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M1 Pacific Motorway extension to Raymond Terrace

Environmental impact statement – Chapter 23: Cumulative impacts

Transport for NSW | July 2021

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23. Cumulative impacts

Cumulative impacts may arise from the interaction of construction and operation activities of the project, and other developments in the area. When considered in isolation, specific project impacts may be considered minor. These minor impacts may, however, be more substantial when the impact of multiple projects on the same receivers are considered.

This chapter presents an assessment of the potential cumulative impacts associated with the construction and operation of the project when considered together with other developments and activities occurring near the project and presents the approach to the management of these impacts.

Table 23-1 outlines the SEARs as they relate to cumulative impacts and where they are addressed.

Table 23-1 SEARs (cumulative impacts)

Secretary's requirement	Where addressed in EIS
2. Environmental Impact Statement	
1. The EIS must include, but not necessarily be limited to, the following:	
(o) An assessment of the cumulative impacts of the project taking into account other projects that have been approved but where construction has not commenced, projects that have commenced construction, and projects that have recently been completed	Projects identified for the cumulative impact assessment, including their approval status, are described in **Section 23.2**. For this assessment, these projects are referred to as "developments". An assessment of the potential cumulative impacts of the project on key environmental issues (as identified in the SEARs) is provided in **Section 23.3**.

23.1 Assessment methodology

The following websites were searched in September 2020 for recent or proposed developments that could interact with the project:

- NSW DPIE Major Projects Register
- Transport for NSW (formerly Roads and Maritime Services)
- Port Stephens Council
- Cessnock City Council
- City of Newcastle.

Developments considered in the cumulative impact assessment were selected based on the following criteria:

- Size: all major developments or known developments planned in the study area were considered
- Location: includes developments planned near the project
- Timeframe: relevant developments recently completed or likely to be carried out at some point during the construction of, and would interact with, the project.

Generally, cumulative impacts have been qualitatively assessed, with the expected cumulative impacts determined based on the perceived likelihood of impact and scale of interaction between the project and those identified for the cumulative assessment (refer to **Table 23-2**). In some cases, a quantitative assessment (e.g. traffic modelling) was also carried out to identify and assess the potential cumulative impacts of the project. Further information on the planned or proposed upgrades to the road network that were included in the operational traffic assessment are provided in **Section 7.2.3**.

Consultation with the relevant stakeholders for the developments listed in **Table 23-2** has been ongoing in order to understand how these other developments interact with the project and ensure they are appropriately considered in the cumulative impact assessment.

23.2 Identified developments

Identified developments that may contribute to the cumulative impacts of the project are described in **Table 23-2** and their relative location compared to the project shown on **Figure 23-1**. As the alignment for the Lower Hunter Freight Corridor development has not yet been determined, this development is not shown on **Figure 23-1**. The Chichester Trunk Gravity Main is also not shown on **Figure 23-1**, but is described as an existing utility in **Section 5.3.15**.

Where construction timeframes are not known, predictions have been made about the likelihood of overlapping construction periods, based on the most current and publicly available information. As discussed in **Chapter 5**, construction of the project is expected to begin in 2023 and be completed in 2028, with work occurring across the full length of the construction footprint during this period.

Table 23-2 Developments considered in the cumulative impact assessment

Project	Description	Status	Proximity	Construction timeframes	Relevance in consideration of cumulative impact
Black Hill Employment Lands	• Part of the Emerging Black Hill Precinct • Subdivision of land (about 223 hectares) to create 39 light industrial lots and one environmental conservation lot. The development will be delivered in six stages, including the remediation of the site and removal of vegetation to ensure that the site is suitable for future industrial use.	Refused in October 2020 by the Hunter and Central Coast Regional Planning Panel, but subject to current Land and Environment Court appeal proceedings.	In Black Hill; south of John Renshaw Drive and west of the M1 Pacific Motorway	No timeframe information (construction overlap assumed)	For the purpose of the cumulative impact assessment, it has been assumed that this land will be developed in the future, even though development consent has not yet been granted to the current proposed development of the land. For the purposes of this assessment, the following has been assumed: • Located about one kilometre west of the construction footprint, near John Renshaw Drive, Black Hill • Likely to be some overlap in the construction timeframes • Likely to be in concurrent operation with the project.
Black Hill Hunter Business Park	• Part of the Emerging Black Hill Precinct • A three lot “englobo” industrial subdivision of the site which has an area of about 183 hectares. The development will be delivered in stages, with stage one comprising of a 62 lot industrial subdivision totalling 41.7 hectares • Land clearing of the whole development footprint, to be undertaken in stages.	Pending outcome of the development application lodged with Newcastle City Council in January 2021.	Next to the construction footprint in Black Hill; south of John Renshaw Drive and west the M1 Pacific Motorway	No timeframe information (construction overlap assumed)	For the purpose of the cumulative impact assessment, it has been assumed that this land will be developed in the future even though development consent has not yet been granted to the current proposed development of the land. For the purposes of this assessment, the following has been assumed: • Located next to the construction footprint in Black Hill, south of John Renshaw Drive and west of the M1 Pacific Motorway • Likely to be some overlap in the construction timeframes • Likely to be in concurrent operation with the project.

Project	Description	Status	Proximity	Construction timeframes	Relevance in consideration of cumulative impact
Kinross Industrial / Weathertex, Heatherbrae	• Subdivision of land to create 142 commercial and industrial lots, to be carried out in nine stages.	Approved in 2009	In Heatherbrae; partially within the construction footprint, including land proposed to be used for AS16, AS18 and AS19	Construction and operation is progressing in stages, with some stages under construction in 2021-22.	• Located in Heatherbrae to the east and west of Masonite Road, partially within the construction footprint • Likely to be consecutive (back to back) construction and concurrent operation • If the Kinross Industrial / Weathertex development is constructed prior to, or at the same time as the project, AS16, AS18 and AS19 may be unavailable for use.
Newcastle Power Station	• The construction and use of a 250 megawatt gas-fired power station. Associated infrastructure will include gas pipelines, electricity transmission lines, site access provisions and associated ancillary facilities. An underground gas supply line will connect the new power station with the existing Newcastle Gas Storage Facility.	Approved in March 2021	In Tomago, between Old Punt Road and the Pacific Highway; within the construction footprint next to AS12 and AS13.	Construction planned between 2021 and 2022. Construction expected to take up to two years.	• Located within the construction footprint at Tomago, between Old Punt Road and the Pacific Highway • Potential to be consecutive (back to back) construction and concurrent operation • Consideration of the project has been given in the siting and layout of the power station.
Hunter Gas Pipeline	• A planned underground gas pipeline from the Wallumbilla Gas Supply Hub near Roma, Queensland to connect to the NSW gas transmission network in Newcastle.	Approved in 2009	Planned to cross the Pacific Highway at Tomago.	Construction planned between 2023 and 2028.	• This development will interact with the construction footprint as it will cross the Pacific Highway at Tomago • Likely to be some overlap in the construction timeframes.

Project	Description	Status	Proximity	Construction timeframes	Relevance in consideration of cumulative impact
Pacific Highway improvements at Hexham (Hexham Straight)	• Widening of about 6km of the Pacific Highway from four to six lanes. The development includes replacing the bridge at Ironbark Creek, adjustments to connecting roads and relocation of utility assets.	In planning	At Hexham, between Sandgate and Hexham Bridge; south of the construction footprint	Timing is to be confirmed, however may occur within the same timeframe	• Located about one kilometre south of the project at Hexham • Potential to be concurrent or consecutive (back to back) construction, and concurrent operation.
Lower Hunter Freight Corridor	• A planned future rail infrastructure development enabling a dedicated freight rail line between Fassifern and Hexham, bypassing Newcastle, while improving regional and interstate links • This development is currently under preliminary investigation.	In planning	Between Black Hill and Tarro	No timeframe information available	• The investigation area extends from Fassifern to Hexham and Tarro • The design of the project allows for the Lower Hunter Freight Corridor.
Richmond Vale Rail Trail to Shortland, including Shortland to Tarro cycleway	• A 32km cycling and walking track along the former Richmond Vale rail line between Kurri Kurri and Hexham, along the former Chichester to Newcastle water pipeline between Shortland and Tarro, and through the Hunter Wetlands National Park.	In planning	Between Kurri Kurri and Hexham, to Shortland and Tarro	No timeframe information available	• The Shortland to Tarro Bike Trail would intersect the project at Tarro • The Richmond Vale Rail Trail has been considered in the design of the project.
Chichester Trunk Gravity Main upgrade – Tarro	• Construction of 2.2km of new 1200mm diameter buried water main between Beresfield and Tarro	Completed in 2016	At Tarro, south of the New England Highway, within the construction footprint	Completed	• A section of the upgraded water main would be impacted by the project and would require protection and/or relocation.

Project	Description	Status	Proximity	Construction timeframes	Relevance in consideration of cumulative impact
M1 Pacific Motorway Upgrade – Weakleys Drive and John Renshaw Drive	• Replacement of a roundabout with a signalised intersection, including additional turning lanes and cyclist provisions	Completed in 2019	At Black Hill at the intersection of Weakleys Drive and John Renshaw Drive, within the construction footprint	Completed	• The project provides a connection to the recently upgraded Weakleys Drive and John Renshaw Drive intersection via northbound and southbound ramps • The project has been designed to operate in conjunction with the recent intersection upgrade.

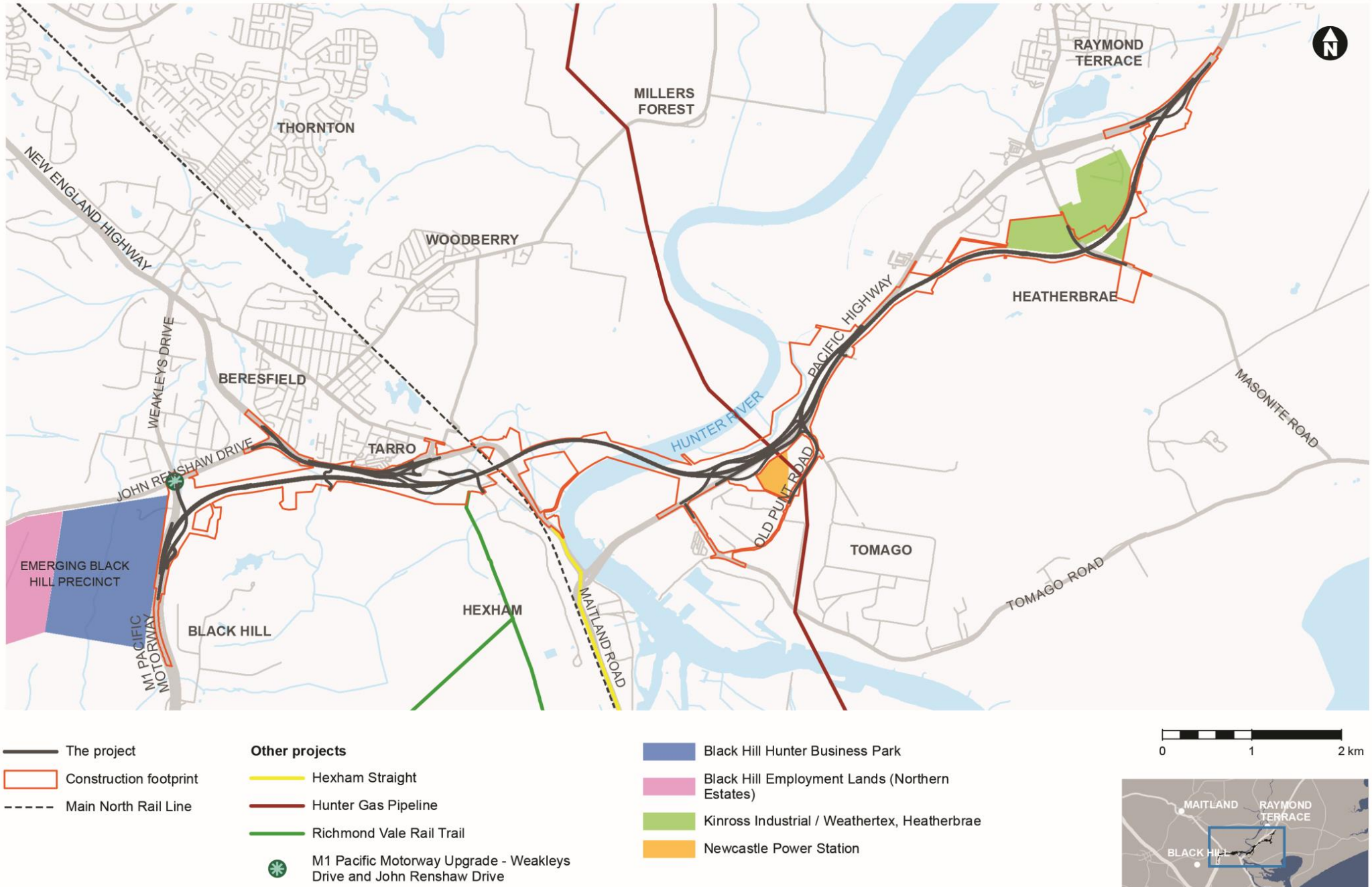

Figure 23-1 Developments considered in the cumulative impact assessment

23.3 Assessment of potential impacts

As described in **Section 23.2**, the identified developments with the potential to interact with the project are in various stages of delivery and planning, with a number of developments yet to be approved by the relevant authority. The likely impacts of these developments will be assessed by the relevant approval authority as part of the development consent process for each development.

The potential cumulative impacts during construction and/or operation are described and assessed in **Table 23-3**.

Table 23-3 Potential cumulative impacts during construction and operation

Key issue	Level of cumulative impact	Potential cumulative impact
Traffic and transport	• Minor negative short-term impacts. • Positive long-term impacts.	**Construction** There is the potential for minor cumulative traffic and transport impacts should the construction timeframes and/or operation of the developments identified in **Section 23.2** overlap with the project's construction timeframe. To support the cumulative traffic impact assessment and characterise likely future traffic conditions, the traffic model for the project included consideration of the Hexham Straight and the developments proposed in the Emerging Black Hill Precinct (Black Hill Employment Lands and Black Hill Hunter Business Park). The traffic model has also taken into account forecasts for population and employment growth, and inter-regional traffic growth for future years. Refer to **Chapter 7** (traffic and transport) and the Traffic and Transport Working Paper (**Appendix G**) for further details. With the exception of construction work on the southern side of the M1 Pacific Motorway / Weakleys Drive intersection, construction of the project is not expected to interact with the construction of developments in the Emerging Black Hill Precinct. Should the project and the Emerging Black Hill Precinct developments be constructed concurrently, it is unlikely that construction accesses would be impacted. Further, cumulative traffic volumes from these potential interactions would be considered minor when compared with existing traffic volumes on the road network in this location. Transport would be responsible for managing any approvals to works at this potential conflict point and should the other upgrades be required in this location associated with the development, construction works on this important part of the road network would be managed closely by Transport with clear controls and conditions in place to minimise cumulative construction impacts. Cumulative construction traffic volumes are not expected to exceed capacity (including heavy vehicle capacity) across the road network, however overlapping construction timeframes may extend potential disruptions relating to amenity (such as travel times) for road users. Any developments requiring construction work to be carried out on, or utilising, the National Land Transport Network or state roads would be subject to approval by Transport, and conditions would be applied to facilitate collaborative construction work arrangements with the project.

