.5 microns in diameter ($PM_{2.5}$) which forms the finer proportion of atmospheric PM_{10} and given their size are able to travel further and generally persist for longer in the atmosphere.

The Upper Hunter Valley Fine Particle Characterisation Study (Hibberd et al. 2013) carried out in 2012 identified the main contributing sources of PM_{2.5} at Singleton and identified both vehicles and industry contributed about 17 per cent (plus or minus two per cent) of annual PM_{2.5} emissions. Soil dust and fugitive

coal dust also contributed about 12 per cent (plus or minus two per cent) of annual PM_{2.5} emissions at Singleton. Other major sources of PM_{2.5} included secondary ammonium sulphate and pollutant aged seasalt.

The DPIE Singleton station monitors ambient $PM_{2.5}$ concentrations. The maximum 24 hour $PM_{2.5}$ concentration for 2018 was 19.2 $\mu g/m^3$ which is below the 24 hour EPA criterion of 25 $\mu g/m^3$. The annual average concentration for 2018 however was found to be just above the EPA annual criterion of 8 $\mu g/m^3$ recorded at 8.1 $\mu g/m^3$.

Sensitive receptors and land use

The land use surrounding the proposal is mainly rural and residential. Areas of higher density residential include Singleton Heights, Darlington and Singleton, with the majority of sensitive receptors lying to the east of the proposal and divided by the Main North railway line. The residential area contains a mix of sensitive land uses including houses, schools, retirement homes and sporting fields. There is also an industrial development located to the west of the proposal at McDougalls Hill, as well as low density residential areas and a caravan park.

The TRAQ model calculates pollutant concentrations directly downwind of vehicle emissions from the road at pre-specified distances. Typically, the nearest sensitive or commercial receptor is located at least 10 metres or more from the kerb of the road. For this assessment the modelled concentrations directly downwind of the proposal have been modelled at discrete receptor locations at the kerb as well as 10 metres, 20 meters, 30 metres and 50 metres from the kerb.

6.9.3 Potential impacts

Construction Impacts

Step 1: Screening Assessment

The IAQM method recommends assessment of dust impacts for construction activities where sensitive receptors are located closer than:

- 350 metres from the boundary of the proposal
- 50 metres from the routes used by construction vehicles on public roads, up to 500 metres from the site entrance.

There are a number of sensitive receptors located within 350 metres of the proposal area and therefore further assessment of dust impacts was carried out for the proposal.

Step 2: Risk Assessment of Unmitigated Impacts

Step 2A: Dust Emission Magnitude

Under the IAQM methodology, dust emission magnitudes are estimated according to the scale of works being carried out and other considerations such as meteorology, types of material being used, or general construction methodology. The IAQM guidance provides examples to aid classification and is presented in Appendix H. The dust emission magnitude is based on the scale of the anticipated works and should be classified as Small, Medium, or Large.

Potential dust emission magnitudes for the proposal were estimated based on the indicative construction work methodology described in Section 3.3 and presented in Appendix H. Potential dust generating activities and associated magnitude are included in Table 6-44.

Table 6-44: Dust Emissions Magnitude

Activity	Potential Dust Generating Activities	Magnitude
Demolition	 A number of buildings on acquired properties would require removal within the proposal area. Progressive demolition of building structures would occur using modified excavators. Details regarding building removal and demolition works are detailed in Section 3.3.1. 	Large
Earthworks	 Large scale earthworks would be required as part of the proposal with the majority of earthworks associated with filling for the new road and embankments. The estimated quantities of materials associated with earthworks are provided in Table 3-6 	Large
	 Other earthworks would be associated with utility adjustment or relocation, including electricity, water and sewerage, gas and telecommunications and landscaping works 	
	 Stockpiling would occur at the Waterworks Lane, Gowrie Gates and Northern connection construction sites 	
	 A number of heavy earth moving vehicles would be required during earthworks. An indicative list of plant and equipment is provided in Section 3.3.3. 	
Construction	 Large construction footprint area as shown in Figure 3-2 to Figure 3-6. Construction activities are described in detail in Section 3.1 but include construction of about eight kilometres of new highway; bridges, connections to existing road infrastructure, utility adjustments or relocation, drainage infrastructure and urban design and landscaping works 	Large
	 A number of ancillary facilities would also be constructed including construction compounds and laydown/stockpiling areas as described in Section 3.4 	
	A number of dust generating materials would be required for construction including aggregates, sand, concrete and fly ash	
	A range of plant and equipment would be used during construction. An indicative list of plant and equipment is provided in Section 3.3.3	
Construction traffic	 Construction of the proposal would generate a large number of light and heavy vehicles movements. Estimated heavy vehicle movements are shown in Table 3-7 	Large
	Construction vehicle activities include the movement of construction workers, delivery of construction materials; spoil movement and waste removal and delivery of construction equipment and machinery	
	 Temporary access roads would be built to facilitate the movements of construction vehicles and construction materials to key construction work areas for bridges and bypass connection points within the proposal footprint. Construction vehicle and light vehicle access routes are shown in Figure 3-2 to Figure 3-6. 	

Step 2B: Sensitivity of the Surrounding Area

The IAQM methodology defines the sensitivity of the area to dust impacts, as low, medium or high sensitivity. This sensitivity takes into account a number of factors including the specific sensitivities of receptors in the area, the proximity and number of receptors, local background concentrations of PM₁₀ and site-specific factors including if there are natural shelters to reduce the risk of wind-blown dust.

Surrounding vegetation primarily includes roadside vegetation and pasture within 100 metres from the bulk of dust-emitting activities likely to take place. However, the northern portion of the proposal area is adjacent to an ecologically endangered community (EEC) as described in Section 6.1.2.

High levels of dust deposition on vegetation have the potential to reduce photosynthesis in plants due to shading of the upper leaves. This ecological impact is typically observed upwards of seven grams of dust per metre square of leaf surface. An extremely high amount of dust deposition from construction works would be required before ecological effects from the proposal were observed, particularly given the cumulative EPA dust deposition criteria in NSW is four grams per metre square per month. As such dust deposition from construction impacts on surrounding ecological communities is likely to be negligible. The classifications are determined according to matrix tables provided in the IAQM guidance document. Individual matrix tables for dust soiling and human health impacts are provided. Factors used to determine the sensitivity of the surrounding area are described as follows:

- Receptor sensitivity (for individual receptors):
 - High sensitivity are locations where members of the public are likely to be exposed to elevated concentrations of PM₁₀ for eight hours or more in a day. For example private residences, hospitals, schools, or aged care homes
 - Medium sensitivity include places of work where exposure is likely to be eight hours or more in a day
 - Low sensitivity are locations where exposure is transient, one or two hours maximum. For example parks, footpaths, shopping streets, and playing fields.
- Ambient annual mean PM₁₀ concentrations (only applicable to the human health impact matrix)
- Number of receptors in the area (categorised as one to 10, 10 to 100 or greater than 100)
- Proximity of receptors to dust sources based on radii of 20 metres, 50 metres 100 metres and 350 metres from the source.

Sensitivity of the area surrounding the proposal was estimated according to the IAQM guidance. The overall sensitivity of the potential receivers to both dust and human health impacts is classified as high, based on the following factors in Table 6-45.

Table 6-45: Sensitivity of the Area with Accordance with the IAQM

Potential Impact	Sensitivity of the Area	Justification
Dust Soiling	High	Greater than 100 high-sensitivity receptors (residential) within 50 metres of construction activities.
Human Health (PM ₁₀)	High	 Greater than 100 high-sensitivity receptors (residential) within 50 metres of construction activities Annual average PM₁₀ concentration in the Singleton area between 23 μg/m³ and 26.8 μg/m³ which is either just below or above the EPA criterion of 25 μg/m³.

Step 2C: Unmitigated Risks of Impacts

The dust emission magnitudes for each activity were combined with the sensitivity of the area to determine the risk of construction dust air quality impacts, with no mitigation applied. The risk of impacts for each activity was assessed according to the IAQM risk matrix methodology.

The outcome of the semi-quantitative air quality risk assessment indicates that the unmitigated air quality impacts from the construction phase of the proposal described in Table 6-44 pose a high risk for both dust soiling and human health impacts within 50 metres to the proposal. The majority of residential receptors are situated over 50 metres from the proposal and would have a medium to low risk given their offset distance from the proposal.

Step 3: Mitigation Strategies

A range of mitigation strategies aimed at reducing the likelihood of air quality impacts to offsite sensitive receptors were identified (refer to Section 6.9.4). These mitigation strategies should be considered for all work elements of the proposal.

Step 4: Reassessment

The final step of the IAQM methodology is to determine whether there are significant residual impacts, post mitigation, arising from the proposal. The guidance states:

"For almost all construction activity, the aim should be to prevent significant effects on receptors through the use of effective mitigation. Experience shows that this is normally possible. Hence the residual effect will normally be 'not significant'."

It is anticipated that with the implementation of the recommended mitigation strategies provided in Section 6.9.4, the residual effect (impacts) of the proposal would be 'not significant' at all locations for both dust soiling and human health impacts.

Operational Impacts

Traffic Forecast Data

Traffic movements on the proposed Singleton bypass have the potential to result in motor vehicle emissions from fuel combustion, fluid evaporation, brake and tyre wear, and re-suspended road dust. Emissions from motor vehicles would comprise mainly hydrocarbons, CO, NO_x and PM₁₀.

Traffic activity including the number of vehicles, the vehicle type mix and vehicle speeds can directly influence the near roadside air pollutant concentrations. Vehicle emissions would vary based on the vehicle type mix or ratio of light to heavy vehicles, fuel type mix (for example, petrol and diesel), and the distribution of vehicles by age of manufacture. Traffic forecast data as detailed in the traffic and transport chapter of this REF have been used to estimate vehicle emissions and to quantify air quality impacts attributed to operation of the proposal.

AADT volumes including vehicle type mix, were forecast for the design opening year (2026) and 10 years after opening (2036). The traffic data was then used to estimate vehicle emissions for daily average traffic taking into account the traffic volume, vehicle mix, speed, number of lanes and road grade. Peak hourly traffic speed has been based on average estimated afternoon peak traffic volumes. The proposed road grades would vary throughout the proposal between negative six per cent and five per cent. For each section of road modelled the highest grade has been adopted as a conservative measure. The traffic data used for this assessment is provided in Appendix I.

Potential reductions in traffic numbers along local roads within the Singleton area as a result of the proposal have not been quantified as part of this assessment. Operation of the proposal would reduce traffic numbers; including heavy vehicles through Singleton, improving both traffic flow and travel times.

The reduction in both vehicle numbers and congestion would potentially result in a reduction in vehicle emissions and associated ground level concentrations.

Dispersion Calculation

For the purpose of this assessment a Level 1 Screening Assessment has been carried out in accordance with the Approved Methods using the Tool for Roadside Air Quality (TRAQ) (Version 1.3) developed by Roads and Maritime. Air emissions from key sections along the proposal that would experience changes in traffic have been generated using the total traffic volume with percentages of vehicles in each age bracket and type category. Road grade and speed information was also included in the calculations.

Vehicle emission factors from the World Road Association, referred to as PIARC (formerly the Permanent International Association of Road Congress) are used by TRAQ to estimate emissions from relevant roads in the vicinity of Singleton bypass. In 2004, PIARC (2004) published a document with comprehensive vehicle emissions factors for different road gradients, vehicle speeds and for vehicles conforming to different European emission standards. The emission data in TRAQ have been modified to take into account the age, vehicle mix and emission control technology of the Australian vehicle fleet using DPIE data.

To assess air quality impacts it is necessary to have information on existing pollutant levels in the area in which the proposal would be likely to contribute to these levels. TRAQ provides 90th percentile background data for CO (one hour and eight hour), NO₂ (one hour) and PM₁₀ (24 hour) in the Lower Hunter as well as annual averages. In the absence of local data at Singleton for CO (one and eight hour) 90th percentile, background concentrations for the Lower Hunter have been adopted for CO for this assessment. Local air quality data for NO₂ and PM₁₀ has been identified and discussed in Section 6.9.2. This data has been added to the TRAQ background air quality database and incorporated into the dispersion model.

Carbon Monoxide

Predicted 2026 and 2036 incremental and cumulative maximum one hour and eight hour CO concentrations are presented in Appendix H and show that predicted CO concentrations comply with EPA criteria both incrementally and cumulatively for 2026 and 2036.

Nitrogen Dioxide

Predicted 2026 and 2036 incremental and cumulative maximum one hour and annual average NO₂ concentrations are presented in Appendix H and show that predicted NO₂ concentrations comply with EPA criteria both incrementally and cumulatively for 2026 and 2036.

Particulate Matter

Predicted 2026 and 2036 incremental and cumulative maximum 24-hour and annual average PM₁₀ concentrations are presented in Appendix H and indicates the potential for maximum 24 hour average exceedances along the main alignment of the proposal. Predicted cumulative exceedances are limited to the area within 20 metres of the proposed kerb. It should be noted however that predicted exceedances are largely due to existing high background concentrations:

- Background data from the Singleton north-west station has been used for the calculation of all
 cumulative concentrations. Singleton north-west station has higher particulate concentrations than the
 other two stations due to the proximity of nearby mining activities and as such the use of this station
 provide a worst case indication (and potentially over-conservative) of background particulate
 concentration
- Predicted emission concentrations take into account both the emissions that come out of a car on a
 cold morning whilst it is warming up and worst case meteorological conditions typical of winter nights.
 The steepest (positive) road grade recorded within each section of the alignment was also assumed for

each model run. These assumptions are also considered worst case and result in a conservative estimation of the pollutant concentrations.

The predicted cumulative exceedances of the annual average criterion are largely attributed to the high background concentrations observed at the Singleton north-west station that recorded higher particulate concentrations than the other two stations due to the proximity of nearby mining activities (refer to Appendix H for further information).

Further analysis of the worst case incremental PM₁₀ impacts attributed to the proposal identify that:

- Worst case predicted 24 hour PM10 concentrations occur at the kerb before the exit ramp to Singleton at the southern connection which contributes 30 per cent (2026) to 32 per cent (2036) of the EPA criterion. The contribution of the proposal to the exceedance decreases with distance contributing 12 per cent (2026) to 13 per cent (2036) of the criteria at a distance of 10 metres from the kerb and five per cent (2026) to six per cent (2036) by 50 metres. It also should be noted that only minor changes to the existing alignment of the New England Highway at the southern connection are proposed an as such no significant incremental increases to PM10 concentrations at sensitive receptors are anticipated
- All other modelled sections of the proposal alignment worst case predicted 24 hour PM10 concentrations attributed 10 per cent (2026) to 11 per cent (2036) or less of the criterion at a distance of 10 metres from the kerb and under five per cent (2016 and 2036) by 50 metres. The highest incremental concentrations were generally found to occur along the main alignment of the proposal. Predicted incremental impacts at Magpie Street, Gowrie Gates, Putty Road and the southern connection were below three per cent of the criterion 10 metres from the kerb for 2026 and 2036
- Worst case predicted annual average PM10 concentrations occur at the kerb before the exit ramp to Singleton; contributing 24 per cent (2026) to 26 per cent (2036) of the EPA criterion. The contribution of the proposal decreases with distance to 10 per cent (2026 and 2036) of the criteria at a distance of 10 metres from the kerb and four per cent (2026 and 2036) by 50 metres
- All other modelled sections of the alignment worst case predicted annual average PM10 concentrations attributed less than 10 per cent (2026 and 2036) of the criterion at a distance of 10 metres from the kerb and under five per cent (2016 and 2036) by 50 metres. The highest incremental concentrations were generally found to occur along the main alignment. Predicted incremental impacts at Magpie Street, Gowrie Gate, Putty Road and Singleton entry and exit ramps and southbound traffic to the New England Highway were below three per cent of the criterion 10 metres from the kerb for 2026 and 2036.

Worst case incremental PM10 impacts are provided in full in Appendix H.

Based on the analysis above it is evident that the worst case predicted incremental contributions from the proposal are smaller than the existing background concentrations within the area. Both 24 hour PM10 and annual average contributions for most sections of the alignment were found to make up approximately 10 per cent or less of the criteria; with the incremental contributions further decreasing with distance from the kerb.

As discussed in Section 6.9.2 the TRAQ is limited to the assessment of PM10 emissions. PM10 emissions from vehicles however are predominantly made up of the finer PM2.5 particle fraction (about 95 percent). To enable an estimate of potential PM2.5 impacts, predicted PM10 have been scaled to provide an indicative estimate of PM2.5 contributions from the proposal (refer to Appendix H).

Based on the assumption that 95 per cent of PM10 emissions are PM2.5 the worst case predicted incremental 24 hour PM2.5 concentration of 14.3 μ g/m3 for 2026, and 15.5 μ g/m3 for 2036 occurred at the kerb before the exit ramp to Singleton at the southern connection. The proposal contribution decreases with distance with 5.8 μ g/m3 (2026) and 6.1 μ g/m3 (2036) at 10 metres from the kerb and 2.6 μ g/m3 (2026) and 2.7 μ g/m3 (2036) 50 metres from the kerb.

When accounting for the maximum recorded 24 hour concentration at Singleton for 2018 of 19.2 µg/m3 the worst case predicted incremental 24 hour PM2.5 concentration at 10 metres from the kerb was equal to the 24 hour EPA criterion (25 µg/m3) for 2026 and just above the criterion for 2036. Predicted 24 hour average

cumulative concentrations of PM2.5 were compliant with the EPA criteria at a distance of 20 metres or greater from the kerb before the exit ramp at the southern connection. As discussed above however only minor changes to the existing alignment on this section of road are proposed as such no significant incremental increases to PM10 concentrations at sensitive receptors are anticipated. All other sections of the alignment were compliant the 24 hour EPA criterion (25 µg/m3) at 10 metres from the kerb and beyond.

The existing annual average PM2.5 concentration recorded at Singleton for 2018 was 8.1 μ g/m3; just above the 8.0 μ g/m3 EPA criterion. Therefore the incremental contribution from the project has been reviewed in isolation. The worst case predicted annual average PM2.5 concentration of 5.8 μ g/m3 for the year 2026 and 6.2 μ g/m3 for the year 2036 occurred at the kerb before the exit ramp to Singleton. The contribution of the proposal decreased with distance with 2.3 μ g/m3 (2026) and 2.5 μ g/m3 (2036) at 10 metres from the kerb and 1.0 μ g/m3 (2026 and 2036) 50 metres from the kerb. Annual PM2.5 incremental contributions were found to be higher along the main alignment with predicted incremental impacts at entry and exit ramps generally less than 1.0 μ g/m3 10 metres from the kerb for 2026 and 2036.

6.9.4 Safeguards and Management Measures

Given the background particulate concentration in the region surrounding the proposal, careful consideration of the design and implementation of the mitigation measures is needed. The measures in Table 6-46 are recommended to minimise the potential for generation of dust during construction.

Table 6-46: Summary of air quality mitigation measures

Impact	Environmental safeguards	Responsibility	Timing
Air quality	 An Air Quality Management Plan will be prepared and implemented as part of the CEMP. The Plan will identify: Potential sources of air pollution (such as dust, vehicles transporting waste, plant and equipment) during construction Air quality management objectives consistent with any relevant published EPA and/or DPIE guidelines Mitigation and suppression measures to be implemented, such as spraying or covering exposed surfaces, provision of vehicle clean down areas, covering of loads, street cleaning, use of dust screens, maintenance of plant in accordance with manufacturer's instructions Methods to manage works during strong winds or other adverse weather conditions A progressive rehabilitation strategy for exposed surfaces When the air quality, suppression and management measures need to be applied, who is responsible, and how effectives will be assessed. Community notification and complaint handling procedures 	Construction contractor	During Construction
Air quality	As part of the AQMP, a monitoring program would be developed for monitoring construction dust		

Impact	Environmental safeguards	Responsibility	Timing
	from the proposal. The monitoring plan would be implemented prior to construction and during the construction period to assess effective implementation of air quality safeguards, identify any unexpected or inadvertent impacts, and identify recommended revisions or improvements.		