Key issue	Level of cumulative impact	Potential cumulative impact
		Operation The employment-driving developments planned in the Emerging Black Hill Precinct are expected to be key generators of traffic in the region in future years. The Emerging Black Hill Precinct is expected to account for 11 per cent of all trips in the study area by 2038, and 12 per cent of all trips by 2048. By 2048 (when the precinct is assumed to be 100% complete), the precinct is expected to account for 7,528 trips to Black Hill in the morning peak period, and 8,635 trips in the evening peak period. Once operational, the project would provide an improved highway environment for road users, with additional benefits to be experienced with the implementation of the Hexham Straight development. The improved road network performance associated with the project would assist in mitigating the likely increases in traffic volumes and travel times expected to result from the developments identified in **Section 23.2**. However, the Emerging Black Hill Precinct developments substantially impact the performance of the network in future horizon years due to the magnitude of traffic generated out of the developments. These developments would be required to implement additional capacity improvements, such as alternate access and road upgrades, to ensure future operation through this area of the road network. Cumulative impacts on traffic and transport are further discussed in **Chapter 7** (traffic and transport) and the Traffic and Transport Working Paper (**Appendix G**).
Noise and vibration	• Minor negative short-term impacts • Minor negative long-term impacts.	**Construction** There is the potential for minor cumulative noise and vibration impacts where construction timeframes overlap, particularly in areas close to sensitive receivers. Generally, construction works for the project would occur over a temporary period at one particular location then move to another, so impacts would be short-term in nature. Project construction work would typically also be located closer to sensitive receivers than the other developments identified in **Section 23.2**, meaning construction noise from other developments would be substantially less than the construction noise from the project. **Operation** Noise and vibration impacts have been assessed using the traffic model for the project, which accounts for forecasted traffic growth and traffic generated by the Emerging Black Hill Precinct for the design year 2038. The noise mitigation measures identified in **Chapter 8** (noise and vibration), such as low noise pavements, noise barriers and at property treatments, have therefore considered the cumulative impacts of forecast increases in traffic noise generated by the developments identified in **Section 23.2**. Cumulative impacts on noise and vibration are further discussed in the Noise and Vibration Working Paper (**Appendix H**).

Key issue	Level of cumulative impact	Potential cumulative impact
Biodiversity	• Moderate negative long-term impacts.	Cumulative biodiversity impacts associated with the direct loss of native vegetation and increased habitat fragmentation have the potential to have impacts in the long-term. The developments which have the highest potential to add to the cumulative biodiversity impacts of the project are the Emerging Black Hill Precinct developments, the Newcastle Power Station and the Kinross Industrial / Weathertex development. Should the developments identified in **Section 23.2** be developed, it is estimated that a total of 180 hectares of vegetation would be removed, including threatened flora species, PCTs, TECs, threatened fauna and Koala habitat and Coastal Wetlands. This is a conservative estimate based on publicly available information. The project would involve the removal of an additional 174 hectares of vegetation (of which around 136 hectares comprise TECs). The project would also directly impact 161 individuals of *Diuris arenaria*, which is listed as Vulnerable under the TSC Act. In addition, clearing for the Kinross Industrial / Weathertex development (in the location of ancillary facility AS16) has already occurred, removing about 25 hectares of remnant vegetation, including *Diuris arenaria.* Cumulatively, the project and the Kinross Industrial / Weathertex development would impact 721 plants of this species, representing around 49.8 per cent of the estimated local population. Cumulative impacts on biodiversity are further discussed in the Biodiversity Assessment Report (**Appendix I**).
Hydrology and flooding	• Negligible-minor negative short-term impacts • Negligible-minor negative long-term impacts.	**Construction** Should construction of the project take place concurrently with the developments identified in **Section 23.2**, there is potential for increased rates, volumes and velocities of construction runoff and stormwater to be discharged into the nearby receiving waterways, such as Windeyers Creek, Viney Creek and the Hunter River. It is expected that the developments identified in **Section 23.2** would implement appropriate construction management measures to control discharge. Potential cumulative impacts on groundwater flow during construction are expected to be minor to negligible as no material impacts to groundwater level and flow are anticipated to occur due to the project. **Operation** During operation, it is expected that cumulative impacts on flow, geomorphic stability and sensitive receiving environments will be negligible, however some of the developments identified in **Section 23.2** are expected to result in minor cumulative flooding impacts. The Kinross Industrial / Weathertex development is expected to result in cumulative flooding impacts of up to a 0.04m total increase in 1% AEP flood levels around this project. The Newcastle Power Station development is also expected to result in a minor additional increase in flood levels on the eastern floodplain of the Hunter River between Tomago and Heatherbrae, particularly in the 20% AEP event, due to an anticipated 30 per cent increase in runoff volumes from the power station site. It is expected that these developments would effectively manage and mitigate their associated flood risks. Cumulative impacts on hydrology and flooding are further discussed in the Hydrology and Flooding Working Paper (**Appendix J**).

Key issue	Level of cumulative impact	Potential cumulative impact
Surface water and groundwater quality	• Negligible short-term impacts • Negligible negative long-term impacts.	**Construction** Potential cumulative impacts on surface water and groundwater quality during construction are expected to be negligible. Should construction of the project take place concurrently with the developments identified in **Section 23.2** there is potential for construction runoff to be discharged into nearby receiving waterways, which may result in elevated levels of heavy metals, hydrocarbons or other contaminants such as litter that may impact aquatic ecosystem health. There is also potential for increased erosion and sedimentation, and subsequent cumulative downstream water quality impacts. However, with the implementation of management measures it is expected that downstream water quality impacts and erosion and sedimentation would be mitigated. There is potential for earthworks and excavation associated with the Kinross Industrial / Weathertex development to result in changes to drinking water quality in the Tomago Sandbeds Catchment Area, however construction activities associated with the developments identified in **Section 23.2** are expected to be managed to avoid impacts to the Tomago Sandbeds Catchment Area. Construction discharges would be designed and implemented in accordance with standard practices and guidelines to ensure minimal water quality impacts. No cumulative groundwater quality impacts are expected. **Operation** With the implementation of water quality control measures, cumulative impacts on surface water and groundwater quality during operation, including to the Tomago Sandbeds Catchment Area, are expected to be negligible, as drainage structures and water quality control measures for runoff would be designed to ensure minimal impacts and to comply with licenced discharges. Cumulative impacts on surface water and groundwater quality are further discussed in the Surface Water and Groundwater Quality Working Paper (**Appendix K**).

Key issue	Level of cumulative impact	Potential cumulative impact
Aboriginal heritage	• Major permanent impacts for lower altitude areas that fringe the Hexham Swamp • Moderate permanent impacts for higher altitude areas at Black Hill • Moderate permanent impacts in the Tomago Sands area • Minor permanent impacts on the Hunter River floodplain.	For Aboriginal heritage, overlapping construction or operational timeframes do not usually add to the overall level of impact as it does for other environmental impacts. This is because once physical changes are made, regardless of whether they are made at the same time or separately, the impact level does not change. Land within the construction footprint has historically been extensively disturbed by farming and settlement to the point that there is little undisturbed land remaining. Other past disturbing activities include the establishment of rail and road corridors, bridges, petrol stations, industrial precincts, warehouses and saleyards. In consideration of these historical matters, the design of the project has adopted as narrow a footprint as possible in all areas in order to minimise cumulative impacts to Aboriginal sites. The design has also placed the main alignment as close as possible to existing infrastructure to further limit impacts to previously undisturbed areas. The impacts of the historical development on the cultural landscape where the project is located have been substantial, including the relocation of the Chichester Trunk Gravity Main. All identified Aboriginal archaeological sites within the construction footprint have been considered in relation to the project, however some level of impact is unavoidable. While the project is a relatively narrow, linear infrastructure project, when assessed cumulatively with previous development in the area the overall impact on the remaining resource is increased. Cumulative impacts are considered to be comparatively high for the lower altitudes in the Black Hill area that fringe Hexham Swamp however, lesser in the Tomago Sands area and Black Hill, and even less so in the Hunter River floodplain. Cumulative impacts on Aboriginal heritage are further discussed in the Aboriginal Cultural Heritage Assessment Report (**Appendix L**).
Socio-economic	• Minor negative and positive short-term impacts • Minor positive long-term impacts.	**Construction** It is anticipated that there would be minor short-term socio-economic impacts on local communities as residents and businesses in close proximity to the construction footprint may experience a range of amenity impacts such as noise, vibration, visual changes, air quality and traffic and access impacts. Where construction timeframes for the developments identified in **Section 23.2** would occur sequentially, there is also potential for extended period of disturbance and disruptions for local communities (for example, construction noise, dust, traffic delays and disruptions), potentially resulting in construction fatigue for some community members. The developments identified in **Section 23.2** would also cumulatively increase construction traffic on the road network and result in increased demand for construction workers. The project would have a positive cumulative impact for local businesses and workers due to increased demand for goods and services to support construction activities, as well as an increased demand for construction workers from the Hunter region. **Operation** During operation, the project is expected to have a minor positive cumulative impact on future industrial development in the area through improved access and connectivity for freight and commercial vehicles. Cumulative impacts on socio-economics are further discussed in the Socio-economic Working Paper (**Appendix M**).

Key issue	Level of cumulative impact	Potential cumulative impact
Land use and property	• Minor negative short-term impacts • Minor positive long-term impacts.	**Construction** There is the potential for minor cumulative land use and property impacts associated with the loss of farming land and prolonged disruptions to private property accesses. The project is located next to existing road infrastructure where possible to minimise land use and property impacts, however extended disruptions on land uses surrounding the project and developments identified in **Section 23.2** may be experienced due to sequential or consecutive construction timeframes. Impacts from the Lower Hunter Freight Corridor may result in additional property acquisition, loss of farming land and disruption to private property accesses in the Black Hill and Tarro areas. **Operation** Following construction, the project is expected to have positive cumulative impacts in relation to road access and transport efficiency, particularly for freight and commercial vehicles. The project would support existing land uses and future industrial and commercial growth and development in the area, for example in the Emerging Black Hill Precinct. Cumulative impacts on land use and property are further discussed in the Land Use and Property Working Paper (**Appendix N**).
Urban design, landscape character and visual amenity	• Minor short-term impacts • Minor long-term impacts.	**Construction** There is the potential for minor cumulative urban design, landscape character and visual amenity impacts associated with extended periods of traffic disruptions and altered access arrangements, extended periods of impacts on local communities in the study area (including noise, dust, traffic, lighting and visual disruptions leading to construction fatigue), and an increase in construction traffic on the road network. **Operation** Permanent land use changes as a result of other developments identified in **Section 23.2** would contribute to the cumulative landscape character and visual impact of the project once operational. This would also involve changes to the built form and spatial character of the area. As the project is located in an area undergoing considerable change and development, the contribution of the project to cumulative landscape character and visual amenity impacts on communities in the area is considered minor. Cumulative impacts on urban design, landscape character and visual amenity are further discussed in the Urban Design, Landscape Character and Visual Amenity Working Paper (**Appendix O**).

Key issue	Level of cumulative impact	Potential cumulative impact
Soils and contamination	• Minor negative short-term impacts • No negative long-term impacts expected.	**Construction** There is the potential for minor cumulative soils and contamination impacts associated with ground-disturbing activities for the developments identified in **Section 23.2**. Considering the project is generally located next to existing infrastructure, the cumulative soils and contamination impacts of the project are expected to be minor. Potential cumulative soils and contamination impacts during construction represent an increased risk of ASS exposure and mobilisation of contaminants into waterways surrounding the project. Should construction of the project be carried out consecutively or simultaneously with the construction of the developments identified in **Section 23.2**, cumulative impacts associated with dust generation and ground contamination may be experienced. **Operation** No cumulative impacts on soils and contamination are expected during project operation. Cumulative impacts on soils and contamination are further discussed in the Soils and Contamination Working Paper (**Appendix P**).
Non-Aboriginal heritage	• Negligible impacts.	For non-Aboriginal heritage, overlapping construction or operational timeframes do not usually add to the overall level of heritage impact as it does for other environmental impacts. This is because once physical changes are made to a heritage place, regardless of whether they are made at the same time or separately, the impact level does not change. The project would have a direct impact on some non-Aboriginal heritage items, as well as indirect visual impacts on other heritage sites and landscapes. A number of the developments identified in **Section 23.2** either would, or have the potential to, impact on non-Aboriginal heritage items, however the project is not expected to result in any further, cumulative impacts to these items. Cumulative impacts on non-Aboriginal heritage are further discussed in the Non-Aboriginal Heritage Working Paper (**Appendix Q**).
Air quality	• Minor negative short-term impacts • Negligible negative long-term impacts.	**Construction** Potential cumulative air quality impacts during construction are expected to be negligible. Some of the developments identified in **Section 23.2** would contribute to local air quality during construction, with cumulative air quality impacts expected where construction timeframes overlap. However, the contribution of the developments identified in **Section 23.2** to local air quality is not significant enough to influence the assumed background levels or outcomes of the air quality assessment. **Operation** Cumulative local air quality impacts are expected to be negligible during project operation. Cumulative impacts on air quality are further discussed in the Air Quality Working Paper (**Appendix R**).

Key issue	Level of cumulative impact	Potential cumulative impact
Waste	• Negligible negative short-term impacts • Negligible negative long-term impacts.	**Construction** There is the potential for minor cumulative waste impacts during construction associated with overlapping construction timeframes. Construction of the project is expected to produce manageable waste quantities and waste that is generated by the project will be managed using the waste hierarchy as a guideline. Waste that is not able to be reused onsite will be processed at a licensed waste facility. Construction of concurrent developments would affect the amount of waste that is generated in the area, however additional waste generated by the developments identified in **Section 23.2** are expected to have a negligible impact on the capacity of regional waste facilities. **Operation** The project is expected to generate minimal waste during operation. Waste expected from the other developments identified in **Section 23.2** is expected to be minimal, except for Black Hill Employment Lands and Black Hill Hunter Business Park, which would likely generate more operational waste. Cumulative impacts on waste are further discussed in the Waste Working Paper (**Appendix S**).
Climate change risk	• Minor negative long-term impacts.	Construction and operational greenhouse gas emissions arising from the project would contribute towards the total annual greenhouse gas emissions of NSW and Australia. By reducing road traffic congestion, the project would result in lower carbon emissions per kilometre travelled when compared to the 'without project' scenario. The project would therefore have a positive cumulative impact on carbon emissions per kilometre travelled for road users travelling on the project to and from the developments identified in **Section 23.2**. The contribution of the project to the cumulative impact on climate change risk and greenhouse gas in the area is minor. Cumulative impacts on climate change risk and greenhouse gas are further discussed in the Climate Change Risk Working Paper (**Appendix U**).

23.4 Environmental management measures

Developments which have the potential to interact with the project have been considered during the development of the project design (refer to **Chapter 4**).

In addition to the measures outlined in **Chapter 7** (traffic and transport) to **Chapter 22** (safety and risk), the environmental management measures presented in **Table 23-4** will be implemented to minimise the cumulative impacts of the project.

Table 23-4 Environmental management measures (cumulative impacts)

Impact	ID	Management measure	Responsibility	Timing
Cumulative impacts	CI01	The construction contractor will review traffic impacts before the start of construction and as required during construction. Any changes to manage cumulative traffic impacts will be included in the Traffic Management Plan (TMP).	Contractor	Prior to construction/ construction

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24. Summary of environmental management measures

This chapter collates the environmental management measures for the project that have been identified through the impact assessment process in response to the SEARs, detailed in **Table 24-1**. All management measures listed in **Table 24-2** will be incorporated into the Construction Environmental Management Plan (CEMP) and/or operational framework for the project as required.

Table 24-1 SEARs (environmental management measures)

Secretary's requirement	Where addressed
2. Environmental Impact Statement	
1. The EIS must include, but not necessarily be limited to, the following:	
(l) measures to avoid, minimise or offset impacts must be linked to the impact(s) they treat, so it is clear which measures will be applied to each impact;	**Section 24.1.1** provides a summary of environmental management measures detailed in **Chapter 7** (traffic and transport) to **Chapter 23** (cumulative impacts).

24.1 Environmental management framework

A number of environmental management measures have been identified in order to minimise adverse environmental impacts which could potentially arise as a result of the project. These management measures will be incorporated into the detailed design and applied during the construction and operation of the project.

The main project specific environmental management plan to ensure that appropriate practices are followed during construction is the CEMP. A CEMP for the project will be prepared in accordance with DPIE's Environmental Management Plan Guideline for Infrastructure Projects (DPIE 2020g) and will detail how the performance outcomes, commitments, and environmental management measures for the project will be implemented and achieved during all stages of construction. The CEMP will also provide the roles and responsibilities of key construction personnel and describe how environmental risks associated with the project will be managed and be complemented by the various sub-plans included in **Table 24-2**.

The CEMP would also include reference to all relevant Transport for NSW environmental processes and procedures that are commonly used and proven control measures during the delivery of major road infrastructure projects. These processes and procedures serve to comply with relevant NSW environmental legislation, regulation and guidelines. Management measures included in **Table 24-2** are in addition to these existing Transport processes.

The CEMP will be prepared prior to construction of the project (or as required) and will be reviewed and certified by Transport prior to the commencement of any on-site work. The CEMP will be a working document, subject to ongoing change and updated as necessary to respond to specific requirements.

24.1.1 Summary of management measures

A summary of the environmental management measures that will be implemented during the construction and operation of the project is presented in **Table 24-2**.

Table 24-2 Environmental management measures for the project

Impact	Reference	Environmental management measure	Responsibility	Timing
Traffic and transport				
Management of traffic during construction	TT01	A Traffic Management Plan (TMP) will be prepared and implemented in accordance with the Traffic Control at Work Sites Manual (Roads and Maritime Services 2018b) and QA Specification G10 Control of Traffic. The TMP will include: • Confirmation of haulage routes, including minimisation of haulage movements during peak periods on routes where feasible. • Access management plan to ensure access to properties can be maintained where it is safe and feasible during construction • Site specific traffic control measures (including signage) to manage and regulate traffic movement • Measures to manage temporary changes to the road network including use of barriers, lane occupancies or temporary road closures • Measures to maintain pedestrian and cyclist access (including communication, signage and alternative routes) • Requirements and methods to consult and inform the local community of impacts on the local road network (including for out of hours work) • Access to ancillary and 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.	Contractor	Prior to construction/ construction
Property access	TT02	Existing accesses to properties and businesses will be maintained during construction. Where this is not feasible or reasonable, temporary alternative access arrangements will be provided following consultation with the affected property and business owners.	Transport / Contractor	Detailed design/ prior to construction/ construction
	TT03	Access will be maintained to rail infrastructure facilities along Aurizon access road. Transport will liaise with Aurizon and ARTC during detail design and construction.	Transport / Contractor	Detailed design/ prior to construction/ construction
Impacts to bus services	TT04	Any changes to bus stops will be implemented in consultation with Transport, relevant councils, and relevant bus operators.	Contractor	Prior to construction/ construction

Impact	Reference	Environmental management measure	Responsibility	Timing
Emergency vehicle access	TT05	Where possible, access for emergency vehicles will be maintained at all times during construction. Any site-specific requirements will be determined in consultation with the relevant emergency services agency.	Contractor	Construction
Maritime impacts	TT06	A navigational channel would be provided during construction within the Hunter River	Contractor	Construction
Damage or impacts on local road infrastructure	TT07	A road dilapidation report will be prepared before impacts on local roads commence. The report will document the existing conditions of local roads. This report will be issued to councils and stakeholders as relevant.	Contractor	Prior to construction
Noise and vibration				
General construction noise and vibration	NV01	A Construction Noise and Vibration Management Plan (CNVMP) would be prepared for the project to mitigate and manage noise and vibration impacts. The CNVMP would include: • All potential significant noise and vibration generating activities associated with the activity • Measures to be implemented during construction to minimise noise and vibration impacts, such as restrictions on working hours, respite periods, staging, placement and operation of ancillary facilities, temporary noise barriers, haul road maintenance, and controlling the location and use of vibration generating equipment • A monitoring program to assess performance against relevant noise and vibration criteria • Process for the implementation of respite periods to provide residents with respite from ongoing impact • Arrangements for consultation with affected receivers, including notification and complaint handling procedures • Contingency measures to be implemented in the event of noncompliance with noise and vibration criteria.	Contractor	Prior to construction/ construction
	NV02	Where reasonable and feasible, implementation of recommended operational noise mitigation would be carried out within 12 months of construction activities commencing.	Transport / Contractor	Prior to construction/ construction
Vibration impacts to residential and commercial structures	NV03	Where vibration generating activities will be carried out within minimum working distances for cosmetic damage, vibration monitoring will be carried out. Where monitoring indicates cosmetic damage criteria are exceeded, alternative low vibration work practices will be investigated and implemented.	Contractor	Construction

Impact	Reference	Environmental management measure	Responsibility	Timing
Vibration impacts to utilities	NV04	Where works are within 25m of utilities consultation will be carried out with the relevant utility authorities to establish site specific mitigation measures to manage potential vibration impacts.	Contractor	Construction
Vibration impacts to heritage structures	NV05	Heritage items within 100m of vibration intensive work are to be considered on a case by case basis and further investigation would be carried out during detailed design to confirm the structural integrity (i.e. structurally sound or unsound) of all potentially affected structures. Where items are considered sensitive to vibration, appropriate vibration criteria would be determined after detailed inspections have been completed.	Contractor	Prior to construction/ construction
Blasting	NV06	If blasting is to be included as part of the construction work, the CNVMP would include a Blast Management Plan (BMP). The BMP would be prepared in consultation with the EPA, demonstrating that all blasting and associated activities would be carried out in a manner that would not generate unacceptable noise and vibration impacts or pose a substantial risk impact to residences and sensitive receivers.	Contractor	Prior to construction/ construction
Operational road traffic noise impacts	NV07	Operational noise and vibration mitigation measures would be identified in an Operational Noise and Vibration Review (ONVR). Requirements for mitigation measures, including quieter noise pavements, noise barriers, and at-property treatments, would be reviewed as part of the ONVR and as the detailed design progresses. Detailed information on floorplans and facade construction for school classrooms, places of worship and childcare centres determined to exceed the applicable Noise Criteria Guideline (NCG) (Roads and Maritime Services 2015c) internal noise criteria will be obtained during design development. The implementation of treatments would be carried out in accordance with the Noise Mitigation Guideline (NMG) (Roads and Maritime Services 2015d).	Transport / Contractor	Detailed design/ construction/ prior to operation
Operational road traffic noise impacts	NV08	Within 12 months of starting project operation, actual operational noise performance would be compared to predicted operational noise performance to analyse the effectiveness of the operational road traffic noise mitigation measures. Additional reasonable and feasible mitigation would be considered where any additional receivers are identified as qualifying for consideration of noise mitigation under the NMG.	Transport / Contractor	Operation

Impact	Reference	Environmental management measure	Responsibility	Timing
Impacts from Out of Hours Works	NV09	An Out of Hours Work Procedure will be included as part of the CNVMP. The procedure will follow the approach in Roads and Maritime Services' Construction Noise and Vibration Guideline (Roads and Maritime Services 2016b) and include, but not be limited to: • Scheduling of noise intensive or high noise impact work to evening periods where feasible • Use of alternative plant and equipment and/or construction techniques to minimise noise • Notification and consultation requirements including preparation of a 'look ahead' program for likely out of hours work • Use of temporary noise barriers • Respite periods • Representative noise monitoring • Offers of reasonable and temporary alternative accommodation or an act of good will • Use of negotiated agreements.	Contractor	Construction
Biodiversity				
Loss of vegetation and habitat for flora and fauna including threatened species	B01	A Flora and Fauna Management Plan (FFMP) will be prepared in accordance with the 'Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects' (RTA 2011). It will address terrestrial and aquatic matters and include, but not necessarily be limited to: • Plans for the construction footprint and adjoining areas showing native vegetation, flora and fauna habitat, threatened species and endangered ecological communities • Procedures addressing relevant matters specified in the 'Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects' (RTA 2011) • Procedures for the protection of aquatic fauna associated with instream works. All personnel working on site will receive training to ensure awareness of requirements of the FFMP and relevant statutory responsibilities.	Contractor	Detailed design/ prior to construction
	B02	Pre-clearing surveys will be carried out in accordance with 'Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects' (Guide 1: Pre-clearing process) (RTA 2011).	Contractor	Prior to construction
	B03	If any threatened species, not assessed in the biodiversity assessment, are identified in the construction footprint, the unexpected species find procedure is to be followed under 'Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects' (RTA 2011).	Contractor	Construction
	B04	Vegetation and habitat removal will be carried out in accordance with 'Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects' (Guide 4: Clearing of vegetation and removal of bushrock) (RTA 2011).	Contractor	Construction

Impact	Reference	Environmental management measure	Responsibility	Timing
	B05	Revegetation will be carried out in accordance with 'Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects' (RTA 2011) (Guide 3: Re-establishment of native vegetation) and the Landscape Plan prepared for the project.	Contractor	Construction
	B06	Re-use of woody debris and bushrock and installation of nest boxes would be carried out in accordance with the 'Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects' (RTA 2011), Guide 5 & Guide 8.	Contractor	Construction
Potential impacts to aquatic habitat	B07	Aquatic habitat will be protected in accordance with Guide 10: Aquatic habitats and riparian zones of the 'Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects' (RTA 2011) and where practicable, Section 3.3.2 Standard precautions and mitigation measures of the 'Policy and guidelines for fish habitat conservation and management Update 2013' (DPI 2013a)	Contractor	Construction
Fragmentation of habitat and barrier effects and fauna mortality during operation	B08	Fauna crossing and exclusion fencing structures would be designed and constructed to facilitate fauna connectivity and exclusion across the project in accordance with the Biodiversity Assessment Report.	Transport/ Contractor	Detailed design/ construction
Edge effects on adjacent native vegetation and habitat	B09	Exclusion zones will be set up at the limit of clearing in accordance with 'Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects' (RTA 2011) (Guide 2: Exclusion zones).	Contractor	Construction
Injury and mortality of fauna during clearing and construction	B10	Fauna will be managed in accordance with 'Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects' (RTA 2011) (Guide 9: Fauna handling).	Contractor	Construction
Invasion and spread of weeds	B11	Weed species will be managed in accordance with 'Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects' (RTA 2011) (Guide 6: Weed management).	Contractor	Construction

Impact	Reference	Environmental management measure	Responsibility	Timing
Invasion and spread of pest animal, pathogens and disease	B12	Pest species and pathogens will be managed in accordance Guide 2: Exclusion zones of the 'Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects' (RTA 2011), the Commonwealth *Biosecurity Act 2015,* NSW *Biosecurity Act 2015* and where relevant, the Australian Ballast Water Management Requirements.	Contractor	Construction
Noise, light and vibration	B13	The need for artificial lighting during construction and operation will be minimised where feasible, including directing lighting away from vegetated areas where practicable.	Contractor	Detailed design/ construction
Hydrology and flooding				
Flooding impacts during construction	FH01	A Flood Management Plan (FMP) will be prepared for the project and will detail the processes for flood preparedness, materials management, weather monitoring, site management and flood incident management. The FMP will also address procedures and responsibilities for flood response (preparation of site upon receipt of flood warning, evacuation of site personnel) during and recovery following a flood event. The FMP will also include: • Consideration of temporary traffic arrangements to minimise impact on flood evacuation route traffic capacity. • Appropriate measures to manage potential flood impact associated with temporary ancillary facilities subject to flooding within 20% AEP flood level • Where feasible, the size of the ancillary facilities and the height and extent of temporary access tracks will be reduced to minimise flood impacts • Ancillary facilities will also be designed to provide for conveyance of flood flows in order to minimise flooding impacts to adjacent properties and environment.	Transport/ Contractor	Prior to construction
Potential changes to flood impacts resulting from detailed design	FH02	Any changes to the design described in this EIS would be further investigated during detailed design, including further flood investigations and hydrological and hydraulic modelling to ensure the flood immunity objectives and performance criteria for the project are met. The detailed design will consider refinement to temporary and permanent access roads to further reduce flood afflux with impacts to drainage capacity, where reasonable and feasible.	Transport / Contractor	Detailed design
Flooding impacts on property	FH03	Consultation will be carried out with landowners impacted by flood affects from the project which exceed the flood management objectives (afflux, change in flood hazard, change in time of inundation) about reasonable and feasible management measures. Further modelling may be carried out at detailed design to assess impacts to property.	Transport/ Contractor	Detailed design

Impact	Reference	Environmental management measure	Responsibility	Timing
Impacts on existing drainage systems	FH04	Existing hydraulic capacity of drainage systems will be maintained during construction where practicable.	Contractor	Construction
	FH05	The requirement to provide further upgrades to existing drainage systems will be considered at detailed design where there is: • An increase of more than 20 per cent in the peak discharge rate during operation • An increase in drainage system capacity within the project footprint but where downstream infrastructure has not been upgraded.	Contractor	Detailed design
Impacts to flood mitigation schemes	FH06	The design of temporary and permanent works will ensure there is minimal impact to the function and flow capacity of the Hunter Valley Flood Mitigation Scheme or as otherwise agreed during consultation with operators of the scheme.	Transport/ Contractor	Detailed design
Impacts to river banks immediately downstream of project discharge locations during construction	FH07	Monitoring of temporary construction phase stormwater discharge locations to minimise downstream geomorphological impacts from the project will be included in the Construction Soils and Water Management Plan.	Contractor	Construction
Impacts to river banks immediately downstream of project discharge locations during operation	FH08	The project design aims to ensure that stormwater discharge velocities are controlled at the project outlet to ensure minimal downstream impacts occur immediately downstream of the project. A geomorphological survey will be completed of the waterways downstream of the discharge points where there is greater than 20 per cent increase in stormwater discharge from the project. Waterways (channels and banks) immediately downstream of these project discharge locations will be monitored for a minimum period of twelve months or until establishment and stabilisation. Monitoring will look for evidence of initiation of erosion and scour and, if required, carry out appropriate remediation measures.	Transport/ Contractor	Operation
Impact to surface water and groundwater hydrology	FH09	Baseline monitoring of hydrological attributes would be carried out prior to the commencement of construction, with ongoing monitoring during construction and the initial stages of operation (refer to Hydrology and Flooding Working Paper (**Appendix J**)).	Transport/ Contractor	Prior to construction / construction/ operation