6.10 Landscape character and visual impacts

This section summarises the Landscape Character, Visual Impact Assessment and Urban Design report that was completed for the proposal. The detailed assessment is provided in Appendix B.

6.10.1 Methodology

The landscape character and visual impact assessment (LCVIA) was carried out in accordance with the Roads and Maritime Environmental Impacts Assessment Practice Note – Guidelines for Landscape Character and Visual Impact Assessment EIA-N04 (2018). The LCVIA was carried out as part of the design process to support the development of the concept design.

The report assesses the potential landscape character and visual impacts of the proposal. The assessment is based on the sensitivity of a number of individual Landscape character zones (LCZs) and views and magnitude of change at each one associated with the proposal.

For the assessment of landscape character, sensitivity is the degree to which the landscape is susceptible to a specific type of change. The magnitude of change is the combination of the scale, extent and duration of the change.

For the assessment of visual impacts, sensitivity is dependent on the location, number and expectations of receptors and the quality of the existing view. The magnitude of change is the scale, size and character of the proposal, the extent of visibility and the contrast with the existing view.

Definitions of sensitivity and magnitude are described in further detail in Appendix B. Sensitivity and magnitude are combined to give an impact rating of high, moderate, low or negligible.

6.10.2 Existing environment

The environment surrounding the proposal area includes cropping and pasture farmland, pockets of native vegetation and creek lines. The town of Singleton includes low density residential and low to medium density commercial premises with the New England Highway extending from south to north through the town.

Landscape character zones

The proposal area transitions through a number of LCZs as described in Table 6-47 and shown in Figure 6-29. An assessment of the sensitivity of each of these landscape zones and the magnitude of impacts has been completed and an overall landscape character impact rating assigned (refer to Table 6-48 and Appendix B).

Table 6-47: Landscape character zones

LCZ	Description
1 Enclosed Rural Landscape	Heavily vegetated remnant bushland of Ironbark-Spotted Gum-Grey Box Forest, creating a sense of an enclosed landscape with tall vertical scale.
2 Open Rural Landscape	A predominantly open rural setting with remnant and regrowth tree stands scattered throughout an undulating to rolling landform of pasture land. The character ranges from areas with no trees, to areas that have moderate stands of trees.

LCZ	Description
3 Industrial	Typical industrial character including large factory-style bulky buildings, wide streets and no structured landscape works or substantial street tree planting. Most of the industrial area is hidden from view from the existing highway.
4 Large Lot Residential	Small acreage lots varying from mostly cleared, to heavily-wooded with trees creating a rural / bushland residential setting. The rural setting is highlighted with a number of properties with rural style post, rail and wire fencing. Streets have open drains, degraded road edges and wide grass verges. The area is mostly screened from view from the existing highway.
5 New Residential Suburbs	Comprises mostly low to medium density residential development with standard amenities such as schools, parks, sporting facilities and local shops set within a curving street pattern influenced by the landform. The streetscape is characterised by front yard gardens of varying styles and plant species.
6 Agricultural Floodplain	The main features comprise the winding Hunter River with sections of tree- lined embankments and patchwork patterns of the agricultural alluvial floodplain. The valley floor contrasts the grasslands of rolling hills and the urban development. Houses are sporadically placed on elevated positions and the rural setting is further emphasised by rural roads, gravel driveways and agricultural fences.
7 Singleton Old Town	The Singleton town centre is broadly encompassed by the Main North railway line, Hunter River and the New England Highway. It comprises a vibrant 'high street' commercial and retail strip with recent streetscape upgrades. Formal parks and botanic gardens reminiscent of a Victorian era and the combination of urban patterns, dominant tree species and architectural styles of historic buildings are reminders of early European settlement.

LEGEND PROPOSAL WATERWAY LCZ 3 - INDUSTRIAL LCZ 6 - AGRICULTURAL FLOODPLAIN LCZ7 - OLD TOWN TRAIN STATION LCZ 1 - ENCLOSED RURAL LANDSCAPE LCZ 4 - LARGE LOT RESIDENTIAL LCZ 5 - NEW RESIDENTIAL SUBURBS LCZ 2 - OPEN RURAL LANDSCAPE RAILWAY LINE 1,000 INGLETON HUNTERVIEW FERN GULLY LONG POINT SINGLETON

Figure 6-29: Landscape Character Zones Map, 1:35,000 at A3

6.10.3 Potential impacts

Construction

Landscape character impact

The construction of the proposal would not impact on the identified LCZs.

Visual Impacts

During construction, positioning of plant and equipment within the view of surrounding properties and existing road users would result in minor, temporary visual impacts. The proposal would require earthworks which would expose subsoil and the removal of vegetation within the proposal area. Vegetation removal would include trimming and/or clearing of some planted and remnant native trees. Some of this vegetation contributes to the amenity and character of the proposal area. This would lead to temporary visual impacts during construction until the works are complete and disturbed areas rehabilitated.

Operation

The proposal is likely be visually prominent from several key viewpoints around Singleton. The proposal features a number of elements that would be obvious within the predominantly rural landscape including embankments/batters, bridges and noise walls. Change resulting from the proposal would mainly affect residents and businesses adjoining the proposal area, and road users.

Landscape character impact

A summary of the landscape character impact is provided in Table 6-48 and described in further detail below. Overall the impacts of the proposal on landscape character is rated as negligible for zone 3, 4 and 5, moderate too low for zone 1 and high to moderate for zone 2, 6 and 7.

Table 6-48: Summary of impacts on landscape character

LCZ	Sensitivity	Magnitude	Significance of impact rating
1 Enclosed Rural Landscape	Low	Moderate	Moderate to Low
2 Open Rural Landscape	Moderate	High	High to Moderate
3 Industrial	Low	Negligible	Negligible
4 Large Lot Residential	Moderate	Negligible	Negligible
5 New Residential Suburbs	Moderate	Negligible	Negligible
6 Agricultural Floodplain	High	Moderate	High to Moderate
7 Singleton Old Town	High	Moderate	High to Moderate

The LCZs with the highest impact ratings are all considered to have a long-term duration of the landscape effects. LCZ 2 would be impacted by the large northern connection landform, involving substantial cuttings and a raised embankment across the eastern side slopes of McDougalls Hill and associated watercourses.

The proposal would provide about 2.3 kilometres of 11 metre high embankment and a 1.7 kilometre long bridge over the floodplain, both topped in locations with noise walls up to 3.5 metres in height. The proximity of the bridge over the floodplain to Glenridding would adversely affect the character of this area, impacting LCZ 6 and LCZ 7.

Singleton old town (LCZ 7) would indirectly be affected by the placement of embankments and subsequent loss of extensive floodplain context and backdrop views of the Greater Blue Mountains World Heritage Area, with these elements being important to the landscape character.

Visual Impacts

A visual impact assessment was completed for seven viewpoints within the proposal area. Details of this assessment are provided in Appendix B and a summary of the results are provided in Table 6-49. The viewpoints used in the analysis are shown on Figure 6-30.

To assist with the visual impact assessment, visualizations of the proposal from each of the assessed viewpoints were developed and are provided in full in Appendix B. The current and indicative views for the viewpoints which were assessed as having the highest impacts are shown on Figure 6-32 to Figure 6-36.

Table 6-49: Summary of visual impacts across the proposal area

Viewpoint	Sensitivity	Magnitude	Significance of impact rating
1 - New England Highway - South	Low	Moderate	Moderate to Low
2 - Ellen Avenue	High	Moderate	High to Moderate
3 - Army Camp Road	Moderate	Moderate	Moderate
4 - New England Highway - North	Low	Low	Low
5 - New England Highway - Bunnings	Low	Low	Low
6 – Maison Dieu Road	Low	Low	Low
7 - Mitchell Avenue	High	High	High

Elements of the proposal that are likely to be the most visually intrusive include the earth embankments, bridges and vehicle movements. Vehicle headlights may also cause visual impacts at night.

The greatest visual impacts would be at Ellen Avenue (viewpoint 2, looking south towards the bridge over the floodplain), Army Camp Road (viewpoint 3, looking north towards the bridge over the floodplain) and Mitchell Avenue (viewpoint 7, looking west towards a hill crest where vegetation removal would be carried out for the proposal). The visual impact rating for these viewpoints is primarily influenced by:

- Ellen Avenue (viewpoint 2): The view is within a residential area with a large number of sensitive visual receptors with high quality existing views across the floodplain. The proposal would remove the middle ground and background of the existing view
- Army Camp Road (viewpoint 3): There are high quality views of the floodplain and the peaks of Mount Royal National Park. The proposal would comprise a large scale visual element contrasting with the existing view
- Mitchell Avenue (viewpoint 7): The view is within a residential area with views of a vegetated hillside.
 While the proposal would not be visible above the hillside crest, the proposal would involve the removal of mature trees on the crest of the hill which would form a moderate to high degree of contrast with the existing view.

Potential visual impacts at the other viewpoints are generally low given the low quality of existing views and that the scale and character of the proposal would generally be consistent with existing setting with a low to moderate degree of contrast.

The proposal would result in reduced traffic volumes through Singleton town centre which is likely to have positive impacts on visual amenity along the existing New England Highway.

LEGEND

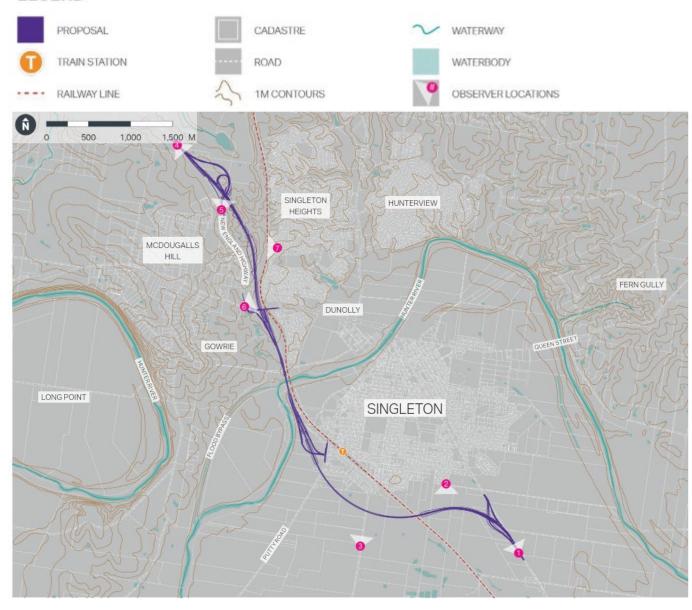


Figure 6-30: Visual Receptor Location Map, 1:35,000 at A3



Figure 6-31: Current view of Ellen Avenue (viewpoint 2)



Figure 6-32: Indicative view of proposal at Ellen Avenue (viewpoint 2)



Figure 6-33: Current view of Army Camp Road (viewpoint 3)



Figure 6-34: Indicative view of proposal at Army Camp Road (viewpoint 3)



Figure 6-35: Current view of Mitchell Avenue (viewpoint 7)



Figure 6-36: Indicative view of proposal at Mitchell Avenue (viewpoint 7)

6.10.4 Safeguards and management measures

Table 6-50: Summary of landscape and visual mitigation measures

Impact	Environmental safeguards	Responsibility	Timing
Landscape and visual	All plant material to be locally sourced (seed collection preferred), with any seed collection to commence within three months of construction contract award, where possible.	Roads and Maritime	Detailed design
Landscape and visual	 An Urban Design Plan will be prepared as part of the CEMP. The Plan will include: Location and identification of vegetation in the proposal area to be retained and proposed landscaped areas Details of the staging of built elements including retaining walls, bridges and noise walls Details of the staging of landscape works Maintenance measures for landscaped or rehabilitated areas, including timings A landscape monitoring program including an inspection program with frequency. 	Construction contractor	Pre-construction

6.11Property and land use

6.11.1 Existing environment

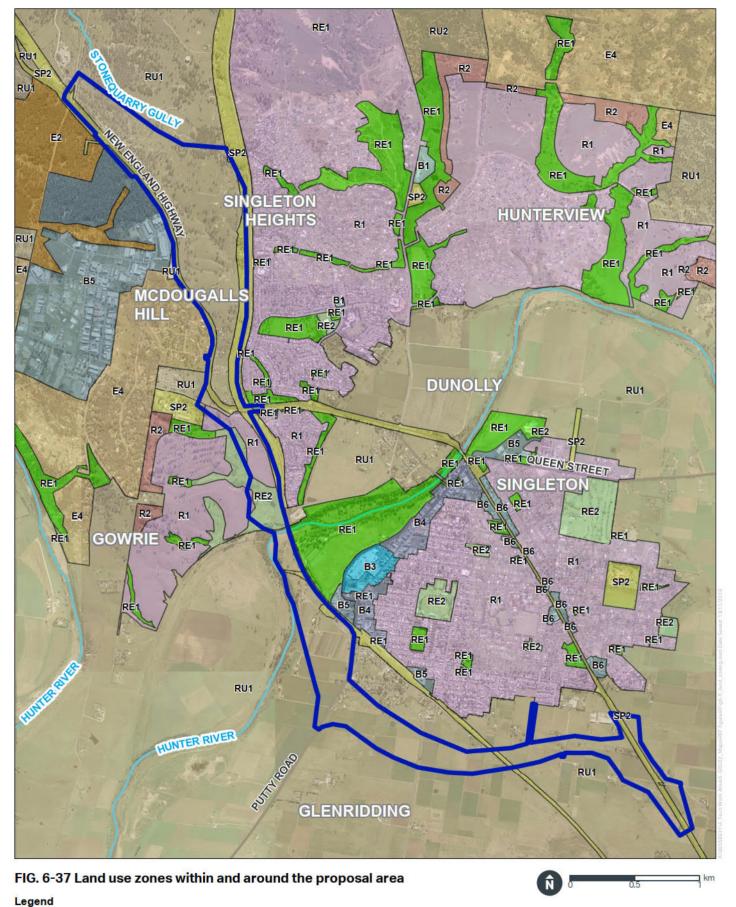
Land uses surrounding the proposal area generally include cleared agricultural land to the south-west, residential, commercial and open space areas comprising the town of Singleton to the east, residential areas at Singleton Heights and Darlington to the north-east, industrial land uses to the west at McDougalls Hill and areas of remnant vegetation at Rixs Creek to the north. The proposal area is intersected by key infrastructure including the New England Highway and Main North railway line.

Land use zones that occur within the proposal area include:

- RU1 (Primary production)
- SP2 (Infrastructure)
- RE2 (Private recreation)
- R1 (General residential).

The majority of the land within the proposal area is zoned RU1 (Primary production). Land use zoning within and around the proposal area is show in Figure 6-37.

There are a number of utility services within the proposal area as described in Section 3.5.



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Proposal area Other features State roads Watercourse Land use zoning B1 Neighbourhood Centre B3 Commercial Core B4 Mixed Use B5 Business Development

Proposal features



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6.11.2 Potential impacts

Construction

Long term impacts on land use and property would occur from the commencement of construction following acquisition of the land. This would result in some properties subject to partial acquisition requiring new or alternate property access arrangements. Property acquisition for the proposal is summarised in Table 3-8.

The proposal area encompasses an area of around 240 hectares of which around 215 hectares is classed as RU1 (Primary production). Table 6-51 outlines the extent of impact to land use zones within the proposal area.

Table 6-51: Impact to land use within the proposal area

Land use zone	Impacted area (indicative)
RU1 (Primary production)	215 hectares
SP2 (Infrastructure)	5 hectares
RE2 (Private recreation)	10 hectares
R1 (General residential)	10 hectares

Land for ancillary facilities would be leased by Roads and Maritime for the construction of the proposal or located on land already acquired by Roads and Maritime for the proposal. Lease arrangements would be negotiated with the property owner.

Impacts to adjacent land uses during construction, such as amenity impacts, are discussed throughout Section 6.12.

Operation

Properties that would be acquired for the proposal are listed in Table 3-8. Based on the concept design, it is anticipated that:

- Fifty three individual lots would be subject to acquisition, including
 - Forty four privately owned lots
 - Nine publicly owned lots.

Six of the privately owned lots have already been acquired by Roads and Maritime as owner initiated acquisition under Roads and Maritime's 'preferred option' policy. The remaining lots are owned by 29 separate owners. The nine publicly owned lots are owned by four separate owners (ARTC, Singleton Council, The Minister for Public Works and The State of NSW).

Of the 47 individual lots still subject to acquisition:

- Eleven privately owned lots and five publicly owned lots would be subject to total acquisition
- Twenty seven privately owned lots and four publicly owned lots subject to partial acquisition.

As identified in Table 3-8, for properties that would be partially acquired, acquisition would generally comprise around less than one third of the total property area.

The land zones for the 47 individual lots still subject to acquisition include:

- Forty two zoned RU1 (Primary production)
- Three zoned RE2 (Public recreation)

- One zoned R1 (General residential)
- One partially zoned RE2 (Private recreation) and R1 (General residential).

The land zoned as RE2 identified above comprises part of an approved subdivision which has not yet been developed and is therefore not currently being used for the purpose of private recreation.

Property acquisition would be confirmed during detailed design. Infrastructure within the acquired areas of land would be demolished. A list of items that would be demolished in Table 6-52.

Table 6-52: Structures to be demolished for the proposal

Structure	Number of structures to be demolished		
Dwelling	11		
Shed	16		
Other	1 (Council works depot and pump station)		

The proposal would result in a permanent change in land use from the existing land uses to a road corridor. This would remove the ability of the land to be developed for residential or agricultural purposes in the future.

The proposal would result in the fragmentation of eight properties, owned by eight separate owners, which are primarily agricultural properties. This fragmentation would potentially affect the ability for land owners to access a part of their property that is otherwise not directly impacted by the proposal. Mitigation measures are provided in Section 6.5.3 to manage this impact, ensuring access to properties including access to fragmented land is considered, or alternate access arrangements are provided. Potential impacts to the ongoing use of fragmented properties is described in Section 6.12.

All properties affected by changed access arrangements as a result of the proposal would be provided with restored or new permanent access arrangements during operation, including the properties that would be fragmented.

Impacts to adjacent land uses during operation, such as amenity impacts, are discussed throughout Section 6.12.

6.11.3 Safeguards and management measures

Mitigation measures provided in Table 6-13 would be implemented to minimise potential property and land use impacts. Mitigation measures relevant to managing impacts to property access are described in Section 6.5.3 and mitigation measures relevant to managing social and economic impacts associated with acquisition are described in Section 6.12.

Table 6-53: Summary of mitigation measures to minimise impacts to land use and property

Impact	Environmental safeguards	Responsibility	Timing
Property acquisition	Property acquisition will be carried out in accordance with the Land Acquisition Information Guide (Roads and Maritime, 2014) and the Land Acquisition (Just Terms Compensation) Act 1991.	Roads and Maritime	Detailed design
Property acquisition	Roads and Maritime will complete property adjustments including fencing,	Roads and Maritime	Detailed design

Impact	Environmental safeguards	Responsibility	Timing
	driveways/access and other property infrastructure impacted by the proposal in consultation with affected property owners.		
Property acquisition	Roads and Maritime will investigate the possibility of licencing land beneath the bridge to impacted landholders to enable continued access for fragmented properties.	Roads and Maritime	Detailed design

6.12 Socio-economic

This section summarises the results of the Socio-economic impact assessment (SEIA) that was completed for the proposal. The detailed assessment is provided in Appendix D.