Impact	Reference	Environmental management measure	Responsibility	Timing
Surface water and groundwater quality				
General	WQ01	A Construction Soils and Water Management Plan (CSWMP) would be developed as a sub plan of the CEMP and will outline measures to manage soil and water quality impacts associated with the construction work, including contaminated land. The CSWMP would include but not be limited to: • Measures to minimise/manage erosion and sediment transport both within the construction footprint and offsite including requirements for the preparation of erosion and sediment control plans (ESCP) for all progressive stages of construction and the implementation of erosion and sediment control measures • Erosion and sediment control measures, which will be implemented and maintained in accordance with Managing Urban Stormwater – Soils and Construction, Volume 1 (Landcom 2004) and Volume 2D (DECC 2008) • Measures to manage stockpiles including locations, separation of waste types, sediment controls and stabilisation in accordance with the Stockpile Site Management Guideline (Roads and Maritime Services 2015e). • Procedures for dewatering (including waterways, wetlands and excavations and temporary sediment basins) including relevant discharge criteria. • Concrete waste management procedures • Measures to manage accidental spills including the requirement to maintain materials such as spill kits, an emergency spill response procedure and regular visual water quality checks when working near waterways • Measures to manage tannin leachate and potential saline soils • Controls for sensitive receiving environments which may include but not be limited to identification of 'no go' zones for construction plant and equipment (where applicable).	Contractor	Prior to construction/ construction/ operation
	WQ02	A soil conservation specialist will be engaged for the duration of construction of the project to provide advice on the planning and implementation of erosion and sediment control including review of the CSWMP and ESCP.	Transport / Contractor	Prior to construction/ construction/ operation
Water reuse	WQ03	A water reuse strategy will be developed as part of the CEMP for both construction and operational phases of the project to reduce reliance on potable water. Any water from sediment basins will be checked to ensure compliance with ANZG (2018) Water Quality Guidelines prior to reuse.	Contractor	Detailed design/ prior to construction/ construction

Impact	Reference	Environmental management measure	Responsibility	Timing
Discharge of saline groundwater to drinking catchment	WQ04	Basins and swales within the Tomago Sandbeds drawdown area will be lined during construction and operation.	Contractor	Detailed design
Discharge of saline groundwater to surface waterways	WQ05	Basins TB04, TB06, TPB10 (PB12), TPB18 (PB24), PB14 and PB15 shall be further investigated to confirm requirement for lining to avoid discharge of saline groundwater to surface waterways during construction and operation.	Transport	Detailed design
Surface water quality and groundwater quality impacts	WQ06	A water quality monitoring program will be developed in accordance with the Guidelines for Construction Water Quality Monitoring (RTA 2003b). The program will monitor surface water quality and groundwater quality during construction and during operation.	Transport / Contractor	Prior to construction/ construction/ operation
Aboriginal heritage				
Impacts on known Aboriginal sites	AH01	An Aboriginal Cultural Heritage Management Plan (ACHMP) will be prepared in accordance with the Procedure for Aboriginal cultural heritage consultation and investigation (Roads and Maritime Services 2011b) and Standard Management Procedure – Unexpected Heritage Items (Roads and Maritime Services 2015f). The ACHMP will be prepared in consultation with all relevant Aboriginal groups. The ACHMP will include: • Details of investigations completed or planned to be carried out and any associated approvals required • Mapping of areas of Aboriginal heritage value and identification of protection measures to be applied during construction • Procedures to be implemented if previously unidentified Aboriginal objects, including skeletal remains, are discovered during construction • An induction program for construction personnel on the management of Aboriginal heritage values • Opportunities for on-going Aboriginal community engagement in the project.	Transport / Contractor	Prior to construction
	AH02	Archaeological salvage excavation, surface collection and exclusion fencing as detailed in Table 9-1 of the Aboriginal Cultural Heritage Assessment Report must be carried out in accordance with the methodology specified in the Chapter 9 of the Aboriginal Cultural Heritage Assessment Report (**Appendix L**).	Contractor / Transport	Prior to construction/ construction

Impact	Reference	Environmental management measure	Responsibility	Timing
Socio-economic				
Community consultation	SE01	A Community Communication Strategy (CCS) will be prepared for the project to facilitate communication with the community and stakeholders including relevant Government agencies, Councils, adjoining affected landowners and businesses, residents, motorists and other relevant stakeholders that may be affected by the project. The strategy will: • Identify people or organisations to be consulted during the delivery of the project • Set out procedures and mechanisms for the regular distribution of information about the project • Outline mechanisms to keep relevant stakeholders updated on site construction activities, schedules and milestones • Outline avenues for the community to provide feedback (including a 24-hour, toll free project information and complaints line) or to register complaints and through which Transport will respond to community feedback • Outline a process to resolve complaints and issues raised.	Transport/ Contractor	Prior to construction
Business impacts	SE02	Signage will be provided in accordance with Transport signage policy to inform the travelling public about services in Beresfield and Heatherbrae.	Transport	Construction/ prior to operation
Land use and property				
Property acquisition	LU01	All partial and full acquisitions and associated property adjustments will be carried out in accordance with the requirements of the *Land Acquisition (Just Terms Compensation) Act 1991* and the Land acquisition reform 2016 in consultation with landowners. This will include the provision of monetary compensation determined in accordance with the provisions of the Act.	Transport	Prior to construction
	LU02	Property adjustments will be completed in consultation with property owners/business managers.	Transport / Contractor	Prior to construction/ construction
Rehabilitation of affected land	LU03	Land subject to temporary use will be rehabilitated as soon as practicable to an appropriate condition, taking into consideration the location, land use characteristics, area and adjacent land uses. This will be carried out in consultation with the land owner.	Transport / Contractor	Construction

Impact	Reference	Environmental management measure	Responsibility	Timing
Urban design and visual amenity				
Landscape character and visual impacts including during construction	UD01	An Urban Design and Landscape Plan (UDLP) will be prepared to support the project. The plan will present an integrated urban design for the project, providing practical detail on the application of design principles and objectives identified in the EIS. The plan will include: • Location and identification of existing vegetation and proposed landscaped areas, including species to be used • Built elements including retaining walls, bridges and noise barriers • Walking and cyclist elements including footpath locations, paving types and pedestrian crossings • Fixtures such as lighting, fencing and signs • Details on the staging of landscape work including related environmental controls such as erosion and sedimentation controls and drainage • Procedures for monitoring and maintaining landscaped or rehabilitated areas • The project will consider CPTED principles during detailed design to minimise safety and security risks to all users and communities in the study area. The project will carry out CPTED reviews at each milestone by a qualified professional. Additional recommendations as a result of reviews will be implemented where reasonable and feasible • Water sensitive urban design solutions. The plan will be prepared in accordance with Transport urban design policy guidelines including: • Beyond the Pavement – Urban design approach and procedures for road and maritime infrastructure planning, design and construction (Transport for NSW 2020a) • Landscape design guideline: Design guideline to improve the quality safety and cost effectiveness of green infrastructure in road corridors (Roads and Maritime Services 2018a) • Bridge Aesthetics: Design Guidelines to improve appearance of bridges in NSW (Transport for NSW 2019a) • Noise wall design guideline: Design guideline to improve the appearance of noise walls in NSW (Transport for NSW 2016a) • Shotcrete Design Guideline: Design guidelines to avoid, minimise and improve the appearance of shotcrete in NSW (Transport for NSW 2016b) • Water sensitive urban design guideline, Applying water sensitive urban design principles to NSW transport projects (Transport for NSW 2017b).	Contractor	Prior to construction
	UD02	Disturbed areas outside the operational footprint and within the construction footprint will be revegetated following completion of construction activities.	Contractor	Construction

Impact	Reference	Environmental management measure	Responsibility	Timing
	UD03	Cut batters and fill embankments for the project will be designed to allow revegetation to assist with the integration of the project into the surrounding landscape where possible depending on site conditions.	Contractor	Construction
	UD04	Project construction elements such as fencing and hoardings will be designed to minimise impacts to landscape character and visual amenity where practicable	Transport/ Contractor	Prior to construction/ construction
	UD05	Temporary and permanent lighting will be installed and operated in accordance with AS/NZS1158 Lighting for Roads and Public Spaces.	Transport/ Contractor	Prior to construction/ construction
Aboriginal cultural heritage	UD06	The project detailed design will incorporate relevant Aboriginal cultural heritage elements of Beyond The Pavement (Transport for NSW 2020a) and Designing With Country (GANSW 2020), where practical.	Transport/ Contractor	Prior to construction/ construction
Soils and contamination				
Soil and groundwater contamination	SC01	A Contaminated Land Management Plan (CLMP) and procedures prepared in accordance with TfNSW's Guideline for the Management of Contamination (Roads and Maritime Services 2013c) will be developed and will include: • Control measures to manage identified areas of potential contamination risk (AOPCRs), where the risk has been assessed as being medium or high and is confirmed within the construction footprint • Procedures for managing unexpected contamination (including buried waste, illegal dumping and asbestos) • Requirements for the disposal of contaminated waste in accordance with the *Protection of the Environment Operations Act 1997* and the Protection of the Environment Operations (Waste) Regulation 2014.	Contractor	Prior to construction/ construction
Salinity	SC02	A Salinity Management Plan will be prepared and implemented as part of the CSWMP and in accordance with the NSW Department of Primary Industries (2014) Salinity Training Handbook. The plan will include (but not be limited to): • Identification and management of saline groundwater discharge sites • Identification of areas sensitive to salinity and subject to saline soil import limitations (such as the Tomago Sandbeds Catchment Area) • Testing and reuse conditions of saline soils • Requirements for reuse of saline water.	Contractor	Prior to construction/ construction

Impact	Reference	Environmental management measure	Responsibility	Timing
Acid sulfate soils	SC03	An Acid Sulfate Soils Management Plan (ASSMP) will be prepared and implemented as part of the CSWMP and in accordance with TfNSW's Guidelines for the Management of Acid Sulfate Materials (RTA 2005c) and the Acid Sulfate Soil Manual (ASSMAC 1998). The ASSMP will outline how potential ASS within sediments of the waterways and soils that will be disturbed within the construction footprint will be handled, tested, treated and reused during construction.	Contractor	Prior to construction/ construction
Former mineral sands processing facility	SC04	A Remediation Action Plan prepared and implemented in accordance with TfNSW Guideline for the Management of Contamination (Roads and Maritime Services 2013c), in consultation with NSW EPA and approved by a NSW EPA accredited site auditor for the former mineral sands processing facility.	Contractor	Prior to construction/ construction
Non-Aboriginal heritage				
Non-Aboriginal heritage impacts	NA01	A Non-Aboriginal Heritage Management Plan (NAHMP) would be prepared prior to construction in consultation with Heritage NSW. As a minimum, the NAHMP would include the following: • A list, plan and maps with GIS layers showing the location of identified heritage items both within, and near, the construction footprint • Procedures to be implemented during construction to avoid or minimise impacts on items of heritage significance including protective fencing • The Unexpected Heritage Items Procedure (Transport for NSW 2019b) which will be followed in the event that unexpected heritage finds are uncovered during construction • A procedure for the unexpected discovery of human skeletal remains as per the Skeletal remains: guidelines for the management of human skeletal remains (NSW Heritage Office 1998).	Transport/ Contractor	Prior to construction
Hannell Family Vault	NA02	• A dilapidation survey will be carried out. • Barrier fencing will be erected between the construction project activities and vault structure.	Contractor	Prior to construction/ construction
Glenrowan Homestead	NA03	• Archival photographic recording of Site 2 will be carried out prior to demolition. • Archaeological salvage excavation at Site 3 under the supervision of an Excavation Director, who meets the NSW Heritage Council criteria will be carried out prior to works proceeding. • A dilapidation survey will be carried out. • Architectural noise treatment at the main house at Site 1 would be sympathetic to the heritage values of the item.	Contractor	Prior to construction
Residence, 29 Eastern Avenue, Tarro	NA04	• A dilapidation survey will be carried out. • Architectural noise treatment at the heritage residence would be sympathetic to the heritage values of the item.	Contractor	Prior to construction

Impact	Reference	Environmental management measure	Responsibility	Timing
Tarro Historic Site	NA05	If construction works are to take place within the site curtilage further archaeological investigation under the supervision of an Excavation Director, who meets the NSW Heritage Council criteria, would be carried out as follows: • Non-invasive survey using ground penetrating radar or other appropriate geophysical inspection technique will be carried out across the curtilage of the heritage item to assist in identifying the presence of burials or other archaeological features. • Following the non-invasive survey, archaeological test excavation of the heritage item within the construction footprint will be carried out to confirm presence and nature of archaeological relics in accordance with a research design and methodology to be developed.	Contractor	Detailed design/ prior to construction/ construction
Tarro Substation and Pumping Station	NA06	• A dilapidation survey will be carried out.	Contractor	Detailed design/ prior to construction/ construction
Newcastle Crematorium and Our Lady of Lourdes Church	NA07	Architectural noise treatment at the heritage buildings would be sympathetic to the heritage values of the item.	Contractor	Detailed design/ prior to construction/ construction
Air quality				
Adverse air quality during construction	AQ01	Preparation and implementation of an Air Quality Management Plan (AQMP) to minimise risks to air quality. The AQMP will identify: • Potential sources of air pollution (including odours and dust) during construction • Air quality management objectives consistent with relevant published guidelines • Identification of all dust and odour sensitive receivers • Measures to manage dust • Requirements to separate temporary project specific asphalt batching plants, if feasible, from the nearest residences by at least 300m • Community notification and complaint handling procedures.	Contractor	Detailed design/ prior to construction

Impact	Reference	Environmental management measure	Responsibility	Timing
Waste				
Avoid, minimise and sustainably manage waste	WM01	A Waste Management Plan (WMP) will be prepared and implemented to manage and minimise the generation of waste and encourage reuse of materials. It will include, but not be limited to: • Identification of the waste types and volumes that are likely to be generated by the project • Adherence to the waste minimisation hierarchy principles of avoid/ reduce/ reuse/ recycle/ dispose • Waste management procedures to lawfully manage the handling and disposal of waste • Identification of reporting requirements and procedures for tracking of waste types and quantities • A resource management strategy detailing the process to identify reuse options for surplus materials • Site-specific waste management plans for concrete and asphalt batching plants • Spoil management procedures outlining reuse and disposal • Identification of areas for management of materials.	Contractor	Detailed design/ prior to construction/ construction
Management of spoil	WM02	Spoil management procedures will be outlined in the WMP. Spoil will be beneficially reused as part of the project before alternative spoil disposal options are considered. Any excess spoil will be managed using the following order of priorities: • Review alignment and profile refinements during detailed design • Assess opportunities to reuse excess spoil in works within the construction footprint or in adjacent land • Beneficial reuse within the construction footprint for rehabilitation of ancillary facilities • Transfer to other nearby Transport projects for immediate use, use on future projects, or routine maintenance • Transfer to a Transport approved site for reuse on other projects • Disposal at an approved materials recycling or licensed waste disposal facility.	Contractor	Construction