6.12.1 Methodology

The SEIA was completed in accordance with the Roads and Maritime *Environmental Impact Assessment Practice Note – Socio-economic assessment* (EIA-N05) (Practice Note) (NSW Roads and Maritime Services, 2013).

The Practice Note outlines the requirements for establishing the socio-economic baseline and guides the process for assessing socio-economic impacts of Roads and Maritime activities. In accordance with the Practice Note, the assessment included the following methodology:

- Definition of the study area. Two study areas comprising the Singleton LGA and Singleton Statistical Area Level 2 (SA2) were used in the SEIA. Refer to Appendix D for further detail
- Desktop assessment including review of background socio-economic impact assessments
- Identification of the appropriate scope of the SEIA. The appropriate level of socio-economic assessment was identified as 'comprehensive'
- Identification and consultation with local communities and stakeholders who could be affected by the proposal
- Development of a baseline profile of the existing socio-economic environment based on information available from the Australian Bureau of Statistics (ABS), relevant local, regional and State policies and plans, as well as the outcomes of consultation carried out for the proposal
- Assessment of the potential construction, operation and cumulative impacts of the proposal on socioeconomic matters, including an assessment of the significance of these impacts
- Identification of management measures for managing and monitoring the potential socio-economic impacts of the proposal.

The SEIA is also informed by the outcomes of various other technical reports prepared for the proposal, including the assessment of impacts to air quality, traffic and transport, noise and vibration, urban design, property and land use, landscape character and visual amenity.

Business surveys, stopper surveys (ie people stopping in Singleton who don't live in the town) and an origin and destination survey were carried out for the proposal. Feedback received during the survey period has been analysed, along with local community plans, to provide insights into community identity, values and goals. The results of the surveys and other feedback have been compiled and are summarised in Appendix D.

The assessment of the significance of socio-economic impacts in accordance with the Practice Note includes consideration of the magnitude of the impact and the sensitivity of the receivers. The criteria for assessing each impact was established based on:

- Magnitude of impact which was made up of scale and intensity, spatial extent and duration
- Sensitivity of affected stakeholders which was defined by the susceptibility or vulnerability of people, receivers or receiving environments to adverse changes caused by the impact, or the importance placed on the matter being affected.

The assessment matrix provided in Table 6-54 has been used to determine the significance of each social impact as a function of the magnitude of the impact and the sensitivity of potentially affected stakeholders.

Table 6-54: Significance of socio-economic impacts

Sensitivity	Magnitude			
	High	Moderate	Low	Negligible
High	High impact	High-Moderate	Moderate	Negligible
Moderate	High-Moderate	Moderate	Moderate-Low	Negligible
Low	Moderate	Moderate-Low	Low	Negligible
Negligible	Negligible	Negligible	Negligible	Negligible

A summary of the magnitude, sensitivity and significance ratings are included in this chapter. Detail regarding the justification for these ratings is provided in full in Appendix D.

6.12.2 Existing environment

Demographics

Singleton is located in the centre of the Hunter Region of New South Wales. The population of the Singleton LGA in 2016 was 22,987 of which 16,136 lived in the township of Singleton. The wider LGA and Singleton have relatively low cultural diversity with only 5.3 per cent of Singleton SA2 speaking another language at home in 2016 (consistent with 3.11 per cent in the Singleton LGA). Over 60 per cent (60.3) of the population was employed full time in 2016, with an unemployment rate of 6.9 per cent, both of which are consistent with the LGA average (59.5 per cent and 6.11 per cent).

Economy

The economy of Singleton and the LGA is quite diverse. The main economic drivers are the mining, tourism, agriculture and defence industries. Coal mining industries have played a significant role in Singleton's history since the late 1800s and today mining accounts for about one fifth of the resident labour force, directly employing around 2800 workers. Around 20 coal mines operate in the Singleton LGA and produce about 57 million tonnes of coal annually. In total, the mining industry has contributed to 36 per cent of local employment and creates \$5.1 billion in regional output annually.

There are about 112 businesses located along John Street and George Street in Singleton, with an additional 49 businesses located in Singleton Square. The range of businesses indicates that Singleton serves a variety of industries such as the mining, tourism and agriculture and provides administrative, retail, commercial, education and health services for local residents of Singleton and the region.

Social infrastructure

Singleton has a wide range of community facilities and assets ranging from places of worship to sporting grounds, recreation, education and essential facilities and services. Social infrastructure located within 400 metres of the proposal area includes:

- Rose Point Park contains an array of BBQ facilities, seating and paths. It is located close to the Hunter River and the CBD. The park also provides for baseball, cricket, netball, rugby, soccer and AFL facilities
- Alroy Park is home to the Junior Singleton Soccer Club and contains play equipment, cricket nets, sport sheds and amenities
- Matilda Park is a small reserve containing no playground equipment or amenities

- Pritchard Park is a small reserve containing a rest/park bench with no playground equipment or other amenities
- James White Park contains play equipment
- Singleton off-leash dog Park
- Singleton Christian College
- Rainbows Early Learning Centre
- Singleton Neighbourhood Centre.

The location of key social infrastructure in proximity to the proposal is shown in Figure 6-38 to Figure 6-42.

Community identity, values

A review of community strategic planning documents relevant to Singleton LGA was carried out to identify values and aspirations specific to the local and regional community. Key community values and aspirations identify Singleton as consisting of:

- A creative, vibrant, inclusive, safe and healthy community
- Resilient informed and connected people
- Well planned, sustainable, vibrant and accessible places
- A sustainable environment
- An innovative, sustainable and diverse economy.

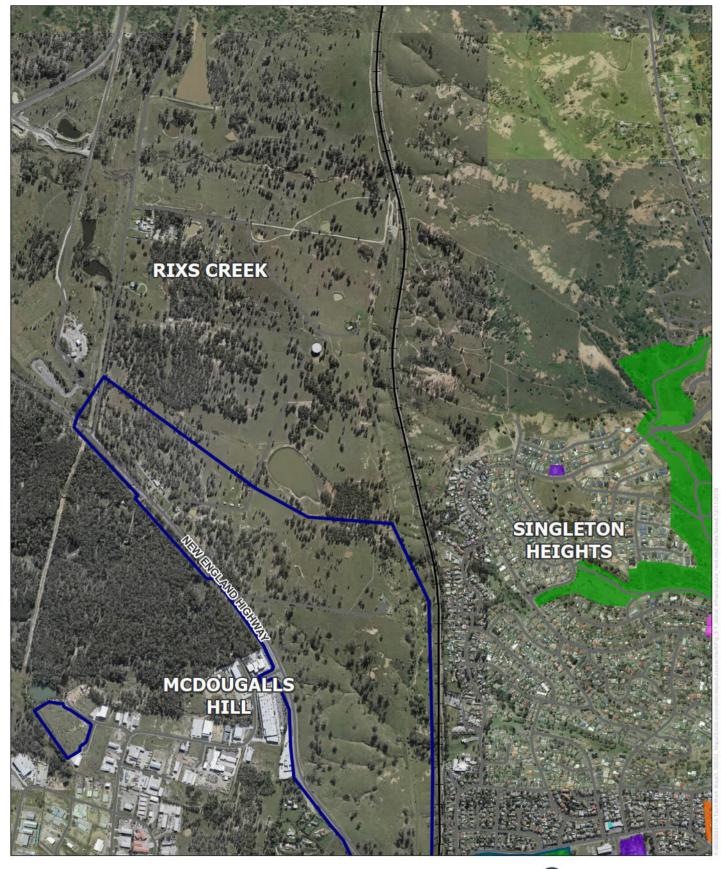
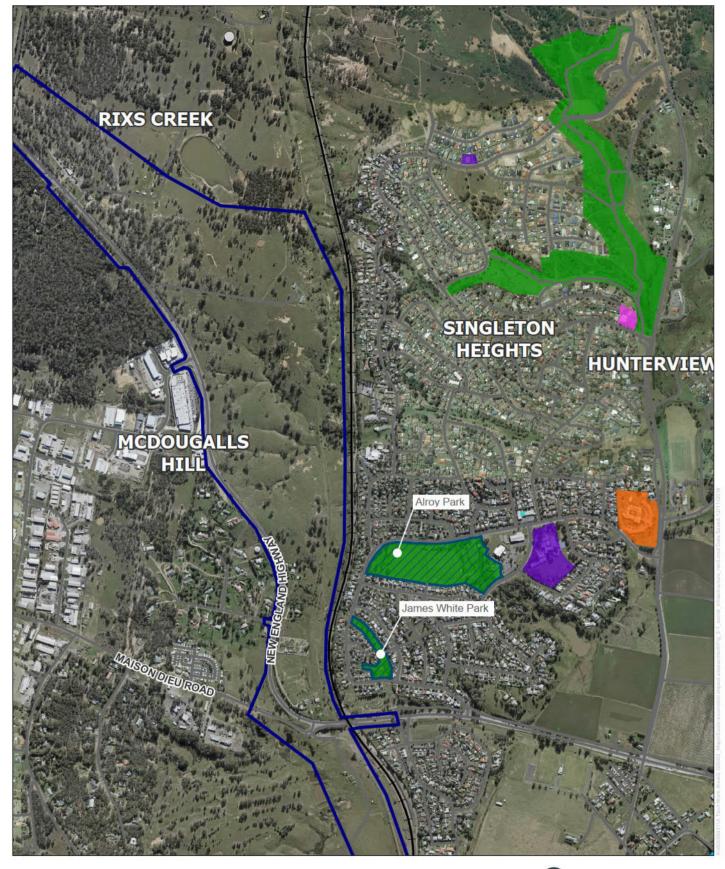


FIG. 6-38 SOCIAL INFRASTRUCTURE SURROUNDING THE PROPOSAL AREA (1 of 5)









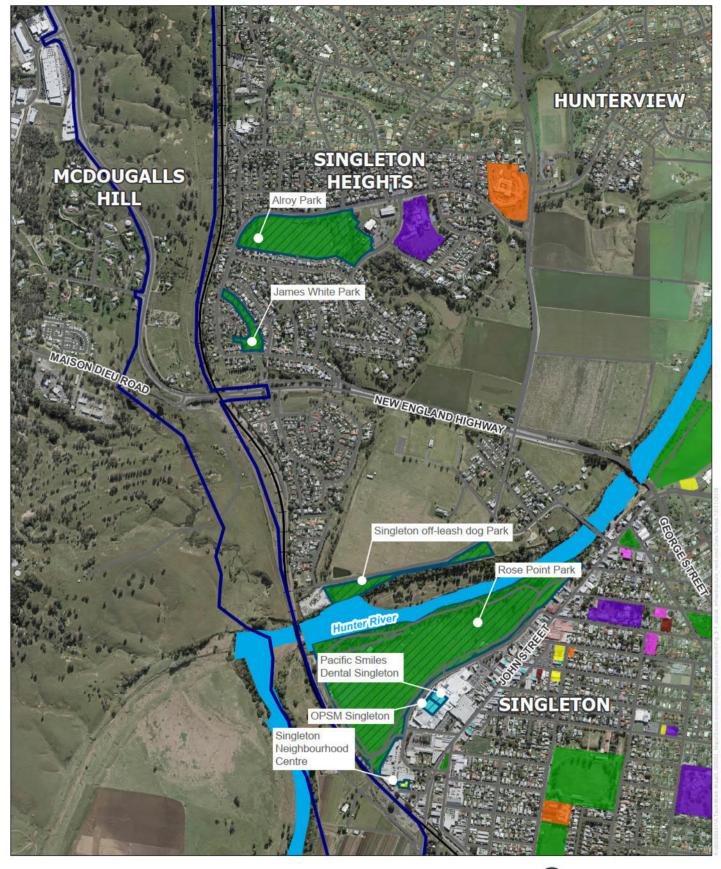
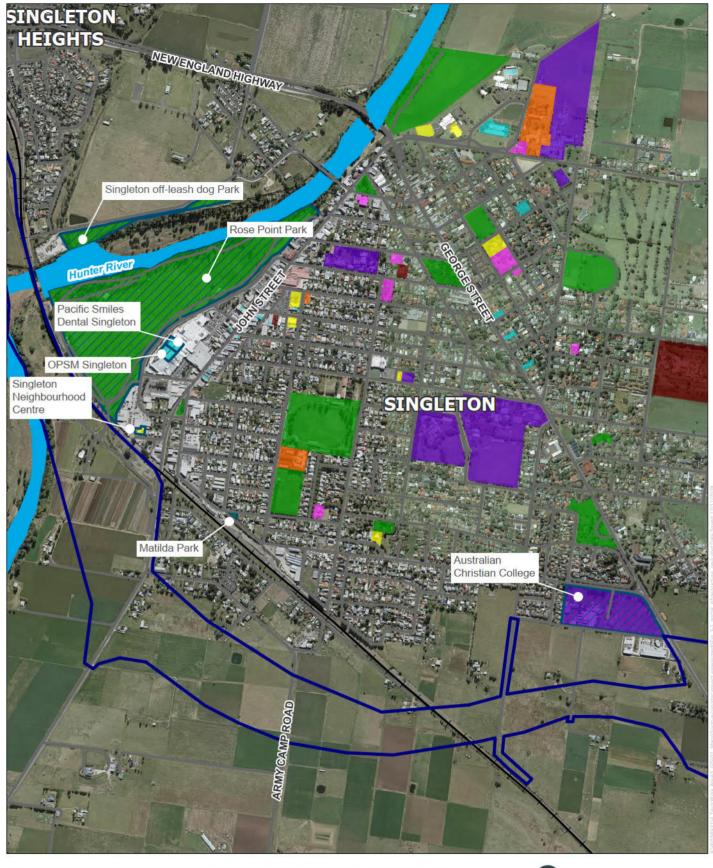


FIG. 6-40 SOCIAL INFRASTRUCTURE SURROUNDING THE PROPOSAL AREA (3 of 5)









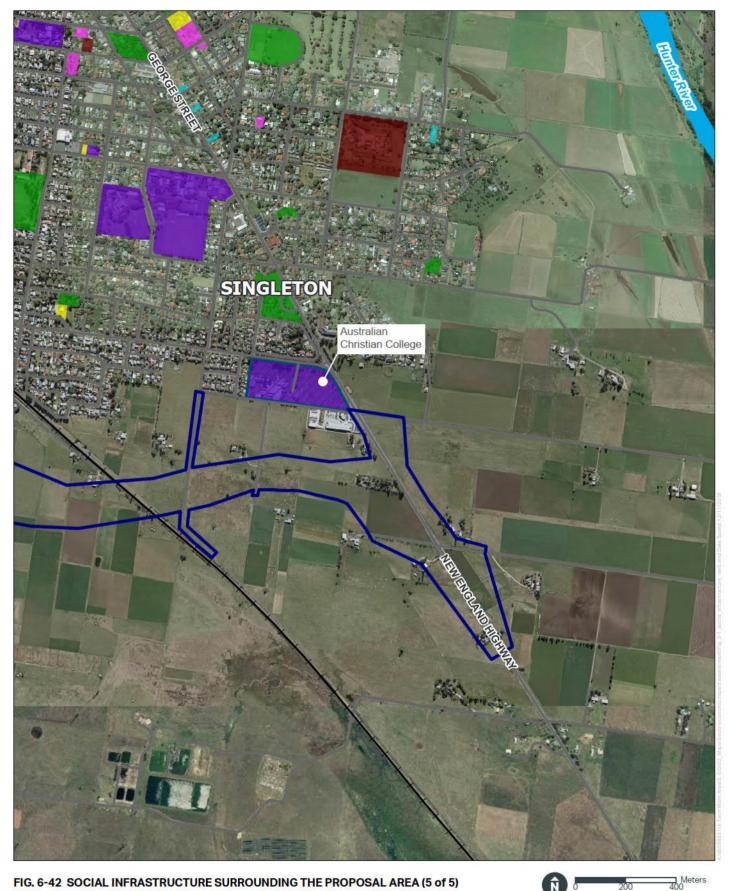


FIG. 6-42 SOCIAL INFRASTRUCTURE SURROUNDING THE PROPOSAL AREA (5 of 5)

Sport and recreation



Legend **Proposal features** Social infrastructure Proposal area Aged care facility Other features Community facility Railway line Educational facility Roads **Emergency Services** Watercourse Medical facility Places of worship

Within 400m of the proposal area

6.12.3 Potential impacts

Construction

Property impacts, including details of property acquisitions and temporary occupation of land for ancillary facilities are discussed in Section 6.11. This section assesses the socio-economic implications of property impacts. Long term impacts to properties are discussed in the section below as operational impacts.

Amenity

Amenity refers to the quality of a place, its appearance, feel and sound, and the way its community experiences the place. Construction of the proposal may impact the local amenity of the area temporarily. This would primarily relate to increases in noise and air emissions, changed traffic conditions and access arrangements, additional traffic on roads and changes to views. These potential impacts have been addressed in other sections of this REF as follows:

- Traffic and transport (refer to Section 6.5)
- Noise and vibration (refer to Section 6.6)
- Air quality (refer to Section 6.9)
- Landscape character and visual amenity (Refer to Section 6.10).

Amenity impacts would be temporary and managed with measures identified as part of REF sections referenced above.

The significance assessment for these impacts is summarised in Table 6-55

Table 6-55 Summary of significance assessment for amenity impacts during construction

Impact	Magnitude of impact	Sensitivity of receivers	Significance
Traffic and transport	Low	Low	Low
Noise and vibration	Moderate	Moderate	Moderate
Air quality	Moderate	Moderate	Moderate
Visual amenity	Low	Moderate	Moderate-low

Impacts to community values

A summary of the assessment of impacts to community values during the construction of the proposal is provided in Table 6-56 and a summary of the significance assessment of these impacts is provided in Table 6-57.

Table 6-56 Assessment of impacts to community values

Value	Assessment
A creative, vibrant, inclusive, safe and healthy community	The proposal area is generally located outside of the township of Singleton and so is unlikely to directly impact the ability of the community to be creative, vibrant, inclusive, safe and healthy. Potential impacts would be limited to indirect amenity impacts which may temporarily impact places or events where these values are demonstrated.

Value	Assessment
Resilient, informed, connected and engaged people	An increase in construction activity has the potential to reduce the amenity and accessibility of impacted areas. The construction of the proposal may also test the resilience of Singleton, however these impacts would be temporary and mitigated appropriately.
Well planned, sustainable, vibrant and accessible places	Potential impacts would be limited to indirect amenity impacts which may temporarily impact social infrastructure or other places within proximity of the proposal area. Construction of the proposal is not anticipated to impact public transport during the construction period. Public transport services would continue to be available to the community.
A sustainable environment	Potential impacts to the environment and sustainability are assessed throughout this REF and safeguards and management measures are recommended to manage potential impacts.
An innovative, sustainable and diverse economy.	The proposal would provide economic benefits through infrastructure investment and direct expenditure associated with on-site construction activities within the local study area. However, potential impacts to local businesses as a result of changes in traffic, access, parking and amenity

Table 6-57 Summary of significance assessment for impacts to community values during construction

Impact	Magnitude of impact	Sensitivity of receivers	Significance
Community values	Low	High	Moderate

Business impacts

The proposal has the potential to impact local businesses as a result of temporary increases in travel times and impacts to local amenity.

The construction of the proposal would allow existing traffic arrangements to continue. Construction worker expenditure during the construction period would benefit local services, such as cafes and takeaways, service stations, trades and services suppliers and potentially some accommodation providers. Temporary changes to speed limits would be limited to the New England Highway and Putty Road, outside of the town centre. Given the limited changes to speed limits and that existing traffic arrangements would continue, the impacts to access and travel time for deliveries and employees travelling to work is considered to be minor.

Additional construction vehicles on the local road network, construction ancillary facilities and construction activities would affect the amenity of the environment surrounding the local businesses.

Most businesses in the local area are located in the town of Singleton and would only experience minor impacts to amenity. The construction of the proposal has the potential to affect the amenity particularly around construction compounds and other construction locations. Potential impacts to amenity would primarily be associated with businesses located in proximity to the proposal around Waterworks Lane and Putty Road where construction works would be closest to the town centre.

The significance assessment for these impacts is summarised in Table 6-58.

Table 6-58 Summary of significance assessment for business impacts during construction

Impact	Magnitude of impact	Sensitivity of receivers	Significance
Access and travel time	Low	Low	Low
Business amenity	Moderate	Moderate	Moderate

Impacts to agriculture

Where the proposal requires acquisition of agricultural land, it has the potential to affect the economic productivity of agricultural businesses. The proposal would only occupy about 0.006 per cent of land used for agricultural purposes within the Singleton LGA and therefore the impact to the agricultural sector within Singleton would be minor. The impact to agricultural land use as a result of land fragmentation is discussed in the sections below.

The significance assessment for this impact is summarised in Table 6-59.

Table 6-59 Summary of significance assessment for agriculture during construction

Impact	Magnitude of impact	Sensitivity of receivers	Significance
To agricultural land	Low	Low	Low

Economic impacts

The economic benefit of construction is multi-dimensional, including:

- Increased expenditure at local and regional businesses through purchases by construction workers
- Direct employment through on-site construction activities
- Direct expenditure associated with on-site construction activities
- Indirect employment and expenditure through the provision of goods and services required for construction.

Construction of the proposal would provide increased local employment opportunities, which would subsequently inject additional revenue into the local economy. This however should be considered in the context of the potential adverse impacts to local business as described above.

Operation

Property acquisition

The proposal would require the acquisition of agricultural land within the proposal area. Acquisition would result in the fragmentation of eight properties, which are primarily agricultural properties. Acquisition and associated land fragmentation has the potential to impact on agricultural operations and ongoing use of the land.

Potential impacts include:

- Reduction in the total agricultural land available to landholders
- The ability of landowners to move livestock or agricultural equipment to fragmented areas of their property that is otherwise not directly impacted by the proposal
- Changes to the lives of those affected by acquisition giving rise to a sense of anxiety or uncertainty, a
 loss of amenity, financial costs and isolation.

Where possible, impacts to agricultural land have been minimised through the options selection and design of the proposal. Property acquisition required for the proposal is described in Section 6.11.2.

Roads and Maritime would consult with the affected landowners regarding potential impacts associated with land fragmentation, including the need for provision of alternate access where required. All land subject to fragmentation impacts with the exception of one is located in the southern section of the proposal. At this location potential fragmentation impacts could be reduced by providing access under the proposal, which is a bridge.

The full or partial acquisition of land may result in major changes to the lives of those affected giving rise to a sense of anxiety or uncertainty, a loss of amenity, financial costs and isolation. Owners may experience health and emotional effects if required to sell their property and relocate as a result of the proposal. These effects may also be experienced by owners facing reduced viability of their property due to severance. Acquisition has the potential to affect people with a deep connection to their property, which may have been in the family for generations. In some instances, it may be difficult to find another property with equivalent facilities and amenity to that being acquired. Property acquisition may result in the fragmentation of social networks and interaction as people move away from friends and family.

To date eight property owners have applied for hardship acquisition. Six of these applications have been settled. Roads and Maritime are carefully assessing the outstanding two cases on their merits.

The significance assessment for these impacts is summarised in Table 6-60.

Table 6-60 Summary of significance assessment for property acquisition impacts

Impact	Magnitude of impact	Sensitivity of receivers	Significance
Property acquisition – land use	Moderate	Moderate	Moderate
Property acquisition – community wellbeing	Moderate	High	High-moderate

Amenity

Amenity within Singleton would be expected to improve as a result of the proposal. Removing a large proportion of traffic (especially heavy vehicles) from Singleton would improve amenity in the vicinity of John Street and George Street by reducing traffic congestion, noise levels and improving air quality and pedestrian safety. This is supported by case studies of towns identified above that have been bypassed. When heavy vehicles in particular have been removed from a town, the result has been the universal improvement in amenity and lifestyle quality for the town concerned. A review of these case studies is in Table 4-1 of Appendix D.

Operation of the proposal may impact the local amenity of the area. This would primarily relate to amenity impacts from road traffic noise, changed traffic patterns and visual impacts where views of the pastoral and wider landscape may be obstructed by the road infrastructure. These potential impacts have been addressed in this REF as follows:

- Traffic and transport (refer to Section 6.5)
- Noise and vibration (refer to Section 6.6)
- Landscape character and visual amenity (Refer to Section 6.10).

Amenity impacts would be appropriately managed with the relevant safeguards provided in each section above.

The significance assessment for these impacts is summarised in Table 6-61.

Table 6-61 Summary of significance assessment for amenity impacts during operation

Impact	Magnitude of impact	Sensitivity of receivers	Significance
Traffic and transport	Low	Low	Low
Noise and vibration	Moderate	Moderate	Moderate
Visual amenity	High	High	High

Social infrastructure

Road traffic noise would generally have a negligible effect on social infrastructure.

Impacts to air quality would generally be negligible given high existing background air quality levels. Views to the proposal from social infrastructure in Singleton are generally obscured by surrounding properties and so visual impacts would be negligible. There would be no change to parking as a result of the proposal, and access to social infrastructure would either be improved by the proposal or would not be impacted.

Specific amenity impacts to social infrastructure are described in detail in Appendix D.

The significance assessment for these impacts is summarised in Table 6-62.

Table 6-62 Summary of significance assessment for amenity impacts during operation for social infrastructure

Impact	Magnitude of impact	Sensitivity of receivers	Significance
Educational, health and community service facilities	Moderate	Moderate	Moderate

Business impacts

Studies of other highway bypass impacts in NSW identify that the most affected businesses are those directly serving the needs of the motorists. These include motor vehicle services, particularly service stations, food and beverage outlets, and accommodation establishments (to a lesser extent).

The stopper surveys for the proposal identified that around 43 per cent of stoppers visit food/beverage businesses during their stop in Singleton. Around a quarter of stoppers (24 per cent) do not visit any business in town, while 13 per cent buy fuel during the stop in Singleton. Seven per cent visit retail businesses and a further 13 per cent, other services.

Business owners may be considerably uncertain about the extent of impact the proposal would have on through traffic and trade. While the above analysis indicates that some businesses would experience a decrease in turnover and reduced employment at least in the short term, evidence from bypassed towns indicates that some highway dependent businesses have been able to reposition themselves and become sustainable in the longer term. Singleton has a diverse economy with employment and business opportunities in a range of industry sectors such as mining, defence, agriculture, education and health services. These economic activities are likely to continue to draw visitors to town who would create ongoing demand for goods and services provided by businesses in Singleton including those along John Street and George Street.

A general reduction in traffic is anticipated along George Street and John Street which would potentially benefit businesses in these locations through generally improved amenity and improved delivery and dispatch efficiency. Increased accessibility and connectivity has the potential to reduce delivery times,

increase delivery reliability and reduce transport costs for businesses. Access for customers travelling to business premises in the area would also be improved as a result of better links to other areas within the Hunter Valley.

The significance assessment for impacts to passing trade is summarised in Table 6-58. Other impacts to businesses would be positive impacts, as described above.

Table 6-63 Summary of significance assessment for business impacts during operation

Impact	Magnitude of impact	Sensitivity of receivers	Significance
Passing trade	Moderate	Moderate	Moderate

Economic impacts

The NSW Government has committed \$92 million towards the proposal under the Rebuilding NSW Plan and allocated \$2.7 million in 2019-2020 to continue development of the proposal (Roads and Maritime, 2019). The operation of the proposal would generate long term benefits through improved economic connectivity and freight efficiency as described below.

The proposal would improve transport connections, reducing commuting time and lowering vehicle operating costs between employment and tourist destinations. This section of the New England Highway is a major transport artery for freight travelling between the Port of Newcastle and the Hunter Valley and has supported the significant growth in transportation for coal and agricultural industries and employment in NSW.

The freight industry is an important part of the NSW economy as an enabler of economic activity, contributing an estimated \$66 billion to NSW State Gross Product (GSP). The proposal is anticipated to remove up to 1500 vehicles per hour (two-way) from the New England Highway through the Singleton town centre. Improvements in the efficiency and reliability of these transport networks would likely result in increased productivity, reduced costs and broader economic benefits for the freight industry and other workforces.

6.12.4 Safeguards and management measures

Mitigation measures provided in Table 6-13 would be implemented to minimise potential land use and property impacts. Measures to manage potential amenity impacts are described in the relevant sections of this REF.

Table 6-64 Summary of mitigation measures to minimise impacts to land use and property

Impact	Environmental safeguards	Responsibility	Timing
Social and economic	 Landowner surveys will be carried out to: Gather information about the current use and activities carried out on their property Identify how the proposal would affect ongoing land use and activities on their property Inform the development of appropriate mitigation measures. 	Roads and Maritime	Detailed design
Social and economic	A Communication Plan (CP) will be prepared and implemented as part of the CEMP to ensure provision of timely and accurate information to the community during	Roads and Maritime / construction contractor	Detailed design and constructio n

Impact	Environmental safeguards	Responsibility	Timing
	construction. The CP will include (as a minimum):		
	 Mechanisms to provide details and timing of proposed activities to affected residents, including changed traffic and access conditions 		
	Contact name and number for complaints		
	 How the project webpage will be maintained for the duration of the proposal. 		
	Minimum consultation activities to be carried out		
	A complaints handling procedure.		
Social and economic	 Roads and Maritime will develop a signage strategy for the entrances to Singleton, in consultation with Singleton Council to encourage motorists to visit Singleton. This will include signage showing: The travel distances and estimated times for travelling routes via the bypass compared to travelling via the Singleton town centre Services and facilities available within the Singleton township Any visitor attractions within the Singleton township 	Roads and Maritime	Detailed design
Social and economic	Roads and Maritime will engage with Singleton Council and local businesses regarding the progress of the proposal to allow businesses time to prepare for changed traffic conditions through the town.	Roads and Maritime	Detailed design and constructio n

6.13 Resource use and waste management

6.13.1 Methodology

A qualitative assessment of potential resource use and waste management has been carried out for the proposal. Various waste and resource streams would be generated during the construction and operational phases of the proposal.

6.13.2 Existing environment

Existing waste streams within the proposal area are limited to private household and agricultural waste as well as roadside litter and other waste material associated with roadside maintenance.

6.13.3 Potential impacts

Construction

Resource use

The proposal will require the use of a number of resources which include (but is not limited to):

- Resources associated with the operation of construction vehicles and machinery, such as diesel and petrol
- Material required for drainage construction, road surface construction and bridgework including road base, asphalt, spray seal, sand, concrete and aggregate
- Materials for earthworks, such as topsoil, mulch, general fill and select fill
- Materials required for road signage, linemarking, roadside barriers and guide posts
- Construction water (for concrete mixing and dust suppression).

The initial estimated source and quantities for these materials are outlined in Section 3.3.5. The materials required for construction of the proposal are not currently limited in availability, however any non-renewable materials would be used conservatively.

The reuse of waste on-site would assist in minimising resources required for construction. Where possible, excavated spoil would be re-used again onsite in construction and landscaping activities. Excess spoil, not suitable for reuse, would be disposed of in accordance with safeguards and mitigation measures outlined below in Section 6.13.4.

Roads and Maritime contractors are required to use recycled-content materials where they are cost and performance competitive and are the environmental equivalent (or better) than non-recycled alternatives as described in the *Roads and Maritime Environmental Sustainability Strategy 2019-2023*.

Waste management

The proposal has the potential to generate waste from the following activities:

- Vegetation removal (including native vegetation and noxious weeds)
- Earthworks
- Utility adjustments
- Removal of the existing pavement

Demolition of structures.

Waste streams likely to be generated during construction of the proposal include:

- Excess spoil unsuitable for reuse
- Green waste as a result of vegetation clearing. Noxious weed material would be separated from native green waste
- Packaging and general waste from staff (lunch packaging, portable toilets etc)
- Chemicals and oils
- Waste water from wash-down and bunded areas
- Redundant erosion and sediment controls
- Asphalt waste from the removal of the existing pavement
- Potential asbestos and other hazardous waste.

Waste would be managed in accordance with the guidance in the *Re-use of waste off-site:* Waste Fact Sheet 9 which identifies potential off-site reuses for typical wastes and the *Management of Wastes on Roads and Maritime Services Land* procedure which includes best practice and contingency planning for construction wastes on sites.

Surplus or contaminated material would be classified and disposed of at a licensed waste facility in accordance with EPA Waste Classification Guidelines (EPA, 2014) or reused in accordance with EPA resources recovery orders and exemptions. Transport and disposal of contaminated and hazardous waste would be carried out in accordance with the Protection of the Environment Operations (Waste) Regulation 2014 which includes notification and tracking requirements.

Operation

It is anticipated that waste volumes during the operation of the proposal would be comparable to existing waste volumes within the proposal area.

Roads and Maritime is committed to ensuring responsible management of unavoidable waste and to promoting the reuse of such waste through appropriate measures in accordance with the resource management hierarchy principles embodied in the *Waste Avoidance and Resource Recovery Act 2001* (WARR Act 2001). The resource management hierarchy principles in order of priority as outlined in the WARR Act are:

- Avoidance of unnecessary resource consumption
- Resource recovery (including reuse, reprocessing, recycling and energy recovery)
- Disposal.

By adopting the above principles, Roads and Maritime encourages the most efficient use of resources and reduces cost and environmental harm in accordance with the principles of ecologically sustainable development.

Construction and operational waste impacts would be managed in accordance with the waste hierarchy as detailed in Section 6.13.3.

6.13.4 Safeguards and management measures

Mitigation measures provided in Table 6-65 would be implemented to minimise potential resource use and waste impacts.

Table 6-65: Summary of mitigation measures to minimise potential resource use and waste impacts

Impact	Environmental safeguards	Responsibility	Timing
Resource use	Use of recycled-content materials would be considered during the detailed design.	Roads and Maritime	Detailed Design
Construction waste	A Waste Management Plan (WMP) will be prepared and implemented as part of the CEMP. The WMP will provide specific guidance on measures and controls to be implemented to support minimising the amount of waste produced and appropriately handle and dispose of unavoidable waste.	Construction contractor	Pre- construction and construction
	 The WMP will include, but not necessarily be limited to: Measures to avoid and minimise waste associated with the project. 		
	 Classification of wastes generated by the project and management options (re-use, recycle, stockpile, disposal). 		
	 Classification of wastes received from off-site for use in the project and management options. 		
	 Identifying any statutory approvals required for managing both on and off-site waste, or application of any relevant resource recovery exemptions. 		
	Procedures for storage, transport and disposal.		
	 Monitoring, record keeping and reporting, including any documentation management obligations arising from resource recovery exemptions. 		
	The WMP would be prepared taking into account the Roads and Maritime Environmental Procedure – Management of Wastes on Roads and Maritime Services Land and relevant Roads and Maritime Waste Fact Sheets.		
Construction waste	 The following resource management hierarchy principles will be followed: Avoid unnecessary resource consumption as a priority. 	Construction contractor	Pre- construction and construction
	 Avoidance will be followed by resource recovery (including reuse of materials, reprocessing, and recycling and energy recovery). Disposal will be a last resort (in accordance with the 		
	Waste Avoidance and Resource Recovery Act 2001).		

6.14Climate change

6.14.1 Methodology

Climate change has the potential to both impact on the proposal through changes to weather events, and be impacted by the proposal through the emission of greenhouse gases (GHG) which contribute to climate change.

The impact of the proposal on climate change has been considered in a qualitative assessment guided by the emissions scopes described below and by considering the likely construction methods, materials, and maintenance activities.

The impact of climate change on the proposal has been reviewed in consideration of the existing climate conditions and forecast climate conditions. Forecast climate conditions were taken from the Hunter Climate change snapshot of the NSW and Australian Capital Territory (ACT) Regional Climate Modelling (NARCliM) project in collaboration with Environment, Energy and Science Group, DPIE.

GHG have been categorised into scopes which relate to whether they were a direct or indirect emission and their origin. There are three scopes of GHG emissions:

- **Scope 1**: GHG emissions released directly from on-site activities associated with the proposal, such as the combustion of fossil fuels in vehicles and motors and from the removal of vegetation
- **Scope 2**: GHG emissions released indirectly from an off-site activity, for example the generation of electricity which is used during the construction and operation of the proposal
- Scope 3: GHG emissions released indirectly as a result of acquiring and disposing of materials for the
 proposal, for example the combustion of fossil fuels to transport building materials to a construction site
 and the consequent break down of building wastes such as vegetation and wood releasing carbon
 dioxide emissions in the decay process.

6.14.2 Existing environment

The existing climate within the Singleton area is characterised by hot, humid summers and mild to cool winters with considerably more intense rainfall in the summer months. Average maximum and minimum temperatures and average rainfall for the Hunter region are provided in Table 6-66.

Based on the climate change projections from the NARCliM project, the Hunter is expected to experience an increase in all temperature variables (average, maximum and minimum) for the near and far future (OEH, 2014). Rainfall is projected to decrease in the period between 2020 and 2039 in spring and winter and to increase in autumn (OEH, 2014). The projections are shown in Table 6-66 alongside the existing environment.

In general, the climate in Singleton is expected to become hotter and drier which is likely to result in more intense storms, floods, droughts and bushfire events.

Table 6-66: Existing and forecast climate at Singleton

Climate Variable	Existing	Projected increase or decrease	
		2020-2039 (Near Future)	2060-2079 (Far Future)
Average maximum temperatures	25.2°C	0.7°C	2.0°C
Average minimum temperatures	10.9°C	0.7°C	2.1°C

Climate Variable	Existing	Projected incre	ease or decrease
Average rainfall (Summer)	192.5mm	-5 to 0%	10 to 20%
Average rainfall (Autumn)	152.7mm	10 to 20%	10 to 20%
Average rainfall (Winter)	119.1mm	-5 to 0%	-5 to 0%
Average rainfall (Spring)	158.6mm	-5 to 0%	0 to 5%

6.14.3 Potential impacts

Construction

Impact of the proposal on climate change

The likely sources of GHG emissions during construction of the proposal are listed in Table 6-67.

While measures would be carried out where possible to reduce GHG emissions, most of the emissions would be largely unavoidable. Therefore the proposal would contribute to climate change. However, the volume of GHG emissions would be negligible on a national and global scale and the proposal is anticipated to have a negligible impact on climate change during construction.

Table 6-67: Likely GHG emissions during the construction of the proposal

GHG sources	Details	Assessment		
Scope 1 emission	ons			
Construction equipment	GHGs would be generated from fossil fuel combustion in plant, equipment and vehicles used for construction activities.	Construction activities would be planned to minimise movements on-site and use lower emission equipment, however GHG emissions related to construction activities would be unavoidable.		
Generator use	Generators may be required during construction. This would create GHG emissions through the combustion of diesel or other fossil fuels.	The use of generators would be limited to circumstances that would reduce the overall length of the construction program, for example to power lights during night works or to power equipment prior to connection to the local power supply. By reducing the overall length of construction, other sources of emissions would be reduced.		
Vegetation removal	Around 32.1 hectares of vegetation would need to be cleared to accommodate the proposal.	The proposal has been designed to minimise the amount of vegetation clearing that would otherwise release stored carbon and reduce the ongoing GHG retention within vegetated areas.		
Scope 2 emission	ons			
Electricity	It is expected that a small amount of electricity would be required during construction, which would be associated with power for the on-site construction buildings and worker facilities.	Electricity would be purchased from the grid, which largely comprises electricity generated from fossil fuels.		