Impact	Reference	Environmental management measure	Responsibility	Timing
Sustainability				
Project sustainability outcomes	SU1	A Sustainability Management Plan (or similar framework) for the project will be developed and implemented during detailed design and construction, detailing measures to meet the project's sustainability objectives and targets. The Sustainability Management Plan will: • Demonstrate leadership and commitments to sustainability • Adopt relevant sustainability performance targets in accordance with the Transport Sustainability Strategy • Identify sustainable procurement requirements • Document the process for the identification, assessment and implementation of sustainability initiatives and opportunities • Document the process to be used to monitor and review of sustainability performance against achieving the project's sustainability targets • Outline the documentation and reporting requirements for sustainability on the project.	Transport/ Contractor	Prior to construction/ construction
Climate change and greenhouse gas				
Flood Risk	CC01	Hydrological and hydraulic assessments would be carried out for any design changes during detailed design and would consider the climate change related flood risks to the project and flood impacts from the project.	Contractor	Detailed design
Safety and risk				
Bushfire	HS01	A Bushfire Management Plan prepared in accordance with the Planning for Bush Fire Protection 2006 (Rural Fire Service 2006). Measures to be implemented to manage bushfire risk include: • Community notifications in the event of a bushfire • Ensuring plant and equipment are fitted with appropriate spark arrestors, where practicable • Ensuring site workers are informed of the site rules including designated smoking areas and putting rubbish in designated bins • Obtaining hot work permits and implementing total fire bans as required • Implementing adequate storage and handling requirements for potentially flammable substances in accordance with the relevant guidelines.	Contractor	Prior to construction

Impact	Reference	Environmental management measure	Responsibility	Timing
Subsidence risk	HS02	• Potential residual risks surrounding the un-remediated exploration shaft near the John Renshaw Drive road corridor would be managed by the contractor.	Contractor	Prior to construction/ construction
Cumulative impacts				
Cumulative impacts	CI01	The construction contractor will review traffic impacts before the start of construction and as required during construction. Any changes to manage cumulative traffic impacts will be included in the Traffic Management Plan (TMP).	Contractor	Prior to construction/ construction

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M1 Pacific Motorway extension to Raymond Terrace

Environmental impact statement – Chapter 25: Environmental risk analysis

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25. Environmental risk analysis

This chapter outlines the environmental risk analysis process carried out for the project, and identifies key environmental risks associated with the project.

25.1 Assessment methodology

25.1.1 Identification of environmental risk categories

The assessment of environmental risk associated with the project included:

- Carrying out a preliminary environmental investigation (PEI) as part of the State significant infrastructure (SSI) scoping report (Roads and Maritime Services 2015b) to identify key environmental issues, support the SSI application for the project, and help to inform the project SEARs
- Assessing the key issues presented in the SEARs that were issued for the project (refer to **Appendix A** for a complete list of the SEARs and how they have been addressed within the EIS).

The identification and assessment of key issues has continued during the preparation of the EIS. Emphasis was placed on using the detailed information gathered during the assessment process to review the environmental aspects of the project. More specifically, the analysis identified:

- Environmental impacts, including environmental issues identified during design development, key environmental issues in the SEARs and by detailed environmental assessments
- Residual environmental impacts after design was developed and reviewed against the risk or issue, combined with the environmental management measures being implemented.

The environmental issues identified for the project and the associated environmental management measures to manage impacts are described in **Chapter 7** (traffic and transport) to **Chapter 22** (safety and risk). **Chapter 24** (summary of environmental management measures) presents a summary of the environmental management measures, while cumulative impacts associated with the project are assessed in **Chapter 23** (cumulative impacts). Environmental issues identified as negligible or minor were not considered further during the risk assessment process.

25.1.2 Likelihood and consequence analysis

An environmental risk analysis, including a likelihood and consequence analysis, was carried out for each environmental issue identified for the project in accordance with the principles of the Australian and New Zealand standard AS/NZS ISO 31000:2009 Risk Management – Principles and Guidelines.

The environmental risk analysis involved:

- Rating the risk of each identified potential impact by identifying the consequences of the impact and the likelihood of each impact occurring
- Considering the probable effectiveness of the project design and proposed environmental management measures to determine the likely residual risk of each impact.

Definitions of likelihood are provided in **Table 25-1** and the definitions of consequences are provided in **Table 25-2**. The risk rating was then determined by combining the consequence and identify the level of risk as shown in **Table 25-3**.

Table 25-1 Likelihood of environmental risks

Likelihood level	Description
Certain	Expected to happen routinely during the project life
Likely	Could easily happen and has occurred on a previous similar project
Unlikely	Possible, but not anticipated

Table 25-2 Consequence of environmental risks

Consequence	Definition
Minor	• Minor effects on biological, social, economic or physical environment, both built and natural • Minor short to medium term damage to small area of limited significance, easily rectified.
Moderate	• Moderate effects on biological, social, economic or physical environment, both built and natural • Moderate short to medium term widespread impacts. More difficult to rectify.
Major	• Serious effects on biological, social, economic or physical environment, both built and natural • Relatively widespread medium to long term impacts. Rectification difficult or impossible.

Table 25-3 Risk rating matrix

Likelihood	Consequence		
	Minor	Moderate	Major
Certain	Medium	High	High
Likely	Low	Medium	High
Unlikely	Low	Low	Medium

Residual environmental impacts have also been assessed through the risk analysis process. Residual risk ratings were identified after considering the environmental assessment carried out for each environmental issue and the implementation of management measures and safeguards incorporated into the construction methodology and project design described in **Chapter 5**.

25.2 Environmental risk analysis

Using the framework described above, the environmental risk analysis results for the project are presented in **Table 25-4**. The risk analysis identifies an initial risk rating for each of the environmental issues and the residual risk rating derived after the implementation of management measures developed and recommended by this environmental impact statement and the safeguards incorporated into the construction methodology and project design described in **Chapter 5**.

Table 25-4 Environmental risk analysis

Environmental issue	Unmitigated consequence	Unmitigated likelihood	Unmitigated risk	Project response and environmental management measures	Residual consequences	Residual likelihood	Residual risk
Traffic and transport							
Construction traffic impacts on road network performance, including delays, increased travel times, road closures and detours, and parking impacts	Major	Certain	High	• Construction methodology and project design described in **Chapter 5** • A Traffic Management Plan would be implemented during construction (TT01) • Other measures as described in **Chapter 7** (traffic and transport).	Moderate	Likely	Medium
Temporary disruptions to public transport, pedestrians and cyclists during construction	Moderate	Likely	Medium		Minor	Likely	Low
Changes to access arrangements during construction and operation	Moderate	Certain	High	• Property access would be maintained during construction in liaison with property owners (TT02) • Permanent access changes developed in consultation with property owner as described in **Chapter 5** • Other measures as described in **Chapter 7** (traffic and transport).	Minor	Certain	Medium
Temporary maritime traffic impacts during construction of bridge B05 over the Hunter River	Moderate	Likely	Medium	• A navigational channel would be kept open during construction (TT06) • Other measures as described in **Chapter 7** (traffic and transport).	Minor	Likely	Low
Improved operational travel times, connectivity and accessibility in the Lower Hunter Region	Positive impact						
Improved operational intersection and road network performance	Positive impact						

Environmental issue	Unmitigated consequence	Unmitigated likelihood	Unmitigated risk	Project response and environmental management measures	Residual consequences	Residual likelihood	Residual risk
Improved operational freight network connectivity	Positive impact						
Improved operational road safety	Positive impact						
Provision of operational public and walking and cycling links	Positive impact						
Noise and vibration							
Noise and vibration impacts at surrounding sensitive receivers from work during standard construction hours	Major	Certain	High	• A Construction Noise and Vibration Management Plan would be prepared to mitigate and manage noise impacts during construction in (NV01) • Requirements for further noise treatments, including quieter noise pavements, noise barriers and at-property treatments would be reviewed as part of the Operational Noise and Vibration Review (NV07) • Where reasonable and feasible, implementation of operational noise mitigation would be carried out within 12 months of commencement of construction (NV02) • Other measures as described in **Chapter 8** (noise and vibration).	Moderate	Likely	Medium
Noise and vibration impacts at surrounding sensitive receivers from work outside of standard construction hours	Major	Certain	High		Moderate	Likely	Medium
Increase in operational road traffic noise at surrounding sensitive receivers	Major	Likely	High		Moderate	Likely	Medium

Environmental issue	Unmitigated consequence	Unmitigated likelihood	Unmitigated risk	Project response and environmental management measures	Residual consequences	Residual likelihood	Residual risk
Biodiversity							
Impacts to threatened flora, fauna habitat, wetlands & aquatic habitat and reduction of the footprint of endangered ecological communities beyond those assessed and offset in this EIS	Major	Certain	High	• Avoidance and minimisation of impacts to sensitive environmental areas has been considered in the development of the preferred project as described in **Chapter 4** and **Chapter 5** • A Flora and Fauna Management Plan will be prepared for construction activities (B01) • Creek corridors will be revegetated with native riparian vegetation suitable for the local area (B05) • Aquatic habitat protection measures will be implemented during construction (B07) • Offset requirements have been quantified as biodiversity offset credit requirements. Refer to **Chapter 9** (biodiversity) for the project's identified offset requirements • Other measures as described in **Chapter 9** (biodiversity).	Moderate	Likely	Medium
Fragmentation of native vegetation and habitat corridors	Major	Likely	High	• Fragmentation has been minimised by design and alignment of the project as described in **Chapter 4** and **Chapter 5** • Connectivity measures will be implemented (B08).	Moderate	Unlikely	Low
Invasion and spread of pests and weeds	Moderate	Likely	Medium	• Weed species, pest species and pathogens will be managed (B11, B12).	Minor	Unlikely	Low
Indirect impacts on fauna from increased light and vibration during construction and operation	Moderate	Likely	Medium	• The project design has minimised the need for lighting • Artificial lighting will be minimised where feasible (B13).	Minor	Likely	Low

Environmental issue	Unmitigated consequence	Unmitigated likelihood	Unmitigated risk	Project response and environmental management measures	Residual consequences	Residual likelihood	Residual risk
Hydrology and flooding							
Adverse construction and operational hydrology and flooding impacts on surrounding land, infrastructure, property, business operations and future development due to increases in flood levels and changes to flood behaviour	Major	Likely	High	• The project's 12 bridges and viaduct have been designed to pass over the Hunter River and its floodplain, minimising flood impacts • Flood assessment has been carried out to assess the construction and operational impacts of the project on the existing flood impacts. • A Flood Management Plan will be prepared to detail specific measures to reduce the potential for flooding impacts during construction (FH01) • Transport will consult with landowners adversely impacted by flooding about reasonable and feasible management measures following the completion of additional flood modelling in detailed design (FH03) • Other measures to be implemented during construction and operation of the project are described in **Chapter 10** (hydrology and flooding).	Moderate	Likely	Medium
Operational flood hazards for road users and emergency services on the project	Moderate	Likely	Medium		Moderate	Unlikely	Low
Groundwater drawdown impacts during construction	Moderate	Likely	Medium		Moderate	Unlikely	Low
Operational scour impacts on creeks and minor drainage lines	Moderate	Likely	Medium		Moderate	Unlikely	Low
Operational impacts to hydrology, water availability and flows	Moderate	Likely	Medium		Moderate	Unlikely	Low

Environmental issue	Unmitigated consequence	Unmitigated likelihood	Unmitigated risk	Project response and environmental management measures	Residual consequences	Residual likelihood	Residual risk
Surface water and groundwater quality							
Surface water quality impacts during construction and operation	Major	Likely	High	• Surface water quality measures including basins, have been included in design of the project as described in **Chapter 5** • Surface water and groundwater impacts will be managed with a Construction Soils and Water Management Plan (WQ01) • A surface water and groundwater quality monitoring program will be implemented during construction operation (WQ06) • Other measures to be implemented during construction and operation of the project are described in **Chapter 11** (surface water and groundwater quality).	Moderate	Likely	Medium
Groundwater quality impacts during construction and operation	Moderate	Likely	Medium		Moderate	Unlikely	Low
Aboriginal heritage							
Impact to Aboriginal archaeological heritage items during construction	Major	Certain	High	• Extensive consultation and investigations have been completed with the Aboriginal community as described in **Chapter 12** (Aboriginal cultural heritage) • Environmental management measures, including a salvage program, are described in Chapter 9 of the Aboriginal Cultural Heritage Assessment Report (**Appendix L**).	Moderate	Likely	Medium
Construction impact to previously unidentified Aboriginal archaeological heritage items	Major	Likely	High	• An Aboriginal Cultural Heritage Management Plan will be prepared for construction which will include an unexpected finds procedure (AH01).	Moderate	Unlikely	Low

Environmental issue	Unmitigated consequence	Unmitigated likelihood	Unmitigated risk	Project response and environmental management measures	Residual consequences	Residual likelihood	Residual risk
Socio-economic							
Temporary impacts to businesses during construction	Moderate	Likely	Medium	• Access will be maintained to businesses during construction of the project (TT02) • A Community Communication Strategy (CCS) will be prepared for the project to facilitate communication with the community and stakeholders including relevant Government agencies, Councils, adjoining affected landowners and businesses, residents, motorists and other relevant stakeholders that may be affected by the project. (SE01)	Minor	Likely	Low
Impacts to businesses during operation	Moderate	Likely	Medium	• The project provides interchanges at four locations enabling access from the Motorway to existing businesses along the main alignment as described in **Chapter 5**. • Signage will be provided to advise motorists of services in Beresfield and Heatherbrae. (SE02)	Minor	Likely	Low
Temporary impacts on social infrastructure and community values during construction	Moderate	Likely	Medium	• Access will be maintained to properties (TT02) • A range of environmental management measures as described in **Chapter 7** (traffic and transport), **Chapter 8** (noise and vibration), **Chapter 14** (land use and property) and **Chapter 15** (urban design, landscape and visual amenity) will be implemented to protect community values during construction.	Minor	Likely	Low

Environmental issue	Unmitigated consequence	Unmitigated likelihood	Unmitigated risk	Project response and environmental management measures	Residual consequences	Residual likelihood	Residual risk
Improved access and transport connections when operational	Positive impact						
Reduced congestion and travel times when operational	Positive impact						
Land use and property							
Temporary and permanent property acquisition, access and land use impacts	Moderate	Certain	High	• Consultation with all impacted property owners has occurred throughout development of the project. • All property adjustments will be carried out in accordance with the *Land Acquisition (Just Terms Compensation) Act 1991* and in consultation with landowners (LU01) • Property access will be maintained during construction (TT02) • Property adjustments will be completed in consultation with property owners / business managers (TT02) • Land subject to temporary use will be rehabilitated as soon as practicable to an appropriate land use in consultation with the land owner (LU03) • Other measures as described in **Chapter 14** (land use and property).	Minor	Certain	Medium