GHG sources	Details	Assessment
Scope 3 emissions		
Construction materials	Extraction and production of materials used for construction of the proposal, such as concrete, steel, road base, pipes, cables, conduits and other materials would result in GHG emissions.	Recycled materials or materials left over from other projects would be used where possible, however GHG emissions related to the production of materials would be unavoidable.
Construction waste	The mulching of cleared vegetation would result in increased GHG emissions, as the breakdown of organic matter to waste material directly releases stored carbon dioxide to the atmosphere.	GHG emissions related to the processing of construction waste would be unavoidable.
Construction transport	GHGs would be generated by staff travelling to and from the construction site and by any transportation related to the movement of construction materials, equipment or plant to the proposal area.	Construction staging would be developed to minimise haulage and other construction vehicle movements, however GHG emissions would be unavoidable.

Impact of climate change on the proposal

Climate change projections for the near future represent an average of projections for the period of 2020 to 2039 (refer to Table 6-66). Although construction timeframes are unknown, the near future projections are considered to be relevant to the proposal.

Construction of the proposal may be susceptible to climate change impacts, including changes in frequency of temperature extremes, and frequency and intensity of rainfall events. The potential impacts associated with these changes include:

- Effect of extreme temperatures on the health and safety of construction workers
- Delays in expected timeframes as a result of weather including rainfall and flooding events
- Increase in risk of erosion and sedimentation, and other environmental impacts from extreme rainfall and flooding.

Operation

Impact of the proposal on climate change

The likely sources of GHG emissions during the operation of the proposal are listed in Table 6-68.

Table 6-68: Likely GHG emissions during the operation of the proposal

GHG sources	Details	Assessment
Scope 2 emission	ons	
Electricity	Electricity would be required during the operation of the proposal for lighting at new intersections.	Electricity would be purchased from the grid, which largely comprises electricity generated from fossil fuels. Lighting would only be installed at the proposal's connections and not along the entire alignment, minimising electricity use.

GHG sources	Details	Assessment				
Scope 3 emission	Scope 3 emissions					
Traffic	The proposal is not expected to increase traffic volumes, therefore there is not anticipated to be an increase in vehicle emissions as a result of the proposal. The proposal would cater for a projected growth in traffic volumes which would occur independent of the proposal.	The proposal would enable traffic to continue at a more consistent speed rather than slowing and increasing speed when travelling through the town of Singleton. This would result in a more efficient use of fuel.				

Impact of climate change on the proposal

Climate and weather can have an impact on the road surface and the safety of a road. The biggest influences on road surface are moisture and temperature, both of which can lead to faster rates of deterioration.

As rainfall decreases overall, the rate of moisture related road surface deterioration should slow (Austroads, 2004). However this could be offset by an increase in ambient temperatures, which may accelerate the rate of deterioration of any seal binders. Drier conditions may also cause pavements to age more quickly due to oxidation and embrittlement (Austroads, 2004). However, these effects are expected to be minor over time and in combination with the Roads and Maritime maintenance regime are likely to have a negligible impact.

More intense rainfall and flooding events could put pressure on the culverts and open drainage channels which serve to keep the road dry. The proposal has been designed in accordance with the Australian Rainfall and Runoff Guideline to achieve a flood immunity for the 1 in 100 year flood event for bridge structures and a flood immunity against the 1 in 20 year event for the approach roads.

6.14.4 Safeguards and management measures

Mitigation measures provided in Table 6-13 would be implemented to minimise potential land use and property impacts.

Table 6-69: Summary of mitigation measures to minimise climate changes impacts

Impact	Environmental Safeguard	Responsibility	Timing
Climate change	Construction equipment, plant and vehicles will be appropriately sized for the task, serviced frequently and will not be left idling when not in use.	Construction	Construction

6.15Hazard and risk

6.15.1 Existing environment

Existing hazards and risks in the vicinity of the proposal are generally associated with the operation of the existing road network and the Main North rail line and flooding hazards arising from the Hunter River.

6.15.2 Potential impacts

Construction

Hazards and risks relating to the construction of the proposal would include:

- Spills or leakage of contaminants such as fuels, chemicals and hazardous substances entering surface and groundwater or contaminating soils
- Discharge of turbid run-off, resulting in pollution of waterways
- Encountering unexpected utilities or contaminated material during earthworks
- Spread of noxious weeds
- Flooding during extreme rain events
- Fire from offsite or caused as a result of construction activities such as hot works
- Changed traffic conditions leading to incidents.

These potential impacts have been addressed in other sections of this REF, including:

- Biodiversity (refer to Section 6.1)
- Surface water, hydrology and flooding (refer to Section 6.2)
- Groundwater (refer to Section 0)
- Soils and contamination (refer to Section 6.4)
- Traffic and transport (refer to Section 0)
- Resource use and waste management (refer to Section 6.13).

In relation to fires during construction these would be managed by a ban on fire being lit as part of the construction works or offsite fire risk managed by adjoining landowners and the Rural Fire Service.

Construction risks would be temporary and managed with the relevant safeguards and management measures outlined in the sections referenced above.

Operation

Operational hazards and risks relating to the proposal could include:

- Fuel and oil spills during maintenance activities or vehicle incidents polluting the natural environment
- Vehicle incidents
- Flooding. Despite the design of the proposal providing flood immunity for the 1 in 100 year flood event
 for bridges structures and 1 in 20 year flood event for approach roads access to the proposal may be
 impacted during flooding. For example inundation of Putty Road near the Putty Road connection access
 ramps.

Fuel and oil spills during operation are discussed in Section 6.2. Vehicle crashes are an inherent aspect of the operation of any road. During the design of the proposal, Roads and Maritime has applied the requirements of all relevant standards as listed in Section 3.2.1.

6.15.3 Safeguards and management measures

Mitigation measures provided in Table 6-70 would be implemented to ensure potential hazards and risks are minimised.

Table 6-70: Summary of mitigation measures to manage hazards and risk

Impact	Environmental Safeguard	Responsibility	Timing
Hazard and risk	Emergency response plans will be incorporated into the construction environmental management plan.	Construction contractor	Pre- construction and construction
Hazard and risk	 A Hazard and Risk Management Plan will be prepared and implemented as part of the CEMP. The Plan will identify: Details of hazards and risks associated with the activity Measures to be implemented during construction to minimise these risks Record keeping arrangements, including information on the materials present on the site, material safety data sheets, and personnel trained and authorised to use such materials A monitoring program to assess performance in managing the identified risks, including "equipment checking and maintenance requirements Contingency measures to be implemented in the event of unexpected hazards or risks arising, including emergency situations." 	Construction contractor	Pre-construction and construction

6.16Cumulative impacts

6.16.1 Methodology

Cumulative impacts could be experienced if construction or operation of the proposal coincides with construction or operation of other local development, such as other road upgrades, public work or private development.

A desktop review of the major project register on the Department of Planning, Industry and Environment website completed on 10 August 2019 identified major projects within the Singleton LGA which have the potential to contribute to cumulative impacts with the proposal. These projects are listed in Table 6-71.

Table 6-71: Major projects within the potential to contribute to cumulative impacts with the proposal (major projects register)

Project	Description	Status and timing	Distance from the proposal
New England Highway Upgrade between Belford and the Golden Highway	 This project proposes to upgrade the last section of road between Newcastle and Belford to a four-lane divided road. The project involves: Provision of dual carriage way in both directions. Replacement of the existing right turn movement from the Golden Highway to the New England Highway with a right turn flyover. The establishment of a road corridor for future development of the New England Highway towards Singleton. 	Detailed design stage Timing not confirmed	8km to the south-east
Muswellbrook Bypass – New England Highway	This project proposes to construct a bypass off the New England Highway around the township of Muswellbrook. A preferred corridor has been preserved within the Muswellbrook LGA. A preferred route the corridor has not yet been identified.	Options assessment stage (not approved). Timing not confirmed.	30km to the north
United Wambo Open Cut Coal Mine	 The project involves merging the existing open cut operations at Wambo and establishing an open cut mine at United Collieries. The project is expected to produce up to 10 million tonnes of run-of-mine coal. Other parts of the project include: Relocating a two kilometre stretch of the Golden Highway Relocating a section of 330 kilovolt and 660 kilovolt transmissions lines to optimise coal recovery from the proposed open cut mine at 	Recommended for approval. Project to commence in 2020.	10 km to the west

Project	Description	Status and timing	Distance from the proposal
	United Collieries.		
Rix's Creek Continuation of Mining	 This project involves approval for the ongoing operation of the existing open cut mine and a small extension to the western boundary of the existing Mine Lease. The main components of this project are: Operation of the mine for 21 years from the date of approval Increasing production limits to a maximum of 4.5 million tonnes of run-of-mine coal Extension of open cut mining of Pit 3. 	Approved Projected to commence in 2020	Adjacent to the north of the proposal area

The Singleton Council website identifies Development Applications (DAs) recently determined within the LGA, including major developments and Council infrastructure maintenance work. Approved projects generally include upgrades to residential properties, residential subdivisions and Council water infrastructure upgrades that would have negligible cumulative impacts within the proposal.

Major projects identified on the Singleton Council website with the potential to contribute to cumulative impacts with the proposal are generally limited to the Singleton Town Centre – Stage 2 Upgrade project. The project includes:

- Enhancement of the gateways to the town centre
- New street lighting
- Undergrounding of power lines
- New landscaping and street furniture
- · Assessment of several intersections and potential upgrades
- Improvements in traffic safety
- Traffic and parking management
- Footpath improvement
- Improvements to pedestrian connectivity.

The project is at a concept design stage and there is no available information on when construction will commence.

6.16.2 Potential impacts

The timing for the construction of the proposal has not yet been confirmed. Therefore the extent of potential cumulative impacts can only be assessed in regards to project information and schedules available at time of publication.

Construction

Cumulative impacts could occur during the construction as a result of the proposal and other developments being carried out in parallel. The key cumulative impacts during construction could include:

- Increased construction vehicle traffic on local roads
- Cumulative air and noise impacts associated with multiple construction activities
- Temporary changes to visual amenity.

Potential cumulative impacts would be temporary and environmental safeguards and management measures would be implemented as appropriate.

The severity of potential cumulative impacts would vary between locations and would generally be dependent on the types of work being carried out, the timing and duration of the work relative to each other, the distance between the work and the receivers and sensitivity of the receiver. In relation to the identified mining projects these are ongoing operations or extension to existing mines which would have low potential to result in cumulative impacts. The nominated road projects may have the potential to cause cumulative construction traffic delays at other locations on the New England Highway if they are constructed at the same time as the proposal. Given that each of these road projects is at a different stage of design or development and that the proposal is not currently funded for construction there is a low potential for cumulative impacts to occur.

Operation

The proposal, combined with other approved and proposed road upgrade projects would result in cumulative traffic benefits on the New England Highway and surrounds through the increased capacity of the road network, improved traffic flow and journey times and improved road safety.

The proposal, combined with other approved and proposed road upgrade projects may contribute to a cumulative loss of rural and agricultural land, however impacts are anticipated to be minor.

The proposal would reduce the number of heavy vehicles travelling within the vicinity of the town centre. The proposal would therefore result in cumulative amenity benefits for the Singleton town centre when combined with renewal projects such as Singleton Town Centre – Stage 2 Upgrade project.

6.16.3 Safeguards and management measures

Measures identified in Section 7.2 would be suitable to manage potential cumulative impacts associated with the proposal.

7. Environmental management

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

7.1 Environmental management plans (or system)

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

A Construction Environmental Management Plan (CEMP) will be prepared to describe the safeguards and management measures identified. The CEMP will provide a framework for establishing how these measures will be implemented and who would be responsible for their implementation.

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

7.2 Summary of safeguards and management measures

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

Table 7-1: Summary of safeguards and management measures

No.	Impact	Environmental safeguards	Responsibility	Timing
GEN1	General - minimise environmental impacts during construction	A CEMP will be prepared and submitted for review and endorsement of the Roads and Maritime Environment Manager prior to commencement of the activity. As a minimum, the CEMP will include the following: • A Surface Water Management Plan (SWMP) • Any requirements associated with statutory approvals • Details of how the proposal will implement the safeguards outlined in the REF • Issue-specific environmental management plans • Roles and responsibilities • Communication requirements • Induction and training requirements • Procedures for monitoring and evaluating environmental performance, and for corrective action • Reporting requirements and record-keeping • Procedures for emergency and incident management • Procedures for audit and review.	Construction Contractor	Pre-construction/construction
B1	Biodiversity	A Flora and Fauna Management Plan will be prepared and implemented as part of the CEMP. It will address terrestrial and aquatic matters and will include, but not necessarily be limited to: (a) plans for the construction site and adjoining area showing native vegetation, flora and fauna habitat, threatened species and threatened ecological communities;	Construction contractor	Pre-construction and construction

No.	Impact	Environmental safeguards	Responsibility	Timing
		 (b) plans showing areas to be cleared and areas to be protected, including exclusion zones and protected habitat features (e.g. hollow-bearing trees), and areas for rehabilitation or re-establishment of native vegetation. The limits of clearing within the construction site and protected habitat features will be clearly delineated using appropriate signage, barriers, fencing or markings; (c) requirements set out in the Landscape Design Guideline (RMS 2018); (d) procedures addressing relevant matters specified in the Biodiversity Guidelines - Protecting and managing biodiversity on RTA projects (RTA 2011) including but not limited to: pre-clearing, including the outcomes of final flora and fauna species checks, establishment of exclusion zones and on-ground identification of specific habitat features to be retained (such as hollow-bearing trees) vegetation clearing and bushrock removal, including staged habitat removal and any specified seasonal limits on clearing activities fauna handling and unexpected threatened species finds rehabilitation, revegetation, re-use of soils, woody debris and bushrock, and other habitat management actions weed, pathogen and pest management procedures addressing relevant matters specified in the NSW DPI (Fisheries) Policy and guidelines for fish habitat conservation and management. (f) monitoring during construction and post-construction (g) adaptive management measures to be applied if monitoring indicates unexpected adverse impacts. 		
B2	Biodiversity	Measures to further avoid and minimise the construction footprint and native vegetation or habitat removal will be considered during the detailed design stage and implemented where practicable and feasible. Measures to avoid and minimise impacts should be prioritised in the following order: (a) critical habitat (b) threatened species, endangered ecological communities, groundwater dependent ecosystems or their habitat	Construction contractor	Pre-construction and construction

No.	Impact	Environmental safeguards	Responsibility	Timing
		 (c) native vegetation and habitat supporting flora and fauna connectivity and/or that supports other environmental objectives such as protecting water quality, hydrology or erosion and sediment controls (d) native vegetation of higher quality condition (e) other native vegetation. 		
B3	Biodiversity	Consistent with the Biodiversity Guidelines - Protecting and managing biodiversity on RTA projects (RTA 2011), and any specific requirements of the approved Flora and Fauna Management Plan, management arrangements will be implemented to ensure unavoidable vegetation and bushrock removal minimises biodiversity impacts as far as practicable. As a minimum that will include: (a) no vegetation clearing or bushrock removal beyond limits identified in this (b) avoiding identified exclusion zones and protected habitat features. (c) avoiding mixing of topsoil with woody debris materials (d) separation of woody vegetation suitable for re-use during construction and rehabilitation or revegetation works (e) implementation of staged clearing (f) trimming and pruning to be undertaken in accordance with relevant Australian Standards (g) in riparian zones: avoiding clearing during likely flood periods; ensuring cleared vegetation does not enter the waterway; installation of suitable sedimentation and erosion control; retaining roots and stumps to maintain bank stability; applying the hierarchy for snag management set out in the Guidelines.	Construction contractor	Pre-construction and construction
B4	Biodiversity	 Prior to the commencement of construction, carry out: Targeted surveys to confirm the presence of the following along the Hunter River and unnamed tributary to the north of the Hunter River within the area to be impacted by the proposal River red gum (<i>Eucalyptus camaldulensis</i>) (endangered population - BC Act) Hunter Floodplain Red Gum Woodland in the NSW North Coast and 		

No.	Impact	Environmental safeguards	Responsibility	Timing
		 Sydney Basin Bioregions (EEC – BC Act) Threatened flora survey, fauna habitat assessments and ground-truthing of vegetation mapping, between the Hunter River and the southern extent of the area surveyed by Umwelt (2019), north of the New England Highway near Gowrie Gates, within the area to be impacted by the proposal Ground truthing surveys of the regional vegetation mapping within the McDougalls Hill ancillary facility to confirm presence of: Central Hunter Ironbark – Spotted Gum – Grey Box Forest in the NSW North Coast and Sydney Basin Bioregions EEC (BC Act) Central Hunter Valley Eucalypt Forest and Woodland CEEC (EPBC Act) No clearing of threatened native vegetation is to be carried out within the McDougalls Hill ancillary facility. Subject to the outcomes of the above, a consistency review or environmental assessment may be required. 		
B5	Biodiversity	The unexpected species find procedure is to be followed under <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011) if threatened ecological communities, not assessed in the biodiversity assessment, are identified in the proposal site.	Construction contractor	Construction
B6	Biodiversity	A nest box strategy would be developed and implemented during the detailed design stage in accordance with <i>Guide 5: Re-use of woody debris and bushrock</i> and <i>Guide 8: Nest boxes of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011). The strategy is to include: (a) a trial of artificial hollow creations. (b) reinstallation of suitable hollows removed by the proposal. (c) Installation of nest boxes in the event that there are not sufficient. trees for artificial hollow creation and hollows for reinstallation.	Construction contractor	Detailed design
В7	Biodiversity	Prior to the commencement of construction, carry out monitoring to determine the presence of threatened microbats in the culverts that are part of the former Great Northern Railway.	Construction contractor	Pre-construction

No.	Impact	Environmental safeguards	Responsibility	Timing
		If threatened microbats are identified, collect the following information: (a) Species present. (b) Total number of individuals and groups per occupied roost site. (c) Description of occupied roost sites. (d) Breeding status of the colony, including approximate adult to juvenile ratios.		
B8	Biodiversity	If roosting threatened microbats are found during pre-construction monitoring, a Bat Management Plan is to be developed and implemented. The Bat Management Plan is to be prepared by a microbat specialist and include the following: (a) A monitoring program for both during and outside of breeding periods. (b) Details of construction activities to be monitored that may affect microbat habitat, particularly light, noise, vibration, alteration of drainage into culverts. (c) Mitigation measures to be implemented during construction, including regular inspections of impacts from sedimentation and weed encroachment to culvert entrances, consider timing and nature of immediately adjacent works in relation to known breeding period of relevant threatened microbats. (d) Adaptive management measures to be implemented if monitoring indicates a decline in bat numbers or if bats are observed leaving the roost during construction activities. (e) A process for evaluating the effectiveness of management measures.	Construction contractor	Pre-construction/ construction/ post construction
B9	Biodiversity	In accordance with Section 199 of the FM Act, Roads and Maritime would notify DPI Fisheries in writing of any proposed dredging or reclamation in the Hunter River and its tributary. Roads and Maritime would consider any matters raised by the Minister.	Roads and Maritime	Pre-construction
B10	Biodiversity	In accordance with Section 219 of the FM Act, Roads and Maritime would seek a permit from DPI Fisheries for any temporary blockage of fish passage. Roads and Maritime would consider any matters raised by the Minister.	Roads and Maritime	Pre-construction