Environmental issue	Unmitigated consequence	Unmitigated likelihood	Unmitigated risk	Project response and environmental management measures	Residual consequences	Residual likelihood	Residual risk
Urban design, landscape and visual amenity							
Landscape character and visual impacts from construction activities and construction support sites	Moderate	Likely	Medium	• The Urban Design and Landscape Concept Plan (UDLP) will be updated to support the detail design of the project. (UD01). • Construction elements such as fencing and hoardings will be designed to minimise impacts to landscape character and visual amenity where practicable (UD04) • Other measures as described in **Chapter 15** (urban design, landscape and visual amenity).	Minor	Likely	Low
Landscape character and visual impacts of operational roads, interchanges (including ramps), tie-ins, bridges (including the viaduct)	Moderate	Likely	Medium		Minor	Likely	Low
Soils and contamination							
Soil erosion, impacts from acid sulfate soils and offsite sedimentation during construction	Major	Likely	High	• A Construction Soils and Water Management Plan, including erosion and sediment controls, will be prepared for the project (WQ01) • A Contaminated Land Management Plan, Salinity Management Plan and an Acid Sulfate Soils Management Plan will be prepared for the project (SC01, SC02, SC03) • A Remediation Action Plan will be prepared and implemented for the former mineral sands processing facility. (SC04).	Moderate	Likely	Medium
Impacts resulting from contaminated material, including asbestos and the former mineral sands processing site at Tomago during construction	Major	Certain	High		Moderate	Likely	Medium

Environmental issue	Unmitigated consequence	Unmitigated likelihood	Unmitigated risk	Project response and environmental management measures	Residual consequences	Residual likelihood	Residual risk
Non-Aboriginal heritage							
Impacts to known non-Aboriginal archaeological heritage items during construction	Major	Likely	High	• A Non-Aboriginal Heritage Management Plan would be prepared detailing processes and procedures to ensure protection of known non-Aboriginal heritage items during construction (NA01) • Transport's standard procedure will be followed in the event that any unexpected heritage items are encountered (NA01) • Site specific requirements for non-Aboriginal heritage items that will be impacted during construction are identified in **Chapter 17** (non-Aboriginal heritage).	Moderate	Likely	Medium
Impacts to previously unidentified non-Aboriginal archaeological heritage items during construction	Major	Likely	High		Moderate	Unlikely	Low
Air quality							
Air quality impacts at surrounding sensitive receivers during construction	Moderate	Likely	Medium	• An Air Quality Management Plan will be prepared identifying controls measures in relation to dust and odour during construction (AQ01)	Minor	Unlikely	Low
Odour impacts from acid sulphate soils and batching plants during construction	Moderate	Likely	Medium		Minor	Unlikely	Low
Air quality impacts at surrounding sensitive receivers during operation due to vehicle movements	Moderate	Likely	Medium		Minor	Unlikely	Low

Environmental issue	Unmitigated consequence	Unmitigated likelihood	Unmitigated risk	Project response and environmental management measures	Residual consequences	Residual likelihood	Residual risk
Waste							
Inappropriate handling, management or disposal of construction waste	Moderate	Likely	Medium	• A Waste Management Plan will be prepared, to manage and minimise the generation of waste and encourage reuse of materials, including procedures to manage unexpected waste volume (WM01) • Other measures as described in **Chapter 19** (waste) and included in the project design in **Chapter 5**.	Minor	Unlikely	Low
Unexpected construction waste volumes	Moderate	Likely	Medium		Minor	Unlikely	Low
Sustainability							
A sustainability assessment was carried out for the project as detailed in **Chapter 20** (sustainability). The assessment described how sustainability principles have been applied to the design, construction and operation of the project, including: • Application of the principles of ecologically sustainable development • Legislation and policies relevant to the project • The sustainability framework that has been developed for the project. With the proposed environmental management measures in place there is a low residual risk of the principles of ecologically sustainable development, relevant legislation and policies, or the sustainability framework not being implemented across all elements of the project.							
Climate change risk and greenhouse gas							
Increase in greenhouse gas emissions from construction	Moderate	Certain	High	• If there are design changes during detailed design, further hydrological and hydraulic assessments would be carried out to consider climate change related flood impacts and risks (CC01) • A Sustainability Management Plan (or similar framework) for the project will be developed and implemented during detailed design and construction, detailing measures to meet the project's sustainability objectives and targets. (SU01)	Minor	Certain	Medium
Impact of climate change on road operations and infrastructure	Moderate	Likely	Medium		Minor	Likely	Low

Environmental issue	Unmitigated consequence	Unmitigated likelihood	Unmitigated risk	Project response and environmental management measures	Residual consequences	Residual likelihood	Residual risk
Safety and risk							
Increased exposure to bushfire risk during construction	Major	Likely	High	• A Bushfire Management Plan will be prepared for the project (HS01).	Moderate	Likely	Medium
Mismanagement of incidents during construction	Moderate	Likely	Medium	• Consultation with emergency services, including the NSW Police, RFS and Fire and Rescue NSW would be carried out during detailed design and construction to ensure emergency access is maintained during construction.	Minor	Likely	Low
Cumulative impacts							
Cumulative construction impacts	Moderate	Likely	Medium	• The construction contractor will review traffic impacts before the start of construction and as required during construction. Any changes to manage cumulative traffic impacts will be included in the TMP (CI01).	Minor	Likely	Low
Cumulative operational traffic impacts associated with the Hexham Straight project	Positive impact						

25.3 Risk analysis outcomes

No potential impacts with a residual risk rating of ‘high’ were identified for the project.

A number of ‘medium’ level residual risks were identified. Through the detailed design of the project further review of the ‘medium’ residual risk level items would be carried out, and where necessary implement additional measures to ensure these risks are suitably managed. During further design development there would be further opportunity to:

- Resolve some of the residual impacts through detailed design refinement
- Develop effective construction methodologies and planning with the construction contractor to ensure that management and mitigation measures are effectively implemented
- Implement a process of review, correction and audit for the Construction Environmental Management Plan.

Other issues which have been identified as having a low residual risk would be adequately managed through the implementation of environmental management measures proposed in this environmental impact statement.

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M1 Pacific Motorway extension to Raymond Terrace

Environmental impact statement – Chapter 26: Project justification and conclusion

Transport for NSW | July 2021

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26. Project justification and conclusion

This chapter presents a justification of the project and a conclusion to the EIS. The justification considers how the project balances strategic and project needs against the protection of the environment and planning outcomes outlined in the objects of the *Environmental Planning and Assessment Act 1979* (EP&A Act), including Ecologically Sustainable Development (ESD) and community consultation.

Table 26-1 outlines the SEARs relating to the project justification and conclusion.

Table 26-1 SEARs relating to project justification and conclusion

Secretary's requirement	Where addressed
1. Environmental Impact Assessment Process	
1. The Environmental Impact Statement (EIS) must be prepared in accordance with Part 3 of Schedule 2 of the *Environmental Planning and Assessment Regulation 2000* (the Regulation).	**Section 26.2** addresses the requirements of Part 3 of Schedule 2 of the Regulation regarding the justification for the project, having regard to the principles of ecologically sustainable development.
2. Environmental Impact Statement	
1. The EIS must include, but not necessarily be limited to, the following: (g) a description of how alternatives to and options within the project were analysed to inform the selection of the preferred alternative / option. The description must contain sufficient detail to enable an understanding of why the preferred alternative to, and option(s) within, the project were selected including: − details of the highway corridors and route options considered, and the criteria that was considered in the selection of the preferred route; and − a justification for the preferred proposal taking into consideration the objects of the *Environmental Planning and Assessment Act 1979* (EP&A Act).	Alternatives to the project and route options considered, including how the preferred route was selected are discussed in **Chapter 4**. A justification for the project against the objects of the EP&A Act is provided in **Section 26.1.2**.

26.1 Justification

26.1.1 Project justification

The Pacific Highway and New England Highway between the M1 Pacific Motorway at Black Hill and Raymond Terrace, along with part of John Renshaw Drive, form part of the National Land Transport Network (NLTN). The project is located along this key freight route facilitating substantial interstate freight movements between NSW, Victoria and Queensland, and particularly the freight task between Sydney, the Hunter region, northern NSW and Queensland.

The project is in one of the most highly trafficked areas of the road network in the region and is more heavily congested than adjacent high standard sections of the M1 Pacific Motorway and Pacific Highway corridor. Key issues along the M1 Pacific Motorway, Pacific Highway and New England Highway corridors applicable to the project include:

- High traffic volumes on the New England and Pacific Highways, the M1 Pacific Motorway and John Renshaw Drive
- Lack of capacity and congestion on highly-trafficked routes

- Major delays, primarily between Beresfield, Tomago and Hexham, caused by intersection arrangements and merge/diverge locations
- Road safety
- Restrictions on heavy vehicle movements
- Accessibility for freight to major nearby existing and future employment areas
- Flood immunity of existing road corridors.

The project would help integrate the needs of the Hunter's road network with those of the broader NLTN. By providing one of the last major upgrades required to complete a free flowing dual carriageway route between Sydney and Brisbane, the project would improve traffic efficiency and congestion caused by the interaction of high volumes of National, interstate, regional and local traffic on the currently constrained road network. The project would also promote connectivity between key residential and employment areas, improve road safety and improve flood immunity in this section of the road network. The project objectives are introduced in **Chapter 3**. A summary of how the project achieves the project objectives is provided in **Table 26-2**.

Table 26-2 Assessment of the project against the project objectives

Objectives	Assessment of the project against the objectives
Improve travel time and road network efficiency for freight and commuters on the NLTN at the key strategic junction of the M1 Pacific Motorway, the New England Highway and Pacific Highway	The project would provide an alternative route to the existing road network, improving freight and commuter connectivity and allowing free movement for freight travelling along this section of the NLTN. Travel times would be substantially reduced between Newcastle, Raymond Terrace, Maitland and other regional industrial areas, improving network efficiency for commuting and freight. The project substantially reduces travel times for both the morning and evening peak periods in future years with travel time reductions of between 7-9 minutes in both peak periods along the M1 Pacific Motorway corridor upon opening of the project.
Provide improved long term route reliability along the M1 Pacific Motorway corridor, particularly in relation to congestion reduction, flood immunity and high demand holiday peak travel	The project would provide key infrastructure for movements along the eastern coast of Australia, improving travel time and travel time reliability between Brisbane in the north and Melbourne and Sydney. The project would provide a minimum 5% AEP flood immunity between Black Hill and Raymond Terrace (including 1% AEP local flood immunity between Black Hill and Tomago), improving from the current 20% AEP flood immunity on the existing network. The project would also provide a new flood emergency and evacuation access route (the project itself). The project would provide free-flow, dual carriageway conditions and avoid existing intersections along the M1 Pacific Motorway corridor to provide improved travel time reliability during high demand holiday periods through this part of the road network.
Improve road safety for all road users	The project would have a positive impact on road safety by: • Reducing congestion on the New England Highway and the Pacific Highway, which is expected to reduce rear-end and lane-change crashes • Reducing potential points of conflict between road vehicles on the network, minimising the risk of congestion-related incidents • Providing an improved road alignment, including wider lands and shoulders with barriers, minimising the risk and impact of any off-road crashes.

Objectives	Assessment of the project against the objectives
Provide more efficient access to facilitate economic growth for the Lower Hunter and key regional employment areas such as the Port of Newcastle, Newcastle Airport, Tomago, Beresfield and Black Hill	The project would improve travel times and connectivity to key activity centres in the region, including the Port of Newcastle, Newcastle Airport, Tomago, Beresfield and Black Hill. The project improves accessibility for oversize and overmass freight and enables end to end access by high productivity vehicles (PBS Class 2B heavy vehicles) along the M1 Pacific Motorway corridor across the Hunter River. The project would also improve access and connectivity to current and future employment and growth areas to and from the M1 Pacific Motorway.

As detailed in **Table 26-2** the project achieves the project objectives and is considered appropriate and justified as the potential negative impacts are outweighed by the longer term positive impacts of the project. The project has sought to avoid and minimise environmental impacts through the options selection and design process and would continue to do so during detailed design. Where potential impacts could not be avoided, appropriate environmental management measures have been identified to manage these impacts. An extensive consultation program with community and government stakeholders has been carried out throughout project development, and would continue through EIS display, detailed design and construction to ensure that all stakeholder issues and concerns are understood, documented and addressed where feasible and practicable.

26.1.2 Objects of the EP&A Act

The objects of the EP&A Act provide a framework within which the justification of the project can be considered. Ecologically sustainable development principles have been considered throughout the project's development and are outlined in **Section 26.1.3**. A summary of this assessment is provided in **Table 26-3**.

Table 26-3 Assessment of the project against the objects of the EP&A Act

EP&A Act object	Comment
To promote the social and economic welfare of the community and a better environment by the proper management, development and conservation of the State's natural and other resources.	The project would promote the social and economic welfare of the community by improving road safety, reducing congestion along the local road network, and increasing connectivity of the local and greater road network to key future employment and growth areas. The project would also provide increased the flood immunity of the road network and provide a new flood emergency and evacuation access route (the project itself) in this location. The project has been designed to avoid impacts on natural and other resources and where impacts to natural and other resources are expected, the project has been designed to minimise impacts. Where impacts cannot be minimised through design, environmental management measures will be implemented.
To facilitate ecologically sustainable development by integrating relevant economic, environmental and social considerations in decision-making about environmental planning and assessment	Ecologically sustainable development principles have been considered throughout the project's development and are outlined in **Section 26.1.3**.

EP&A Act object	Comment
To promote the orderly and economic use and development of land	The project is one of the last major remaining upgrades required to complete a high standard dual carriageway connection between Sydney and Brisbane. The project supports current and future planned economic activity by improving regional and inter-regional connectivity, reducing travel times, and alleviating congestion along the local road network. The project would improve access and connectivity to current and future employment and growth areas to and from the M1 Pacific Motorway and Pacific Highway, including: • Future employment and population growth at Raymond Terrace, which is identified as a strategic centre within the Hunter • Growth and development of employment precincts at Tomago, Thornton, Beresfield and Black Hill. For freight, the project would provide an alternative route to the existing road network, improving freight connectivity and allowing free movement for freight travelling along this section of the NLTN. The project design would allow access for oversize and overmass vehicles to key employment areas in the region, including Tomago. The project also provides a bypass of the existing southbound Hexham Bridge, which is a major constraint to freight movements along the NLTN.
To promote the delivery and maintenance of affordable housing	Not applicable to the project.
To protect the environment, including the conservation of threatened and other species of native animals and plants, ecological communities and their habitats	A range of corridor options and design refinements have been considered for the project since planning began in 2004. As a result of this process, the environmental impacts of the project have been minimised, including impacts to ecological communities and native species and their habitats. While the project has been designed to avoid impacts on the natural and built environment, some impacts are still expected. A number of environmental management measures will be implemented to further minimise the direct and indirect ecological impacts of the project, including biodiversity offsets.
To promote the sustainable management of built and cultural heritage (including Aboriginal cultural heritage)	Environmental impacts have been sought to be avoided or minimised through an extensive evaluation of the project. Community consultation particularly in relation to cultural heritage has provided a strong understanding of potential impacts through the project area. As a result of this process, the environmental impacts of the project have been minimised, including impacts to built and cultural heritage (including Aboriginal cultural heritage). The project design has adopted as narrow a footprint as possible in all areas to minimise impacts to Aboriginal heritage sites. The design has also placed the alignment as close as practicable to existing development and infrastructure to limit regional fragmentation impacts and to avoid impacts on less disturbed areas by consolidating the project corridor with existing development, utilities and road corridors. Management measures have been proposed to mitigate impacts to Aboriginal Heritage, such as an extensive salvage program, as outlined in **Chapter 12** (Aboriginal cultural heritage). **Chapter 17** (non-Aboriginal heritage) outlines the management measures being proposed to address the impacts to non-Aboriginal heritage items.