No.	Impact	Environmental safeguards	Responsibility	Timing
B11	Biodiversity	Instream silt curtains would be implemented and maintained for construction in the Hunter River. Silt curtains would be installed such that they do not block fish passage.	Construction contractor	Construction
B12	Biodiversity	Changes to existing surface water flows would be minimised through detailed design. Any rock platform required to be constructed within the Hunter River bridge would be designed and constructed to prevent blocking the main river channel. The platform would be designed to ensure that flow of the main river channel and fish passage is maintained even during low flow periods. The Department of Primary Industry (DPI) would be consulted on the final design.	Construction contractor	Detailed design
B13	Biodiversity	A wildlife connectivity strategy would be finalised and implemented during the detailed design stage in accordance with the draft Roads and Maritime Wildlife Connectivity Guidelines (RMS 2011). The strategy is to focus on maintaining connectivity in the northern extent of the proposal and is to include, but not be limited to: (a) provision for a rope crossing with an indicative location between chainages 8450 and 8725 (b) identification of trees suitable for retention in the northern connection and tie in to facilitate glider crossings (c) consideration of additional gliding crossing structures where the width of disturbance is greater than 50 metres (d) type and extent of any associated landscaping or structures such as fencing or fauna infrastructure	Construction contractor	Detailed design
W1	Surface water and flooding	A Soil and Water Management Plan will be prepared in accordance with QA Specification G38 and implemented as part of the CEMP. The Plan will identify all reasonably foreseeable risks relating to soil erosion and water pollution associated with undertaking the activity, and describe how these risks will be managed and minimised during construction. That will include arrangements for managing pollution risks associated with spillage or contamination on the site and adjoining areas, and monitoring during and post-construction.	Construction Contractor	Pre-construction/ construction

No.	Impact	Environmental safeguards	Responsibility	Timing
W2	Surface water and flooding	 A flood response management plan will be prepared as part of the CEMP. The Flood Risk Management Plan will address, but not necessarily be limited to: Processes for monitoring and mitigation flood risk Steps to be taken in the event of a flood warning including removal or securing of loose material, equipment, fuels and chemicals. 	Construction contractor	Construction
W3	Surface water and flooding	A site specific Erosion and Sediment Control Plan(s) will be prepared and implemented and included in the Soil and Water Management Plan. The Plan(s) will identify detailed measures and controls to be applied to minimise erosion and sediment control risks including, but not necessarily limited to: runoff, diversion and drainage points; sediment basins and sumps; scour protection; stabilising disturbed areas as soon as possible, check dams, fencing and swales; and staged implementation arrangements. The Plan will also include arrangements for managing wet weather events, including monitoring of potential high risk events (such as storms) and specific controls and follow-up measures to be applied in the event of wet weather.	Construction Contractor	Construction
W4	Surface water and flooding	Stockpiles will be designed, established, operated and decommissioned in accordance with the RTA Stockpile Site Management Guideline 2011.	Construction Contractor	Construction
W5	Surface water and flooding	The rehabilitation of disturbed areas will be undertaken progressively as construction stages are completed, and in accordance with: Landcom's Managing Urban Stormwater: Soils and Construction series RTA Landscape Guideline RMS Guideline for Batter Stabilisation using Vegetation (2015).	Construction Contractor	Construction
W6	Surface water and flooding	Consistent with any specific requirements of the approved Soil and Water Management, control measures will be implemented to minimise risks associated with erosion and sedimentation and entry of materials to drainage lines and waterways. That will include, but not necessarily be limited to: • Sediment management devices, such as fencing, hay bales or sand bags • Measures to divert or capture and filter water prior to discharge, such as drainage channels and first flush and sediment basins • Scour protection and energy dissipaters at locations of high erosion risk • Installation of measures at work entry and exit points to minimise movement of	Construction Contractor	Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
		 material onto adjoining roads, such as rumble grids or wheel wash bays Appropriate location and storage of construction materials, fuels and chemicals, including bunding where appropriate. 		
W7	Surface water and flooding	Batters will be designed and constructed to minimise risk of exposure, instability and erosion, and to support long-term, on-going best practice management, in accordance with Roads and Maritime 'Guideline for Batter Surface Stabilisation using vegetation' (2015).	Roads and Maritime / Construction Contractor	Detailed design/ construction
W8	Surface water and flooding	Two spill containment basins with a minimum volume of 25,000 Litres are to be provided on the north and south side of the Hunter River.	Roads and Maritime / Construction Contractor	Detailed design/ Pre- construction/construction
W9	Surface water and flooding	A Spill Management Plan will be prepared and implemented as part of the CEMP to minimise the risk of pollution arising from spillage or contamination on the site and adjoining areas. The Spill Management Plan will address, but not necessarily be limited to: • Management of chemicals and potentially polluting materials • Any bunding requirements • Maintenance of plant and equipment • Emergency management, including notification, response and clean-up procedures.	Construction Contractor	Pre-construction/ construction
W10	Surface water and flooding	 A water quality monitoring program would be developed and implemented as part of the Soil and Water Management Plan in accordance with Roads and Maritime Guideline for Construction Water Quality Monitoring (Roads and Maritime, 2003). The monitoring program is to include Visual monitoring of local water quality Up and down stream water quality monitoring of the Hunter River prior to the start of construction Monthly up and down stream water quality monitoring for the duration of working within and over the Hunter River. 	Construction Contractor	Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
W11	Surface water and flooding	Any dewatering activities will be undertaken in accordance with the RTA Technical Guideline: Environmental management of construction site dewatering in a manner that prevents pollution of waters.	Construction Contractor	Detailed design/ Construction
E1	Contamination	The CEMP will include an unexpected finds protocol for potentially contaminated material encountered during construction work.	Construction contractor	Construction
E2	Contamination	If contaminated areas are encountered during construction, appropriate control measures will be implemented to manage the immediate risks of contamination. This may include but not be limited to: • Diversion of surface runoff • Capture of any contaminated runoff • Temporary capping. All other works that may impact on the contaminated area will cease until the nature and extent of the contamination has been confirmed and any necessary site-specific controls or further actions identified in consultation with the Roads and Maritime Environment Manager and/or the EPA.	Construction contractor	Construction
E3	Contamination	 An Asbestos Management Plan will be developed and implemented to manage asbestos and asbestos containing material if encountered during the construction. The plan will include: Identification of potential asbestos on site Procedures to manage and handle any asbestos Mitigation measures if asbestos is encountered during construction Procedures for disposal of asbestos in accordance with NSW EPA guidelines, Australian Standards and relevant industry codes of practice. 	Construction contractor	Construction
E4	Soils	An Acid Sulfate Materials Management Plan will be prepared and implemented as part of the CEMP. The Plan will be prepared in accordance with the RTA Guidelines for the Management of Acid Sulfate Materials.	Construction contractor	Construction
T1	Traffic and transport	Disruptions to property access and traffic will be notified to landowners at least five days prior in accordance with the relevant community consultation processes outlined in the TMP	Roads and Maritime	Detailed design
T2	Traffic and	Where any legal access to property is permanently affected, arrangements for	Construction	Detailed design

No.	Impact	Environmental safeguards	Responsibility	Timing
	transport	appropriate alternative access will be determined in consultation with the affected landowner and local road authority.	contractor and Roads and Maritime	
Т3	Traffic and transport	Access to properties will be maintained during construction. Where that is not feasible or necessary, temporary alternative access arrangements will be provided following consultation with affected landowners and the relevant local road authority.	Construction contractor and Roads and Maritime	Construction
T4	Traffic and transport	A detailed construction traffic management plan will be prepared in accordance with <i>Traffic Control at Work Sites Manual Version 4</i> (RTA, 2010) and <i>Specification G10 - Control of Traffic.</i> The plan will be approved by Roads and Maritime before implementation to provide a comprehensive and objective approach to minimise any potential impacts on road network operations during construction. The plan will include: Access and haulage routes Measures to maintain access to local roads and properties Site specific traffic control measures (including signage) to manage and regulate traffic movement Measures to maintain pedestrian and cyclist access Requirements and methods to consult and inform the local community of impacts on the local road network Access to construction sites including entry and exit locations and measures to prevent construction vehicles queuing on public roads. A response plan for any construction traffic incident Consideration of other developments that may be under construction to minimise traffic conflict and congestion that may occur due to the cumulative increase in construction vehicle traffic Monitoring, review and amendment mechanisms.	Construction contractor	Pre-construction
T5	Traffic and transport	Where practical, heavy vehicle movements would be outside the traffic peak hours to minimise impacts on the existing road network operation during construction.	Construction contractor	Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
T6	Traffic and transport	Preparation of pre-construction and post construction road condition reports for local roads likely to be used during construction. Any damage resulting from construction (not normal wear and tear) will be repaired unless alternative arrangements are made with the relevant road authority. Copies of road condition reports will be provided to the local roads authority.	Construction contractor	Pre-construction/ post construction
T7	Traffic and transport	Pedestrian and cyclist access will be maintained throughout construction. Where that is not feasible or necessary, temporary alternative access arrangements will be provided following consultation with affected landowners and the local road authority.	Construction contractor	Construction
N1	Noise and vibration	 A Construction Noise and Vibration Management Plan (CNVMP) would be prepared as part of the Construction Environmental Management Plan. The CNVMP would identify: all potential significant noise and vibration generating activities associated with the activity noise and vibration sensitive receptors measures to be implemented during construction to minimise noise and vibration impacts, such as restrictions on working hours, staging, placement and operation of work compounds, parking and storage areas, temporary noise barriers, haul road maintenance, and controlling the location and use of vibration generating equipment feasible and reasonable mitigation measures to be implemented, taking into account the Roads and Maritime's Beyond the Pavement urban design policy, process and principles. 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 an out of hours works procedure, including approval process and proposed mitigation measures. 	Contractor	Pre-construction/ post construction
N2	Noise and vibration	All sensitive receivers likely to be affected will be notified at least five days prior to commencement of any works associated with the activity that may have an adverse noise or vibration impact. The notification will include details of:	Contractor	Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
		 the project construction period and construction hours contact information for project management staff complaint and incident reporting and how to obtain further information 		
N3	Noise and vibration	 All employees, contractors and subcontractors are to receive an environmental induction. The induction must at least include: All relevant project specific and standard noise and vibration mitigation measures Relevant licence and approval conditions Permissible hours of work any limitations on high noise generating activities Location of nearest sensitive receivers Construction employee parking areas Designated loading/unloading areas and procedures Site opening/closing times (including deliveries) Environmental incident procedures. 	Contractor	Construction
N4	Noise and vibration	Where feasible and reasonable, construction should be carried out during the standard daytime working hours. Work generating high noise and/or vibration levels should be scheduled during less sensitive time periods. Any variations to the standard construction hours will follow the approach RTA Environmental Facts Sheet - Noise Management and Night Works, including consultation with the affected local community	Contractor	Construction
N5	Noise and vibration	Where reasonable ad feasible, high noise generating activities $(75dB(A)L_{eq})$ at receiver) be used during standard construction hours and in continuance blocks of no more than three hours with at least one hour respite between each block of work generating high noise impact, where the location of the work is likely to impact the same receiver.	Contractor	Construction
N6	Noise and vibration	Where high noise generating activities (75 dB(A) L _{eq} at receiver) are required out of hours the following will be implemented: • The equipment will be used prior to 10pm where reasonable and feasible • Where the above cannot be achieved the equipment will be used prior to	Contractor	Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
		midnight where reasonable and feasible It is not proposed to apply a three hour on and a one hour off respite approach in an effort to ensure that the use of such equipment is completed as early in the night as possible.		
N7	Noise and vibration	Where properties have been identified for architectural treatment and these properties would be impacted by noise from construction works, Roads and Maritime would consult with those property owners on the early installation of treatments to provide noise mitigation during the construction of the proposal.	Roads and Maritime	Pre-construction
N8	Noise and vibration	 The following will be implemented for deliveries the and from the proposal Loading and unloading of materials/deliveries is to occur as far as possible from sensitive receivers. Dedicated loading/unloading areas to be shielded if close to sensitive receivers. Delivery vehicles to be fitted with straps rather than chains for unloading, wherever possible. Construction sites would be arranged to limit the need for reversing associated with regular/repeatable movements 	Contractor	Construction
N9	Noise and vibration	Non-tonal reversing beepers (or an equivalent mechanism) must be fitted and used on all construction vehicles and mobile plant regularly used on site and for any out of hours work.	Contractor	Construction
N10	Noise and vibration	The noise associated with the operation of construction ancillary facilities would primarily result from the operation of fixed and mobile plant and truck movements. Consideration would be given to the layout of the site in order to maximise distance and shielding to nearby receivers.	Contractor	Pre-construction and Construction
N11	Noise and vibration	Where practicable, work should be scheduled to avoid major student examination periods such as before or during Higher School Certificate and at the end of higher education semesters.	Contractor	Construction
N12	Noise and vibration	At compound sites, consider positioning site sheds, earth bunds and hoarding to maximise shielding to residential receivers	Contractor	Construction
N13	Noise and	In circumstances where the noise levels are predicted to exceed construction	Contractor	Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
	vibration	noise management levels after implementation of the general work practices, additional mitigation measures are required. These measures include the following: • Monitoring • Notification (letterbox drop or equivalent) • Specific notifications • Phone calls • Individual briefings • Respite Offers • Respite Periods • Duration Respite. • Alternative Accommodation		
N14	Noise and vibration	Vibration intensive equipment size would be selected to avoid working within the structural damage minimum working distances The use of less vibration intensive methods of construction or equipment would be considered where feasible and reasonable.	Contractor	Construction
N15	Noise and vibration	Where the use of vibration intensive equipment within the relevant minimum working distances cannot be avoided, prior to the commencement of vibration intensive work, a detailed inspection will be carried out and a written and photographic report prepared to document the condition of buildings and structures within the minimum working distances. A copy of the report will be provided to the relevant land owner or land manager.	Contractor	Pre-Construction
N16	Noise and vibration	To confirm that the noise level targets are achieved, a post-construction noise monitoring program be carried out in accordance with the Noise Mitigation Guideline (Roads and Maritime 2014d).	Roads and Maritime	Operation
B1	Aboriginal heritage	A total of 16 Aboriginal archaeological sites, detailed in Table 6-37 will be impacted by the proposal. Roads and Maritime should apply for an 'all of area' AHIP for land to be impacted by the proposal (the 'AHIP area' shown on Figure 38 of Appendix E). This AHIP will allow impacts to these sites.	Roads and Maritime	Detailed design / pre- construction
B2	Aboriginal heritage	Impacted open artefact site Singleton Bypass OAS19 (37-6-3903, 37-6-1466 and 37-6-1468) has been assessed as being of moderate scientific significance and	Roads and Maritime	Detailed design

No.	Impact	Environmental safeguards	Responsibility	Timing
		will be partially impacted by the proposal. To mitigate the impact of the proposal on this site, an archaeological salvage program incorporating surface collection and excavation is recommended for the impacted portion of this site. Salvage activities within OAS19 can only occur after an AHIP has been obtained and should be completed in accordance with the research design and methodology provided in Appendix F of AECOM's AAR.		
В3	Aboriginal heritage	Impacted open artefact sites Singleton Bypass OAS2 (37-6-3895), OAS7 (37-6-3889), OAS9 (37-6-3887), OAS10 (37-6-3886), OAS11 (37-6-3892), OAS12 (37-6-3891), OAS13 (37-6-3900), OAS15 (37-6-3898), OAS17 (37-6-3905), OAS18 (37-6-3904), McDougall Hill 2 (37-6-0789) and McDougall Hill 3 (37-6-0788) have been assessed as being of low scientific significance. Regardless, in recognition of their cultural significance, community collection is recommended for these sites, with collection to be limited to the impacted portion of each site. Community collection can only occur after an AHIP has been obtained from OEH and should be completed in accordance with research design and methodology provided in Appendix F of AECOM's AAR.		Detailed design
B4	Aboriginal heritage	Impacted subsurface artefact scatter sites Singleton Bypass OAS21 and OAS22 have been assessed as being of low scientific significance. No further management or mitigation actions are recommended for these sites.	Roads and Maritime	Detailed design
B5	Aboriginal heritage	Should the requirement for impacts to AHIMS registered potential Aboriginal scarred tree 37-6-0681 be confirmed during the detailed design or construction phases of the proposal, a qualified arborist should be engaged to undertake a removal/relocation feasibility assessment of the tree. Subsequent mitigation will depend on the results on this assessment, as follows:	Contractor	Detailed design / pre- construction
		 Should the engaged arborist determine that 37-6-0681 is not suitable for relocation (i.e., due to the health of the tree and/or other factors), a detailed archival recording of the tree and its associated scars should be undertaken by a qualified archaeologist. A minimum of one RAP field representative will be invited to participate in the archival recording. Should the engaged arborist determine that 37-6-0681 is suitable for removal/relocation, the relocation procedure outlined in section 10.1 of Appendix E should be employed. 		

No.	Impact	Environmental safeguards	Responsibility	Timing
		All RAPs should be given the opportunity to review and comment on the arborist's relocation assessment report and if required, the removal methodology (including equipment), keeping place and ongoing access arrangements.		
B6	Aboriginal heritage	Ten Aboriginal archaeological sites, listed in Table 6-37, will not be impacted by the proposal and should be conserved in situ. The protection of these sites to be retained and those sites identified for partial impact will occur in accordance with the measures outlined in the adopted Aboriginal Heritage Management Plan.	Contractor	Detailed design / pre- construction
B7	Aboriginal heritage	Cultural Site A: Gathering Place (Railway Bridge Camps) will be partially impacted by the proposal. Protective fencing should be erected between the zone of construction activity and the unimpacted area(s) of this site prior to any construction activities, with the unimpacted area(s) of the site to be clearly marked on all operational maps as 'no go zones' of environmental and heritage sensitivities. The location of the fencing at Cultural Site A: Gathering Place (Railway Bridge Camps) should be confirmed by a cultural heritage values consultant to ensure that it accurately reflects the mapped site. Fencing should be maintained throughout the duration of works	Contractor	Pre-construction
B8	Aboriginal heritage	An Aboriginal Heritage Management Plan (AHMP) will be prepared and implemented as part of the CEMP. The AHMP will provide specific guidance on measures and controls to be carried out to avoid and mitigate impacts on Aboriginal cultural heritage during construction. This will include protection measures to be applied during construction, as well as contractor training in general Aboriginal cultural heritage awareness and management of Aboriginal heritage values. Site locations will be identified in the proposal's CEMP and marked as environmentally sensitive areas or no-go zones.	Contractor	Detailed design / pre- construction
B9	Aboriginal heritage	All relevant staff and contractors working on site are to receive training to ensure awareness of the requirements of the AHMP and relevant statutory responsibilities. Site-specific training is to be given to personnel when working in the vicinity of identified Aboriginal heritage sites.	Contractor	Pre-construction
B10	Aboriginal heritage	In the event that construction works within the study area uncover any unexpected Aboriginal objects, the relevant provisions of Roads and Maritime's Standard Management Procedure for Unexpected Heritage Items (Roads and Maritime,	Contractor	Pre-construction

No.	Impact	Environmental safeguards	Responsibility	Timing
		2015) should be followed		
B11	Aboriginal heritage	A project specific Aboriginal cultural heritage interpretation plan will be developed to promote understanding and awareness of the cultural heritage values of the study area. The strategy should be prepared in accordance with Roads and Maritime's draft Heritage Interpretation Guideline (2016) in consultation with the RAPs and identified Aboriginal knowledge holders. The Aboriginal heritage interpretation project plan will include: a. Interpretative signage (or similar) relevant to Cultural Site A: Gathering Place (Railway Bridge Camps) and how it sits within the wider cultural landscape. The content of the signage is to be developed by a cultural heritage specialist in consultation with the identified Aboriginal knowledge holders. b. Opportunities for input into (aesthetic) design elements of the proposal such as noise walls, bridge piers or abutments to include the interpretation of the Aboriginal cultural values of the area. c. Provisions for rehabilitation and revegetation of the impacted portion of Cultural Site A: Gathering Place (Railway Bridge Camps) with local Indigenous plant species. The identification of the plant species should be undertaken in consultation with the identified Aboriginal knowledge holders. Opportunities should be provided to local Aboriginal organisations for involvement and potential engagement in the revegetation and landscaping process.	Roads and Maritime	Detailed design / pre- construction
B12	Aboriginal heritage	An educational booklet (or similar) would be developed by a cultural heritage specialist on the cultural values and historical records relating to the broader cultural landscape of which Cultural Site A: Gathering Place (Railway Bridge Camps) is one element. As part of this process the photographic recording of the cultural landscape should occur prior to any construction impacts. The final content of the booklet (or similar) to be developed in consultation with the RAPs and identified Aboriginal knowledge holders. To assist in the production of the recommended educational booklet, photographic recording of the cultural landscape by a cultural values specialist at Cultural Site A: Gathering Place (Railway Bridge Camps) should occur prior to any construction impacts.	Roads and Maritime	Detailed design / Pre- construction
B13	Aboriginal	In accordance with Requirement 16B of the Code of Practice, all stone artefacts	AECOM / Roads	Detailed design / Pre-

No.	Impact	Environmental safeguards	Responsibility	Timing
	heritage	recovered from the proposal area as part of the test excavation program detailed in the AAR is to be stored temporarily at AECOM's head office (Level 8, 420 George Street, Sydney) while options for their long term management are being investigated, as determined through consultation with RAPs. Requirement 26 of the Code of Practice provides standard procedures for the deposition of stone artefacts dealt with under AHIPs and the Code of Practice. These procedures will be strictly adhered to.	and Maritime	construction
B14	Aboriginal heritage	Any Aboriginal objects removed from the study area as a result of test excavation and salvage activities authorised by the Code of Practice or an AHIP should be reburied upon completion of all post-excavation analyses, with the location of the reburial to be determined in consultation with RAPs	Roads and Maritime	Construction
H1	Non-Aboriginal Heritage	 A heritage management plan should be produced and included with in the Construction and Environment Management Plan measures to manage the identified heritage items in relation to the proposed works, including: Heritage protection measures. An induction program for construction personnel on the management of non-Aboriginal heritage values. Procedures to be implemented if previously unidentified non-Aboriginal relics or heritage items are discovered during construction, in accordance with the Roads and Maritime's Standard Management Procedure - Unexpected Archaeological Finds. 	Contractor	Construction
H2	Non-Aboriginal Heritage	 If the use of vibration intensive plant cannot be avoided within the minimum working distance for cosmetic damage the following procedure would occur as a minimum: Notification of the works to the affected residents and community Works would not proceed until attended vibration measurements are undertaken. Vibration monitors are to provide real-time notification of exceedances of levels approaching cosmetic damage criteria. If ongoing works are required a temporary relocatable vibration monitoring system would be installed, to warn operators (via flashing light, audible alarm, short message service (SMS) etc) when vibration levels are approaching the cosmetic 	Contractor	Detailed design and Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
		damage objective.		
Н3	Non-Aboriginal Heritage	Singleton Council should be informed of the proposed impacts to heritage items and their records relating to the corresponding LEP listings should be updated accordingly.	Roads and Maritime	Construction
H4	Non-Aboriginal Heritage	Should any heritage items, archaeological remains or potential relics of Non-Aboriginal origin be encountered, then construction work that might affect or damage the material will cease and notification provided to Roads and Maritime's as per Roads and Maritime Standard Management Procedure - Unexpected Archaeological Finds. Work will only re-commence once the requirements of that Procedure have been satisfied.	Contractor	Construction
H5	Non-Aboriginal Heritage	Roads and Maritime will investigate the need to salvage heritage fabric from listed items removed by the proposal for possible reuse in heritage reinterpretation in consultation with Singleton Council.	Roads and Maritime	Detailed design
H6	Non-Aboriginal Heritage	An archival recording of the Former Pumping Station (I21) will be prepared prior to the removal of the item. The recording will be prepared in accordance with guidelines published by the Heritage Division, Department of Premier & Cabinet.	Contractor	Construction
H8	Non-Aboriginal Heritage	Prior to ground disturbance impacts at the Former Pumping Station (I21), a permit under Section 140 of the <i>Heritage Act 1977</i> would be obtained given the potential for archaeological relics at this location.	Roads and Maritime / Contractor	Detailed design / Construction
A1	Air quality	 An Air Quality Management Plan will be prepared and implemented as part of the CEMP. The Plan will identify: Potential sources of air pollution (such as dust, vehicles transporting waste, plant and equipment) during construction Air quality management objectives consistent with any relevant published EPA and/or DPIE guidelines Mitigation and suppression measures to be implemented, such as spraying or covering exposed surfaces, provision of vehicle clean down areas, covering of 	Construction contractor	Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
		 loads, street cleaning, use of dust screens, maintenance of plant in accordance with manufacturer's instructions Methods to manage works during strong winds or other adverse weather conditions A progressive rehabilitation strategy for exposed surfaces When the air quality, suppression and management measures need to be applied, who is responsible, and how effectives will be assessed. Community notification and complaint handling procedures 		
A2	Air quality	As part of the AQMP, a monitoring program would be developed for monitoring construction dust from the proposal. The monitoring plan would be implemented prior to construction and during the construction period to assess effective implementation of air quality safeguards, identify any unexpected or inadvertent impacts, and identify recommended revisions or improvements.	Construction contractor	Construction
LV1	Landscape and visual	All plant material to be locally sourced (seed collection preferred), with any seed collection to commence within three months of construction contract award, where possible.	Roads and Maritime	Detailed design
LV2	Landscape and visual	 An Urban Design Plan will be prepared as part of the CEMP. The Plan will include: Location and identification of vegetation in the proposal area to be retained and proposed landscaped areas Details of the staging of built elements including retaining walls, bridges and noise walls Details of the staging of landscape works Maintenance measures for landscaped or rehabilitated areas, including timings A landscape monitoring program including an inspection program with frequency. 	Construction contractor	Pre-construction
P1	Property acquisition	Property acquisition will be carried out in accordance with the Land Acquisition Information Guide (Roads and Maritime, 2014) and the Land Acquisition (Just Terms Compensation) Act 1991.	Roads and Maritime	Detailed design

No.	Impact	Environmental safeguards	Responsibility	Timing
P2	Property acquisition	Roads and Maritime will complete property adjustments including fencing, driveways/access and other property infrastructure impacted by the proposal in consultation with affected property owners.	Roads and Maritime	Detailed design
P3	Property acquisition	Roads and Maritime will investigate the possibility of licencing land beneath the bridge to impacted landholders to enable continued access for fragmented properties.	Roads and Maritime	Detailed design
SE1	Social and economic	 Landowner surveys will be carried out to: Gather information about the current use and activities carried out on their property Identify how the proposal would affect ongoing land use and activities on their property Inform the development of appropriate mitigation measures. 	Roads and Maritime	Detailed design
SE2	Social and economic	 A Communication Plan (CP) will be prepared and implemented as part of the CEMP to ensure provision of timely and accurate information to the community during construction. The CP will include (as a minimum): Mechanisms to provide details and timing of proposed activities to affected residents, including changed traffic and access conditions Contact name and number for complaints How the project webpage will be maintained for the duration of the proposal. Minimum consultation activities to be carried out A complaints handling procedure. 	Roads and Maritime / construction contractor	Detailed design and construction
SE3	Social and economic	Roads and Maritime will develop a signage strategy for the entrances to Singleton, in consultation with Singleton Council to encourage motorists to visit Singleton. This will include signage showing: • The travel distances and estimated times for travelling routes via the bypass compared to travelling via the Singleton town centre • Services and facilities available within the Singleton township • Any visitor attractions within the Singleton township	Roads and Maritime	Detailed design
SE4	Social and	Roads and Maritime will engage with Singleton Council and local businesses	Roads and	Detailed design and

No.	Impact	Environmental safeguards	Responsibility	Timing
	economic	regarding the progress of the proposal to allow businesses time to prepare for changed traffic conditions through the town.	Maritime	construction
M1	Resource use	Use of recycled-content materials would be considered during the detailed design.	Roads and Maritime	Detailed Design
M2	Construction waste	A Waste Management Plan (WMP) will be prepared and implemented as part of the CEMP. The WMP will provide specific guidance on measures and controls to be implemented to support minimising the amount of waste produced and appropriately handle and dispose of unavoidable waste. The WMP will include, but not necessarily be limited to: • Measures to avoid and minimise waste associated with the project. • Classification of wastes generated by the project and management options (reuse, recycle, stockpile, disposal). • Classification of wastes received from off-site for use in the project and management options. • Identifying any statutory approvals required for managing both on and off-site waste, or application of any relevant resource recovery exemptions. • Procedures for storage, transport and disposal. • Monitoring, record keeping and reporting, including any documentation management obligations arising from resource recovery exemptions. The WMP would be prepared taking into account the Roads and Maritime Environmental Procedure – Management of Wastes on Roads and Maritime Services Land and relevant Roads and Maritime Waste Fact Sheets.	Construction contractor	Pre-construction and construction
M3	Construction waste	 The following resource management hierarchy principles will be followed: Avoid unnecessary resource consumption as a priority. Avoidance will be followed by resource recovery (including reuse of materials, reprocessing, and recycling and energy recovery). Disposal will be a last resort (in accordance with the Waste Avoidance and Resource Recovery Act 2001). 	Construction contractor	Pre-construction and construction

No.	Impact	Environmental safeguards	Responsibility	Timing
CC1	Climate change	Construction equipment, plant and vehicles will be appropriately sized for the task, serviced frequently and will not be left idling when not in use.	Construction	Construction
R1	Hazard and risk	Emergency response plans will be incorporated into the construction environmental management plan.	Construction contractor	Pre-construction and construction
R2	Hazard and risk	 A Hazard and Risk Management Plan will be prepared and implemented as part of the CEMP. The Plan will identify: Details of hazards and risks associated with the activity Measures to be implemented during construction to minimise these risks Record keeping arrangements, including information on the materials present on the site, material safety data sheets, and personnel trained and authorised to use such materials A monitoring program to assess performance in managing the identified risks, including "equipment checking and maintenance requirements contingency measures to be implemented in the event of unexpected hazards or risks arising, including emergency situations." 	Construction contractor	Pre-construction and construction

7.3 Licensing and approvals

A summary of notification, licences and approvals required for the proposal, prior to construction or the start of certain activities, are outlined below in Table 7-2.

Table 7-2: Summary of licensing and approvals required

Instrument	Requirement	Timing
Protection of the Environment Operations Act 1997 (s43)	Environment protection licence (EPL) for scheduled activities from the EPA.	Prior to start of the activity.
Fisheries Management Act 1994 (s199)	Notification to the Minister for Primary Industries prior to any dredging or reclamation works.	A minimum of 28 days prior to the start of work.
Fisheries Management Act 1994 (s219)	Permit to obstruct the free passage of fish (temporary or permanent) from the Minister for Primary Industries.	Prior to start of the activity.
National Parks and Wildlife Act 1974 (s90)	Aboriginal heritage impact permit from the Chief Executive of Heritage Division, Department of Premier & Cabinet.	Prior to start of the activity.
Crown Lands Act 1989 (s6)	Licence to occupy areas of Crown land.	Prior to start of the activity
Heritage Act 1977	Section 140 excavation permit for ground disturbance impacts at the Former Pumping Station (I21).	Prior to start of the activity.

8. Conclusion

This chapter provides the justification for the proposal taking into account its biophysical, social and economic impacts, the suitability of the site and whether or not the proposal is in the public interest. The proposal is also considered in the context of the objectives of the EP&A Act, including the principles of ecologically sustainable development as defined in Schedule 2 of the Environmental Planning and Assessment Regulation 2000.

8.1 Justification

The New England Highway is recognised for its strategic importance to national and regional economic growth, development and connectivity. The strategic need for the proposal stems from the importance of the New England Highway in providing safe and efficient access as a major freight and commuter route for the Upper and Lower Hunter. The proposal is considered consistent with a number of relevant strategic planning and policy frameworks, as listed in Section 3.2.1.

The preferred option for the proposal was selected because it would best meet the project objectives. The REF has assessed the potential biophysical, social and economic impacts of this option.

The proposal would:

- Reduce traffic volumes along the New England Highway through Singleton
- Improve average travel times on the New England Highway
- Improve road safety along the New England Highway through Singleton
- Support growth in the Hunter region through improved freight movements.

The proposal would result in some adverse environmental impacts during as a consequence of the proposal, including impacts to heritage sites (both Aboriginal and non-Aboriginal), air and noise emissions, biodiversity and reduced visual amenity for some residents and road users. However, these have been avoided or minimised wherever possible through design and site-specific safeguards provided in Section 7 would help to reduce these impacts.

Overall the proposal is justified on the basis that the adverse impacts of the proposal would be outweighed by the long-term beneficial impacts of improved traffic flow, reduced congestion and improved safety for roads users and residents within Singleton.

8.1.1 Social factors

Full and partial property acquisition would be required for the proposal, and construction activities may result in altered access arrangements for some residents. A SEIA was conducted for the proposal as discussed in Section 6.12.

The proposal would have long-term beneficial impacts by maintaining the New England Highway as an important freight and commuter route and improving travel reliability through Singleton. The proposal would provide better access to the town centre by providing a heavy vehicle bypass, thus removing freight traffic through the town centre. This would reduce travel times and congestion and improve road safety and efficiency for through and local traffic in Singleton. The proposal also provides an effective flood evacuation route, while only having a minor impact on flooding.

The proposal has been designed to reduce the social impacts on the community as far as possible, and the remaining impacts would be managed by the safeguards identified in Section 7.

8.1.2 Biophysical factors

Potential impacts to a range of biophysical factors have been assessed throughout Section 6 and mitigation measures would be implemented to manage potential impacts.

The proposal would result in a loss of around 15.2 hectares of vegetation listed under the BC Act. About 16.9 hectares of the Central Hunter Valley eucalypt forest and woodland, listed as critically endangered under the EPBC Act will also be impacted. This would result in a reduction of habitat, including hollow-bearing trees, for a range of birds and mammals including threatened species, and loss of fauna habitat connectivity. An aerial fauna crossing over the New England Highway would be provided to help reduce potential impacts.

An assessment of significance has been carried out for threatened species and ecological communities that are likely to occur in the proposal area. The assessment found that the proposal is unlikely to have a significant impact on all matters listed under the BC Act. It was found that the proposal is likely to have a significant impact on Central Hunter Valley eucalypt forest and woodland listed as critically endangered under the EPBC Act. Roads and Maritime's strategic assessment has been applied to the proposal.

8.1.3 Economic factors

The proposal meets the proposal objectives whilst designing for low maintenance and being economically viable. The proposal's benefit-cost ratio is estimated as 1.3, with a six per cent first year rate of return and an internal rate of return of nine per cent (Roads and Maritime, 2016).

The proposal would improve transport connections, reduce commuting times and lower vehicle operating costs between employment and tourist destinations. This section of the New England Highway is a major transport artery for freight travelling between the Port of Newcastle and the Hunter Valley and has supported the substantial growth in transportation for coal and agricultural industries and employment in NSW.

8.1.4 Public interest

The proposal is considered to be in the public interest as it would improve road safety, traffic efficiency and access through the Hunter Valley and the town centre of Singleton, while also improving amenity such as air quality and reduced noise levels within the township. Whilst the community would experience some negative impacts as a result of the proposal, most would be temporary and would be minimised with the safeguards provided in Section 7.

The diversion of traffic, in particular heavy vehicles, to the bypass would reduce the volume of traffic through Singleton and this in turn is expected to reduce the number crashes and the existing conflict between pedestrians and vehicles.

8.2 Objects of the EP&A Act

sal would provide better access through the e of Singleton and would reduce travel times stion and improve road safety and efficiency and local traffic. sal would, where feasible, limit its use of
,

Object	Comment
	natural and artificial resources and would source locally where possible. Socio-economic impacts are assessed om Section 6.12. The assessment includes management measures to avoid and/or minimise impacts.
1.3(b) To facilitate ecologically sustainable development by integrating relevant economic, environmental and social considerations in decision-making about environmental planning and assessment.	The proposal has considered relevant economic, environmental and social considerations. Ecologically sustainable development is considered in Section 8.2.1 to 8.2.4 below. Potential impacts have been minimised through concept design and would be further mitigated using the measures in Section 7.
1.3(c) To promote the orderly and economic use and development of land.	The proposal is needed to improve safety on the New England Highway and in Singleton. The proposal would provide for future growth and development in Singleton due to reduced traffic volumes and improved movement of heavy freight vehicles. Potential impacts to the development of the land have been minimised through concept design and are discussed in Section 6.11.
1.3(d) To promote the delivery and maintenance of affordable housing.	Not relevant to the proposal.
1.3(e) To protect the environment, including the conservation of threatened and other species of native animals and plants, ecological communities and their habitats.	The proposal would result in a loss of around 15.2 hectares of vegetation listed under the BC Act. About 16.9 hectares of the Central Hunter Valley eucalypt forest and woodland, listed as critically endangered under the EPBC Act would also be impacted. An assessment of significance has been carried out for threatened species and ecological communities that are likely to occur in the proposal area. The assessment found that the proposal is unlikely to have a significant impact on all matters listed under the BC Act. It was found that the proposal is likely to have a significant impact on Central Hunter Valley eucalypt forest and woodland listed as critically endangered under the EPBC Act. Roads and Maritime's strategic assessment has been applied to the proposal. Impacts to biodiversity are discussed in Section 6.1.
1.3(f) To promote the sustainable management of built and cultural heritage (including Aboriginal cultural heritage).	The proposal would result in potential impacts to both Aboriginal and non-Aboriginal cultural heritage. The management of Aboriginal heritage and non-Aboriginal heritage is considered in Section 6.7 and Section 6.8, respectively.
1.3(g) To promote good design and amenity of the built environment.	 The proposal would promote good design and amenity of the built environment. As noted in section 3.2.1, the proposal would be constructed in accordance with the following standards: Guide to Road Design – Austroads (Austroads, 2017) Guide to Road Safety – Austroads (Austroads, 2009) Roads and Maritime Austroads Guide Supplement (Roads and Maritime, 2017)

Object	Comment
	 Road Design Guide (Roads and Traffic Authority of NSW (undated)) Guidelines for Road Safety Audit Practices (Roads and Maritime Services, 2011) Beyond the Pavement, RTA urban design policy, procedures and design principles (Roads and Traffic of NSW, 2009) Roads and Maritime Delineation Manual (Roads and Maritime, 2008-2015) Roads and Maritime Road Technical Directions NSW Speed Zone Guidelines (Roads and Traffic Authority of NSW, 2011).
1.3(h) To promote the proper construction and maintenance of buildings, including the protection of the health and safety of their	Not relevant to the proposal.
1.3(i) To promote the sharing of the responsibility for environmental planning and	Not relevant to the proposal.
1.3(j) To provide increased opportunity for community participation in environmental planning and assessment.	community and relevant key stakeholders during the development of the proposal. Details of this consultation can be found in Section 5.

8.2.1 The precautionary principle

The precautionary principle states 'if there are threats of serious or irreversible damage, lack of scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation'.

The assessment of alternative options has aimed to reduce the risk of serious and irreversible impacts on the environment. Consultation considered issues raised by stakeholders and a range of specialist studies were carried out for key issues to provide accurate and independent information to assist in the development process.

A number of safeguards have been proposed to minimise potential impacts and would be implemented during detailed design, construction and operation of the proposal. No safeguards have been postponed as a result of lack of scientific certainty.

A CEMP would be prepared before construction starts and would ensure the proposal achieves a high-level of environmental performance.

8.2.2 Intergenerational equity

The intergenerational equity principle states, 'the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations'. This principle includes both intragenerational equity (within generations) and intergenerational equity (between generations).