EP&A Act object	Comment
To promote good design and amenity of the built environment	As outlined in **Chapter 15** (urban design, landscape and visual amenity), the design of the project has been guided by five urban design objectives to promote good design and amenity of the built environment: 1. Provide a flowing road alignment that is responsive and integrated with the landscape 2. Provide a landscaped Motorway that integrates with the adjoining natural setting 3. Provide an enjoyable, interesting motorway 4. Value the communities and towns along the road 5. Provide a simplified and unobtrusive road design. An urban design and landscape strategy has also been developed for the project (refer to **Chapter 15** (urban design, landscape and visual amenity)). The strategy has been used to ensure the project fits into the surrounding area, supports local connections and contributes to communities and their natural, built and community setting.
To promote the proper construction and maintenance of buildings, including the protection of the health and safety of their occupants	Not applicable to the project.
To promote the sharing of the responsibility for environmental planning and assessment between the different levels of government in the State	Consultation was carried out with the relevant local councils, State and Commonwealth government agencies in preparation of this environmental impact statement. Consultation carried out to date is discussed in **Chapter 6**.
To provide increased opportunity for community participation in environmental planning and assessment	The project development process has involved extensive, ongoing consultation with relevant stakeholders and the community since planning began in 2004. Consultation carried out for the project, as well as future consultation to be carried out, is discussed in **Chapter 6**.

26.1.3 Ecologically Sustainable Development

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

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

Precautionary principle

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

The precautionary principle has been applied to the project since project inception in 2004. Extensive route options development and stakeholder consultation (refer to **Chapter 4** and **Chapter 6**) has been carried out for the project to avoid or otherwise minimise the environmental impacts of the project. The initial planning for the project saw alternate routes and options not progressing due to potential risks or environmental impacts which would not support the principles of ESD, to avoid impacts to items such as high value biodiversity areas (including wetlands).

The precautionary principle continued to guide the impact assessment and the development of environmental management measures (refer to **Chapter 24** (summary of environmental management measures)). The environmental assessment was prepared using a conservative approach, including an assessment of worst-case scenarios and modelling of the potential impacts of the project to ensure the proposed environmental management measures would effectively manage these impacts. The assessment has been carried out using the best available technical information and has adopted best practice environmental standards and measures to minimise the potential environmental risks of the project. The environmental assessment was carried out in collaboration with key stakeholders and relevant statutory and agency requirements.

This EIS has identified the environmental risks associated with the project and has proposed environmental management measures to avoid or mitigate these risks. Implementation of the identified measures would result in acceptable residual risks and no significant risk of serious or irreversible environmental harm.

Inter-generational equity

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

For road projects, the environmental impacts most relevant to inter-generational equity are biodiversity, water quality, socio-economic, air quality, waste, sustainability and climate change, and cumulative impacts. These are discussed further in **Table 26-4**.

Table 26-4 Inter-generational equity considerations of the project

Aspect	Comment
Biodiversity	Impacts to biodiversity have been avoided and reduced through design refinements as far as practicable. However, the project would still impact biodiversity values, including clearing of native vegetation, habitat removal and fragmentation, and removal of threatened flora. Where impacts to biodiversity could not be avoided, a range of environmental management measures have been proposed to control these impacts. This has included the development of a Biodiversity Offset Strategy, which would be implemented in accordance with the NSW Biodiversity Offsets Policy for Major Projects (OEH 2014b) to offset the vegetation and habitat removal impacts of the project.
Water quality	An assessment of potential impacts to water quality, including groundwater that would be intercepted by project activities, has been carried out for the project. Where potential impacts to water quality have been identified, management measures have been developed to control these impacts. Following the implementation of the proposed management measures, the project is expected to have minor to negligible impacts on existing water quality. Where any minor impacts occur, they are likely to be either highly localised, temporary and/or readily assimilated into the existing waterway.

Aspect	Comment
Socio-economic	The project has been designed with future road traffic needs in mind, taking into consideration future employment and population growth in the region. Once operational, the project would enhance travel times and travel reliability for motorists. Improved access and connectivity provided by the project would support future growth and development of these areas and the wider region. The project would also enable access by high productivity vehicles along the M1 Pacific Motorway and Pacific Highway between Sydney and Brisbane, supporting increased productivity benefits for freight operators. The project would involve diverting traffic from the existing New England Highway and Pacific Highway to travel along the new M1 Pacific Motorway, bypassing Heatherbrae and parts of Beresfield. A reduction in through traffic at Heatherbrae and Beresfield, particularly heavy vehicles, would help to enhance business amenity and improve local business access. Without the bypass, traffic levels in Beresfield and Heatherbrae would continue to increase, impacting on business amenity and customer access. This may reduce the attractiveness of these locations for some customers, particularly in Heatherbrae which has a higher proportion of retail businesses that service customers from surrounding areas. Additionally, the project has provided multiple interchanges to provide opportunity to enter and exit the M1 Pacific Motorway to access these existing businesses.
Air quality	The project will provide free-flow conditions along the main alignment, and the reduction of through motorists from the existing Pacific Highway and most local roads. The assessment of potential air quality impacts for the project has identified that the project would result in reductions in pollutant concentrations along the existing Pacific Highway. Estimated concentrations of CO_2, NO_2, PM_{10}, $PM_{2.5}$ and other key air toxics due to the operation of the project were found to be well below the relevant NSW EPA air quality impact assessment criteria. The project would not result in changes to air quality at local or regional scales that would cause exceedances of air quality criteria at sensitive receivers.
Waste and climate change	Waste generation associated with the project would be short-term (mostly limited to the construction phase) and is not of a scale that is likely to affect the access of current and future generations to resources or waste disposal sites. Sources of greenhouse gas emissions during the construction and operation of the project are negligible
Cumulative impacts	Potential cumulative impacts of the project during construction and operation have been assessed. The assessment identified there is potential for short-term minor cumulative impacts if other projects in the vicinity are under construction at the same time, however, with the exception of Aboriginal heritage in certain sections of the project, these impacts are unlikely to be substantial. The project is expected to have cumulative long-term positive impacts with the Hexham Straight project once both projects are operational.

Conservation of biological diversity and ecological integrity

Conservation of biological diversity and ecological integrity has been a fundamental consideration of the project design development and environmental assessment. As outlined in **Chapter 4**, the project design has been refined several times in order to avoid unnecessary impacts to biodiversity values, including wetlands to the north and south of the Hunter River. These refinements have included:

- Minimising direct impacts to wetlands west of Woodlands Close
- Avoiding and minimising impacts to floodplain wetlands and associated biodiversity with a viaduct across the Hunter River floodplain instead of an embankment
- Minimising fragmentation of habitat, including koala habitat, by aligning the project closely to existing infrastructure and land use
- Avoiding impacts to remnant vegetation, potential habitat for threatened species, connectivity impacts and a population of *Grevillea parviflora* subsp. *parviflora* with the removal of the link road at Tomago.

A biodiversity assessment has been carried out for the project and is provided in **Chapter 9** (biodiversity). This assessment identifies the potential impacts of the project on biodiversity and, where impacts could not be entirely avoided, provides environmental management measures to mitigate these impacts. This has included the development of a Biodiversity Offset Strategy, which would be implemented in accordance with the NSW Biodiversity Offsets Policy for Major Projects (OEH 2014b) to offset the vegetation and habitat removal impacts of the project (refer to **Appendix I**).

Improved valuation and pricing of environmental resources

The principle of internalising environmental costs into decision making requires consideration of all environmental resources which may be affected by the carrying out of a project, including air, water, land and living things. Environmental factors should be included in the valuation of assets and services, such as:

- Polluter pays, that is, those who generate pollution and waste should bear the cost of containment, avoidance or abatement
- The users of goods and services should pay prices based on the full life cycle of costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste
- Environmental goals, having been established, should be pursued in the most cost-effective way, by establishing incentive structures, including market mechanisms, that enable those best placed to maximise benefits or minimise costs to develop their own solutions and responses to environmental problems.

This EIS has examined the environmental impacts of the project and identified appropriate environmental management measures for environmental resources which have the potential to be adversely impacted, including the identification of biodiversity offsets. Management measures to minimise resource use, pollution, waste generation and waste disposal requirements have also been identified. Requirements imposed from implementing these measures would result in an economic cost to Transport and, consequently, appropriate valuation has been given to environmental resources.

26.2 Conclusion

The existing NLTN (M1 Pacific Motorway corridor), between Black Hill to Raymond Terrace is a combination of John Renshaw Drive, the New England Highway and the Pacific Highway. Generally it provides two lanes in both directions with six controlled intersections and speed limits ranging from 60km/h to 90km/h. Construction of the project would address the increasing congestion and travel times along the Pacific and New England Highways, delays at intersections and merge points, and the delays experienced during holiday peak travel times. The project would also improve flood immunity to a minimum 5% AEP flood immunity to travel lanes and a motorway standard road that would reduce crash rates along the M1 Pacific Motorway, New England Highway and the Pacific Highway.

The project would complete one of the last remaining major upgrades required to facilitate significant interstate freight movements between NSW, Victoria and Queensland. Additionally, the project would support freight servicing the Hunter Valley mining industry, the Port of Newcastle, and interstate movements, resulting in local, regional and national economic benefits.

The project is in accordance with a number of key strategic planning and policy documents including but not limited to NSW State Infrastructure Strategy 2018-2038 (Infrastructure NSW 2018), Future Transport Strategy 2056 (Transport for NSW 2018a), and NSW Freight and Ports Plan 2018-2038 (Transport for NSW 2018b).

The preferred option and concept design for the project was identified and refined through an extensive assessment and review process which started in 2004. The preferred option and concept design best meets the project objectives, has been thoroughly evaluated against the key performance criteria of function, environment and socio-economic considerations and ultimately provides value for money.

Key environmental issues have been examined throughout the design development process. Consultation has been carried out with affected community and stakeholders to identify impacts at an early stage, and where possible, avoid, minimise or identify appropriate management measures to be adopted. This has resulted in a number of design changes that have mitigated many of the potential impacts.

The EIS has assessed the potential environmental impacts and identified that the project will impact on a range of nearby receivers, including property and business owners, and the natural environment. Although many potential impacts have been avoided or minimised through design and project development, some residual impacts are still applicable. The key impacts caused by the project include biodiversity, noise and flooding, however, a range of mitigation measures will be implemented to manage these and many other environmental impacts and ensure that the project complies with relevant policy and guidelines.

The project is considered appropriate, justified and in the public interest as the negative impacts are outweighed by the long-term benefits of improved road safety, travel times and overall road network benefits for all road users and realising the completion of this motorway section of the NLTN.

Australian Government

BUILDING OUR FUTURE

NSW GOVERNMENT

M1 Pacific Motorway extension to Raymond Terrace

Environmental impact statement – Chapter 27: Project synthesis

Transport for NSW | July 2021

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27. Project synthesis

This chapter provides a summary of the EIS for the project in response to the SEARs issued by the Secretary of the Department of Planning, Industry and Environment and detailed in **Table 27-1**.

Table 27-1 SEARs relating to the synthesis chapter

Secretary's requirement	Where addressed
2. Environmental Impact Statement	
1. The EIS must include, but not necessarily be limited to, the following: (q) a chapter that synthesises the environmental impact assessment and provides:	
− A succinct but full description of the project for which approval is sought;	A description of the project for which approval is sought is provided in **Section 27.1** and **Section 27.2**
− A description of any uncertainties that still exist around design, construction methodologies and/or operational methodologies and how these will be resolved in the next stages of the project;	A description of project uncertainties and proposed resolutions is provided in **Section 27.3**
− A compilation of the impacts of the project that have not been avoided;	Key project impacts are outlined in **Section 27.4.2**
− A compilation of the proposed measures associated with each impact to avoid or minimise (through design refinements or ongoing management during construction and operation) or offset these impacts;	Proposed measures to avoid or minimise key impacts are discussed in **Section 27.4.1**, **Section 27.4.2** and **Section 27.4.3**
− A compilation of the outcome(s) the proponent will achieve; and	The desired performance outcomes and the outcomes of the project are discussed in **Section 27.5**
− The reasons justifying carrying out the project as proposed, having regard to the biophysical, economic, social considerations, including ecologically sustainable development and cumulative impacts.	A justification for the project, with regard to biophysical, economic, social considerations and cumulative impacts is provided in **Section 27.6**

27.1 Overview of the project

The M1 Pacific Motorway was constructed to provide access between Sydney and Newcastle and was completed in 1998. Construction of the Pacific Highway bypass of Raymond Terrace was also completed in 1998. The Pacific Highway forms part of the National Land Transport Network (NLTN), connecting Sydney and Brisbane, and is a major contributor to Australia's economic activity.

Since 1996, the Australian and NSW governments have been jointly upgrading the Pacific Highway to provide a four-lane divided road from Hexham to Queensland. Although the project will not be delivered under the Pacific Highway upgrade program, completion of the project will contribute to fully realising the benefits of the program. There are only two locations on the east coast corridor linking Sydney to Brisbane where the route is an urban road with traffic signals; at Coffs Harbour and along the existing road network in the construction footprint (including at Black Hill, Hexham, Tomago and Heatherbrae). The project, together with Coffs Harbour bypass, would provide the remaining major upgrades to complete a free flowing dual carriageway route between Sydney and Brisbane.

The project would connect the existing M1 Pacific Motorway at Black Hill and the Pacific Highway at Raymond Terrace within the City of Newcastle and Port Stephens Council local government areas. Upon completion, the project would provide regional benefits and substantial productivity benefits on a national scale.

27.1.1 The completed project

Key features of the project would include:

- A 15 kilometre motorway comprised of a four lane divided road (two lanes in each direction)
- Motorway access from the existing road network via four new interchanges at:
  - Black Hill: connection to the M1 Pacific Motorway
  - Tarro: connection and upgrade (six lanes) to the New England Highway between John Renshaw Drive and the existing Tarro interchange at Anderson Drive
  - Tomago: connection to the Pacific Highway and Old Punt Road
  - Raymond Terrace: connection to the Pacific Highway.
- A 2.6 kilometre viaduct over the Hunter River floodplain including new bridge crossings over the Hunter River, the Main North Rail Line and the New England Highway
- Bridge structures over local waterways at Tarro and Raymond Terrace, and an overpass for Masonite Road in Heatherbrae
- Connections and modifications to the adjoining local road network
- Traffic management facilities and features
- Roadside furniture including safety barriers, signage, fauna fencing and crossings and street lighting
- Adjustment of waterways, including at Purgatory Creek at Tarro and a tributary of Viney Creek
- Environmental management measures including surface water quality control measures
- Adjustment, protection and/or relocation of existing utilities
- Walking and cycling considerations, allowing for existing and proposed cycleway route access
- Permanent and temporary property adjustments and property access refinements
- Construction activities, including establishment and use of temporary ancillary facilities, temporary access tracks, haul roads, batching plants, temporary wharves, soil treatment and environmental controls.