The proposal would result in amenity impacts for some residents of Singleton and road users however would not result in any impacts that are likely to adversely impact on the health, diversity or productivity of the environment for future generations. The proposal would benefit future generations by ensuring road safety and freight efficiency is improved along the New England Highway.

The proposal has included a number of specialist reports to assess social equity both in terms of environmental, social and economic costs and benefits to the current community and future generations. Should the proposal not proceed, the principle of intergenerational equity may be compromised, as public safety may be affected by future traffic incidents associated with the existing New England Highway.

8.2.3 Conservation of biological diversity and ecological integrity

This principle states the 'diversity of genes, species, populations and communities, as well as the ecosystems and habitats to which they belong, must be maintained and improved to ensure their survival'.

The route selection and the development of the concept design have sought to avoid and minimise biodiversity impacts as far as practical.

The proposal will result in a loss of around 15.1 hectares of vegetation listed under the BC Act. About 16.9 hectares of the Central Hunter Valley eucalypt forest and woodland, listed as critically endangered under the EPBC Act will also be impacted. This would result in a reduction of habitat, including hollow-bearing trees, for a range of birds and mammals including threatened species, and loss of fauna habitat connectivity. An aerial fauna crossing over the New England Highway would be provided to help reduce potential impacts.

An assessment of significance has been carried out for threatened species and ecological communities that are likely to occur in the proposal area. The assessment found that the proposal is unlikely to have a significant impact on all matters listed under the BC Act. It was found that the proposal is likely to have a significant impact on Central Hunter Valley eucalypt forest and woodland listed as critically endangered under the EPBC Act. Roads and Maritime's strategic assessment has been applied to the proposal.

8.2.4 Improved valuation, pricing and incentive mechanisms

This principle requires 'costs to the environment should be factored into the economic costs of a project'.

The REF has examined the environmental consequences of the proposal and identified mitigation measures to manage the potential for adverse impacts. The requirement to implement these mitigation measures would result in an economic cost to Roads and Maritime. Incorporating environmental mitigation measures into the physical design and contractual requirements ensures that the costs of environmental impacts and mitigation are recognised by the proposal.

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

8.3 Conclusion

The proposed New England Highway bypass of Singleton, NSW, is subject to assessment under Division 5.1 of the EP&A Act. This REF has examined and taken into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of the proposed activity.

This has included consideration (where relevant) of conservation agreements and plans of management under the NPW Act, biodiversity stewardship sites under the BC Act, wilderness areas, areas of

outstanding value, impacts on threatened species and ecological communities and their habitats and other protected fauna and native plants. It has also considered potential impacts to matters of national environmental significance listed under the Federal EPBC Act.

A number of potential environmental impacts from the proposal have been avoided or reduced during the concept design development and options assessment. The proposal as described in the REF best meets the project objectives but would still result in some impacts including:

- Implications for traffic and transport
- Noise and vibration impacts
- Impacts on flora and fauna
- Flooding impacts
- Surface and groundwater impacts
- Landscape and visual amenity changes
- Impacts to Aboriginal and non-Aboriginal heritage
- Property and land use issues
- Socio-economic impacts.

Safeguards and management measures as detailed in this REF would ameliorate or minimise these expected impacts. The proposal would also result in long-term beneficial impacts including improved road safety, improved freight efficiency and access through the Hunter Valley and the town centre of Singleton. It would also improve amenity within Singleton. On balance the proposal is considered justified.

Significance of impact under NSW legislation

The proposal would be unlikely to cause a significant impact on the environment. Therefore it is not necessary for an environmental impact statement to be prepared and approval to be sought from the Minister for Planning under Division 5.2 of the EP&A Act. A Biodiversity Development Assessment Report or Species Impact Statement is not required. The proposal is subject to assessment under Division 5.1 of the EP&A Act. Consent from Council is not required.

Significance of impact under Australian legislation

The proposal is likely to have a significant impact on threatened species, ecological communities or migratory species, within the meaning of the *Environment Protection and Biodiversity Conservation Act* 1999. This REF has considered the consistency of the activity with relevant recovery plans, threat abatement plans, conservation advices and guidelines provided by the Australian Government. The REF finds that the activity will not threaten the long term survival of nationally listed biodiversity matters and that suitable offset measures can be secured as set out in the Biodiversity Offset Strategy for the proposal.

This REF has been prepared to meet the requirements of the *Environment Protection and Biodiversity Conservation Act 1999* strategic assessment approval for Roads and Maritime Division 5.1 road activities. A referral to the Australian Department of the Environment and Energy is not required.

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Terms and acronyms used in this REF

Term / Acronym	Description
'Do minimum' option	The 'do minimum' option represents the scenario if the proposal was not to proceed. It is called 'Do Minimum' rather than Do Nothing as it assumes that ongoing improvements would be made to the broader road and public transport network including some new infrastructure and intersection improvements to improve capacity and cater for traffic growth.
AADT	Annual Average Daily Traffic The total volume of traffic passing a roadside observation point over a period of a year, divided by the number of days per year. It is calculated from mechanically obtained axle counts.
AAR	Aboriginal Archaeological Report
ABL	Assessment Background Levels
ABS	Australian Bureau of Statistics
Aboriginal object	Any deposit, object or material evidence (not being a handicraft made for sale), including Aboriginal remains, relating to the Aboriginal habitation of NSW.
Aboriginal place	Any place declared to be an Aboriginal place under s.94 of the National Parks and Wildlife Act 1974.
Aboriginal stakeholders	Members of a local Aboriginal land council, Aboriginal groups or other Aboriginal people who have registered their interest with Roads and Maritime to be consulted about a proposed Roads and Maritime project or activity.
ACHAR	Aboriginal Cultural Heritage Assessment Report
Acid sulfate soils	Naturally acid clays, mud and other sediments usually found in swamps and estuaries. They may become extremely acidic when drained and exposed to oxygen and may produce acidic leachate run-off that can pollute waters and liberate toxins.
ACM	Asbestos Containing Material
AEC	Areas of Environmental Concern
AECOM	AECOM Australia Pty Ltd
AEP	Annual Exceedance Probability
AFG	Aboriginal Focus Group AFG meetings are held to consult with Aboriginal stakeholders who have registered their interest to be consulted regarding an RMS project.
AHD	Australian height datum The standard reference level used to express the relative height of various features. A height given in metres AHD is essentially the height above sea level. Mean sea level is set as zero elevation.
AHIMS	Aboriginal Heritage Information Management System
AHIP	Aboriginal Heritage Impact Permit

Term / Acronym	Description
Alluvium	Unconsolidated deposit of gravel, sand or mud formed by water.
AM peak period	AM peak period – 6 - 10am weekdays
Ambient noise	The all-encompassing noise at a point composed of sound from all sources near and far.
Amenity	Amenity refers to the quality of a place, its appearance, feel and sound, and the way its community experiences the place. Amenity contributes to a community's identity and its sense of place.
ANZECC	Australian and New Zealand Environment Conservation Council
Archaeology	The scientific study of human history, particularly the relics and cultural remains of the distant past.
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
ARTC	Australian Rail Track Corporation
Arterial Roads	The main or trunk roads of the State road network that carry predominantly through traffic between regions.
Asphalt or asphaltic concrete	A dense, continuously graded mixture of coarse and fine aggregates, mineral filler and bitumen usually produced hot in a mixing plant.
ASL	Above Sea Level
ASRIS	Australian Soil Resource Information System
Assessment background level [ABL]	The overall background level for each day, evening and night period for each day of the noise monitoring.
Background noise	The underlying level of noise present in the ambient noise when extraneous noise (such as transient traffic and dogs barking) is removed. The L_{90} sound pressure level is used to quantify background noise.
BaPTEQ	Benzo(a)pyrene Toxic Equivalence Quotient
BC Act	Biodiversity Conservation Act
BDAR	Biodiversity Development Assessment Report
BMT WBM	BMT Group Pty Ltd
BoM	Bureau of Meteorology
Bore	A cylindrical drill hole sunk into the ground from which water is pumped for use or monitoring.
Borehole	A hole produced in the ground by drilling for the investigation and assessment of soil and rock profiles.
BTEX	Benzene, Toluene, Ethylbenzene, Xylenes
CBD	Central Business District
CEEC	Critically Endangered Ecological Community
CEMP	Construction Environmental Management Plan

Term / Acronym	Description
CHPP	Coal Handling and Preparation Plant
CLM	Contaminated Land Management Act 1997
CMSC Act	Coal Mine Subsidence Compensation Act 1961
CNVMP	Construction Noise and Vibration Management Plan
CO	Carbon Monoxide
Community cohesion	Community cohesion refers to the connections and relationships between individuals and their neighbourhoods.
Compound site	Facilities used to support the operation of a construction site including site offices, workshops, delivery areas, storage areas, crib sheds, staff vehicle parking, materials, plant and equipment.
Concept design	Initial functional layout design for a road or road system, to establish feasibility, to provide a basis for estimating, and to determine further investigations needed for detailed design.
Construction fatigue	Construction fatigue relates to receivers that experience construction impacts from a variety of proposals over an extended period of time with few or no breaks between construction periods.
Consultation	Inviting feedback from the community and stakeholders to inform a proposal
CoPC	Contaminants of Potential Concern
CSEP	Community and Stakeholder Engagement Plan
CSM	Conceptual Site Model
CTMP	Construction Traffic Management Plan
Cumulative Impacts	Impacts that, when considered together, have different and/or more substantial impacts than a single impact assessed on its own.
Curtilage	The land around a bridge, building or any structure or object that is essential or contributes to the value, function and enjoyment of that object (e.g. a heritage building and surrounding buildings and trees that relate to it form an entire setting).
DA	development application
Day	The period from 0700 to 1800 h Monday to Saturday and 0800 to 1800 h Sundays and Public Holidays.
dB	Decibels – A scale unit used in the comparison of powers and levels of sound energy. Used for measuring noise.
dB(A)	A-weighted decibels A-weighting is applied to instrument-measured sound levels in effort to account for the relative loudness perceived by the human ear, as the ear is less sensitive to low audio frequencies.
DCP	Development Control Plan
DECC	Department of Environmental and Climate Change.
DECCW	NSW Department of Environment, Climate Change and Water

Term / Acronym	Description
Design noise model	A model of the proposal as it was designed, that calculates road traffic noise levels.
Design option	This scenario includes the proposal design alignment. The Road Noise Policy, Noise Criteria Guideline, and Noise Mitigation Guideline refer to this as the 'Build' scenario.
Design year	Ten years after the proposal opens (2036).
DNG	Derived Native Grassland
DoEE	Department of the Environment and Energy
DPE	NSW Department of Planning and Environment
DPI	Department of Primary Industries
EC	Electrical Conductivity
ECC	Endangered Ecological Communities
EIA	Environmental impact assessment
EIA-N05 (Practice Note)	Environmental Impact Assessment Practice Note – Socio-economic assessment
ENMM	Environmental Noise Management Manual (ENMM)
Environment	As defined within the Environmental Planning and Assessment Act 1979 (NSW), all aspects of the surroundings of humans, whether affecting any human as an individual or in his or her social groupings.
EP&A Act	Environmental Planning and Assessment Act 1979 (NSW). Provides the legislative framework for land use planning and development assessment in NSW.
EP&A Reg	Environmental Planning and Assessment Regulation 2000 (NSW)
EPA	Environment Protection Authority
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth). Provides for the protection of the environment, especially matters of national environmental significance, and provides a national assessment and approvals process.
EPL	Environmental Protection Licence
ESCP	Erosion and Sediment Control Plan
Evening	The period from 1800 to 2200 h Monday to Sunday and Public Holidays
Existing road traffic noise model	A model of the existing roads that calculates existing road traffic noise levels. This is used for model validation purposes with concurrently measured road traffic noise levels and traffic counts.
GDE	Groundwater Dependent Ecosystems
GHG	Greenhouse Gas
GNR	geographical name register

Term / Acronym	Description
GSP	NSW State Gross Product
Heavy vehicle	A heavy vehicle is classified as a Class 3 vehicle (a two axle truck) or larger, in accordance with the Austroads Vehicle Classification System.
HRMP	Hazard and Risk Management Plan
HRSTS	Hunter River Salinity Trading Scheme
Hydrology	The study of rainfall and surface water runoff process.
IAQM	Institute of Air Quality Management (IAQM)
ICNG	Interim Construction Noise Guideline
IER	Index of Economic Resources
Impact	Influence or effect exerted by a proposal or other activity on the natural, built and community environment.
Industry value add	This metric refers to the total value of goods and services produced by an industry, minus the cost of goods and services used in the production process.
IRSAD	Index of Relative Socio-economic Advantage and Disadvantage
ISEPP	State Environmental Planning Policy (Infrastructure) 2007.
km	Kilometre
km/h	kilometres per hour
KTP	Key Threatening Process
kV	Kilovolt
L ₁₀	The sound pressure level exceeded for 10% of the measurement period. For 10% of the measurement period it was louder than the L_{10} .
L ₉₀	The sound pressure level exceeded for 90% of the measurement period. For 90% of the measurement period it was louder than the L_{90} .
L _{Aeq}	A-weighted equivalent sound level
LCVIA	Landscape Character, Visual Impacts Assessment
LCZ	Landscape Character Zones
LEP	Local Environmental Plan. A type of planning instrument made under Part 3 of the EP&A Act.
LGA	Local Government Area
LLS	Hunter Local Land Services (LLS)
L _{max}	The maximum sound pressure level measured over the measurement period.
L _{min}	The minimum sound pressure level measured over the measurement period.
Local Road	A road or street used primarily for access to abutting properties.
Local Study Area	The local study area refers to the Singleton Statistical Area Level 2 (SA2) as defined by the Australian Bureau of Statistics.

Term / Acronym	Description
LoS	Level of service – A qualitative measure describing operational conditions within a traffic stream and their perception by motorists and/or passengers.
Magnitude of impacts	Severity or scale and intensity, spatial extent and duration of the impact.
Mtpa	Million tonnes per annum
NBN	National Broadband Network
NCA	Noise Catchment Area
NCG	Noise Critical Guideline
NEPC	National Environmental Protection Council
NEPM	National Environment Protection (Assessment of Site Contamination) Measure
NES	Matters of national environmental significance under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999.
Night	The period from 2200 to 0700 h Monday to Saturday and 2200 to 0800 h Sundays and Public Holidays.
NLTN	National Land Transport Network
NMG	Noise Mitigation Guideline
NML	Noise Management Level
NO ₂	Nitrogen dioxide
NOx	Oxides of Nitrogen
NP&W Act	National Parks and Wildlife Act 1974
NPfl	Noise Policy for Industry
NSW	New South Wales
NSW DI - Water	NSW Department of Industry – Water Division
NTU	nephelometric turbidity unit
NVIA	Noise and Vibration Impact Assessment
NVTA	Noise and Vibration Technical Assessment
OEH	NSW Office of Environment and Heritage
ONVR	Operational Noise and Vibration Review
PAC	Planning Assessment Commission
PACHCI	Procedure for Aboriginal Cultural Heritage Consultation and Investigation
PAD	Potential Archaeological Deposit Any location considered to have a moderate to high potential for subsurface archaeological material.
PAH	Polycyclic Aromatic Hydrocarbons

Term / Acronym	Description
Passing trade	Passing trade refers to customers who choose to visit a business because they see it when walking or driving past, or as a matter of convenience when on route to another destination, rather than an intentional trip with that business as the desired destination.
PCB	Polychlorinated biphenyls
PEI	Preliminary Environmental Investigation Report
PFAS	Per and Poly FluoroAlkyl Substances
PIARC	Permanent International Association of Road Congress
Pinch point	A place of point where congestion occurs
PM peak period	PM peak period
PM ¹⁰	Particulate matter less than 10 microns in diameter.
POEO Act	Protection of the Environmental Operations Act 1997
Property	Based on ownership, with the potential to contain more than one lot and Deposited Plan (DP)
Proposal	The proposal is an eight kilometre bypass west of Singleton with a single lane in each direction.
Proposal area	The proposal area departs the New England Highway near Newington Lane in Whittingham, heads north-west over the Main North railway line across the floodplain over Putty Road and continues over the Hunter River, west of Singleton, before crossing the New England Highway west of Gowrie Gates and re-joining the highway north of McDougalls Hill.
Ps	Singleton Coal Measures (Sandstone, shale, mudstone, conglomerate and coal seams)
Public transport	Includes train, bus (government and private), ferry (government and private) and light rail (government and private) services.
RAPs	Representative Aboriginal Parties
Rating background level [RBL]	The overall background level for each day, evening and night period for the entire length of noise monitoring.
RBL	Rating background levels
REF	Review of Environmental Factors
Regional Study Area	The regional study area refers to the area within the Singleton Local Government Area (LGA)
REMPLAN	REMPLAN Economy
Rest areas	A roadside area with restrooms and other facilities for the use of motorists
RMS	NSW Roads and Maritime Services
RNP	Road Noise Policy
Roads and Maritime	NSW Roads and Maritime Services

Term / Acronym	Description
ROL	Road Occupancy Licence
RTA	Roads and Traffic Authority, former Roads and Maritime
SA2	Statistical Area Level 2 (ABS)
SEIA	Socio – Economic Impact Assessment
SEIFA	Socio – economic indices for areas
Sensitive receiver	Includes residences, educational institutions (including preschools, schools, universities, TAFE colleges), health care facilities (including nursing homes, hospitals), religious facilities (including churches), child care centres, passive recreation areas (including outdoor grounds used for teaching), active recreation areas (including parks and sports grounds), commercial premises (including film and television studios, research facilities, entertainment spaces, temporary accommodation such as caravan parks and camping grounds, restaurants, office premises, retail spaces and industrial premises).
Sensitivity of affected stakeholders	Defined by the susceptibility or vulnerability of people, receivers or receiving environments to adverse changes caused by the impact, or the importance placed on the matter being affected.
SEPP	State Environmental Planning Policy. A type of planning instrument made under Part 3 of the EP&A Act.
SES	State emergency consultation
SHR	State Heritage Register
SIS	Species Impact Statement
Social infrastructure	Social infrastructure facilities generally operate at a local, district and/or regional level and are defined by the scale of the population catchment they serve.
Socio-economic	Involving combination of social and economic matters
SoHI	Statement of Heritage Impacts
Specialised sporting facilities	Bowling clubs, tennis courts, golf courses, basketball courts and gymnasiums (which includes the public swimming pool in Singleton).
SPR	Source Pathway-Receptor
SSD	State Significant Development
State Heritage Register	A register kept by the NSW Heritage Council that lists places, buildings, works, relics, moveable objects or precincts that the Minister for Planning considers are f state heritage significance.
SWMP	Surface Water Management Plan
Sydney-Brisbane Corridor	This transport network is funded by the Australian and State governments and is recognised for its strategic importance to national and regional economic growth, development and connectivity.
TAGG	Transport Authorities Greenhouse Group
TBA	To Be Announced
TEC	Threatened Ecological Communities

Term / Acronym	Description
Traffic noise	The total noise resulting from road traffic. The $L_{\mbox{\scriptsize eq}}$ sound pressure level is used to quantify traffic noise.
TRAQ	Tool for Roadside Air Quality
TRH	Total Recoverable Hydrocarbons
TSPD	Threatened Species Profile Database
TSS	Total Suspended Solids
UNSW	University of New South Wales
WM Act	Water Management Act 2000
WMP	Waste Management Plan
WQO	Water Quality Objectives
Year of opening	The year that the proposal opens (2026).
Zoning	Zoning regulates land use within an environmental planning instrument (usually by different colour codes on a map accompanying a local environmental plan). Land use tables set out the various purposes for which land may or may not be used or developed in each zone.