An overview of the project is provided in **Figure 27-1**. **Chapter 5** describes the project in more detail.

27.2 Construction of the project

The project would likely be built using conventional methods used on most highway projects (refer to **Section 5.4** for more detail on the construction of the project). Key construction components would include:

- Enabling work
- Construction and operation of ancillary facilities
- Drainage and water quality control measures
- Clearing, grubbing and demolition
- Bulk earthwork
- Construction of pavements
- Construction of bridges and viaducts
- Construction of roadside furniture and finishing work
- Traffic management and control
- Landscaping work.

As noted in **Section 5.4.3** and **Figure 5-25**, 21 potential ancillary construction facilities have been identified. These 21 sites have been assessed in this EIS with further investigations to be carried out during detailed design to explore opportunities to use suitable existing sites in the surrounding industrial areas in Black Hill, Beresfield, Hexham, Tomago and Raymond Terrace to potentially reduce the construction footprint.

Construction of the project is expected to begin in 2023 and be completed in 2028. Project staging may occur to most effectively and efficiently complete construction and would be dependent on the confirmed procurement and delivery strategy. The preferred procurement method would be selected and implemented giving consideration to this EIS assessment and the project's subsequent approval conditions. The preferred procurement strategy would be selected to provide best value for money to deliver the project in an efficient manner. Any potential staged opening of the project would require further assessment. Any such project staging would be further investigated as the project progresses towards construction.

Where feasible and reasonable, construction activities would be carried out during the standard construction work hours, however Transport is seeking approval for extended construction hours as the majority of work would be away from residences and sensitive receivers (particularly north of Tarro), (refer to **Section 5.4.12**). Some construction activities would also need to be carried out as out-of-hours work to ensure the safety of the public and construction crews and to minimise disruption to existing traffic flows (refer to **Section 5.4.12**).

The construction methods and management measures to minimise environmental impacts would be detailed in the Construction Environmental Management Plan (CEMP) which would be prepared by the construction contractor.

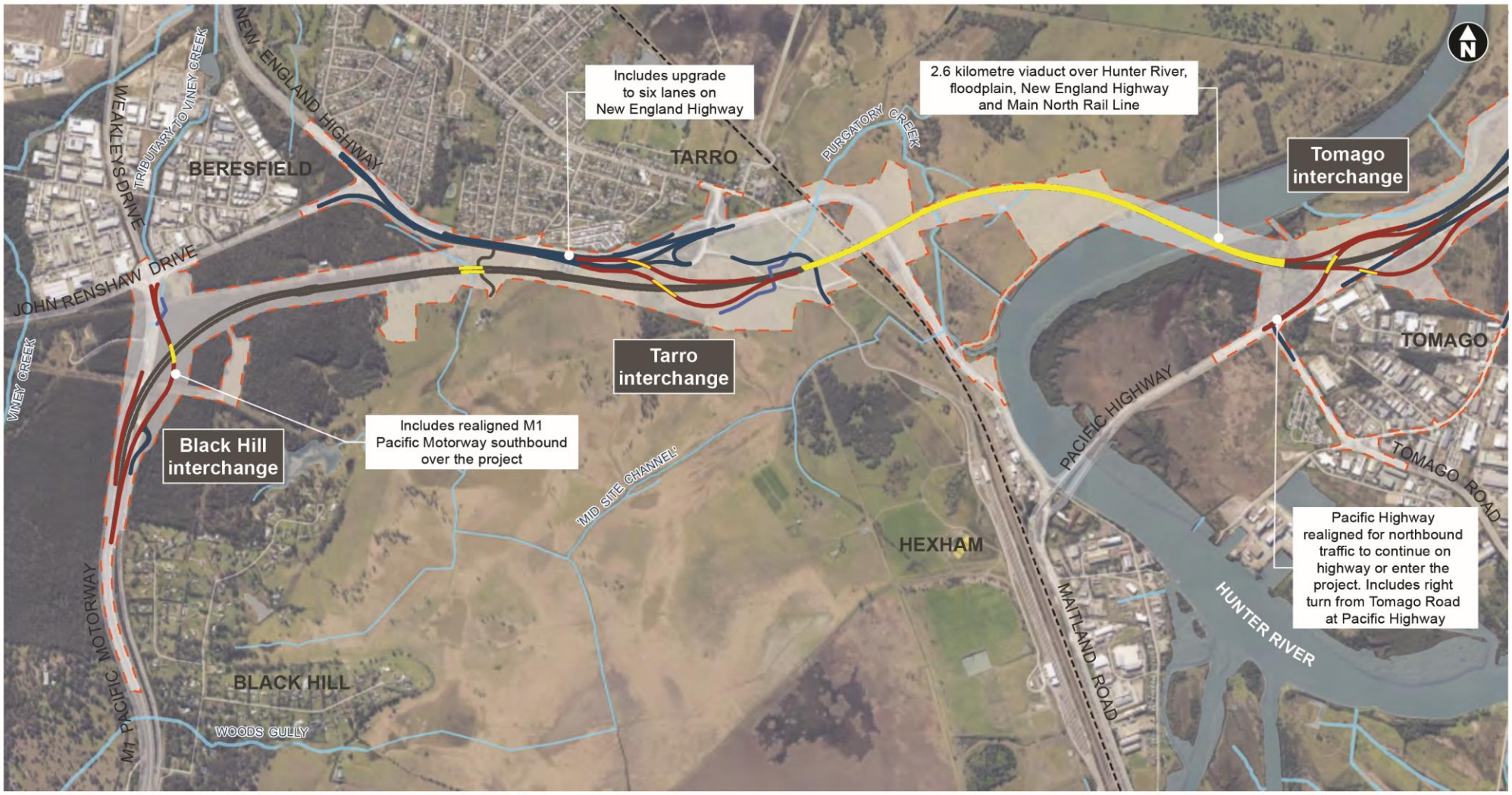

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Figure 27-1 Project key features (map 1 of 2)

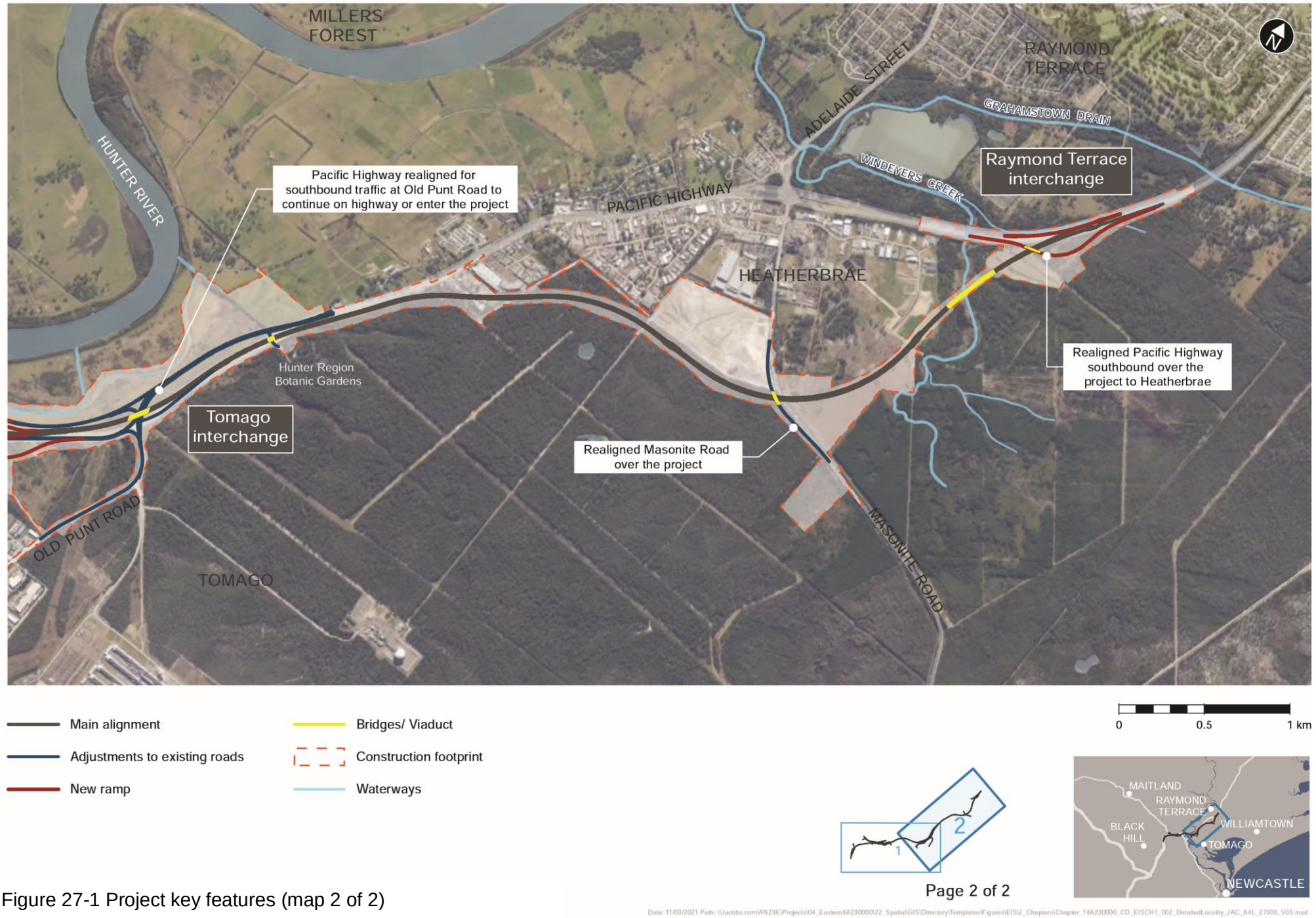

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Figure 27-1 Project key features (map 2 of 2)

27.3 Project uncertainties

The EIS is based on the concept design developed for the project. As such, the design of the project would continue to be refined during detailed design to:

- Consider alternative construction techniques
- Respond to submissions received following the exhibition of this EIS
- Avoid or minimise environmental impacts
- Respond to improved technologies or materials
- Improve value for money.

The final design may therefore vary from the concept design described in **Chapter 5**. Any changes to the project would be reviewed for consistency with the assessment contained in the EIS including relevant management measures, environmental performance outcomes and any future conditions of approval. If design refinements are not consistent, approval would be sought from the Minister for Planning and Public Spaces for any such modifications in accordance with the requirements of Division 5.2 of the EP&A Act.

Areas where further work would be carried out during detailed design to optimise the design outcomes and construction methodology include:

- Design of the alignment, intersections, bridges (including final bridge type and length), ancillary facilities, batter slope specifications, local road network upgrades and emergency crossover access
- Consultation and proposals for relocation or protection of utilities
- Design to best improve earthworks balance across the project
- Construction methodology, including staging and programming.

Table 27-2 outlines key project components that have been identified as requiring further resolution during detailed design, construction and/or operation of the project and references where these uncertainties are further described in this EIS.

Table 27-2 Resolution of project uncertainties

Project uncertainties	Proposed resolution	Timing	Where discussed
The location and layout of construction ancillary facilities, including entry and exit arrangements	Twenty-one ancillary facilities have been assessed to support project construction (refer to **Section 5.4.3** and **Figure 5-25**). The final location, use, type and number of construction ancillary facilities would be confirmed by the construction contractor prior to construction. Opportunities to use suitable existing sites in the surrounding industrial areas in Black Hill, Beresfield, Hexham, Tomago and Raymond Terrace to potentially reduce the construction footprint would be considered. The construction ancillary facilities will be established and operated in accordance with the terms of the project approval.	Detailed design	**Chapter 5**
Design of bridges and structures	Detailed design would seek to further refine and enhance the aesthetic appearance of bridges and associated structures such as piers and retaining walls while considering value for money and effective construction methods for complex structures.	Detailed design	**Chapter 5** and **Chapter 15** (urban design, landscape and visual amenity)
Cuttings and fill embankments	Cuttings and fill embankments would generally be at a slope of 2H:1V, equating to a one metre vertical rise for every two-metre horizontal run, with the exception of the Black Hill interchange, which would have a slope of 2.5H:1V with a 6.5m wide bench where required. Batter slope design would be refined during detailed design based on additional environmental, engineering, earthworks balancing and property constraints.	Detailed design	**Chapter 5**
Utilities	Depending on the utility service being relocated, work may be required to occur outside the construction footprint to meet the utility service provider requirements. However, it is expected that the utility work would be carried out in existing disturbed areas within or next to existing road/local access corridors. A strategy for managing utilities will be developed during detailed design and will include further detailed utility investigations and design, ongoing consultation, and methods for relocation work. These methods will be in accordance with environmental management measures, utility provider's requirements and construction methods.	Detailed design/ construction	**Chapter 5** and **Chapter 14** (land use and property)
Procurement strategy and project staging	Depending on the confirmed procurement and delivery strategy, project staging may occur to most effectively and efficiently complete construction. The preferred procurement method would be selected and implemented giving consideration to this EIS assessment and the project's subsequent approval conditions. The preferred procurement strategy would be selected to provide best value for money to deliver the project in an efficient manner. Any potential staged opening of the project would require further assessment. Any such project staging would be investigated further as the project progresses towards construction.	Prior to construction	**Chapter 5**

Project uncertainties	Proposed resolution	Timing	Where discussed
The final suite of noise mitigation options for road traffic noise that will be adopted and implemented	The operational road traffic noise model will be updated to identify predicted noise levels at the completion of detailed design. Operational noise and vibration mitigation measures would be identified in an Operational Noise and Vibration Review. A reasonable and feasible assessment will then be carried out in accordance with Transport's Noise Mitigation Guideline to determine the final noise mitigation options for the project (which may include noise barriers, noise walls, at-property treatments, or a combination of these). Ongoing community and stakeholder consultation to assist with informing and determining appropriate additional noise mitigation to be carried out.	Detailed design	**Chapter 8** (noise and vibration)
The final suite of environmental management measures for flooding	Any changes to the design described in this EIS would be further investigated during detailed design, including further flood investigations and hydrological and hydraulic modelling to ensure the flood immunity objectives and performance criteria for the project are met. The detailed design will consider refinement to temporary and permanent access roads to further reduce flood afflux with impacts to drainage capacity, where reasonable and feasible.	Detailed design	**Chapter 10** (hydrology and flooding)
The final suite of water quality treatments (both during construction and operation)	The proposed erosion and sediment control measures would continue to be refined and modelled should the design change as part of detailed design with the aim of further reducing the potential surface water quality impacts and to work towards meeting the NSW WQOs.	Detailed design	**Chapter 11** (surface water and groundwater quality)
Property access and acquisition	The extent of property impacts would be refined and confirmed in consultation with the property owners. The project would change existing access arrangements for a number of properties. Property access that is physically affected by the project would be reinstated to at least an equivalent standard, in consultation with the landowner. Any changes to access arrangements would be further refined in consultation with affected property owners.	Detailed design	**Chapter 14** (land use and property)

Project uncertainties	Proposed resolution	Timing	Where discussed
Presence of Per- and polyfluoroalkyl substances (PFAS)	The potential risks associated with PFAS contamination at Tarro and Heatherbrae (AOPCR 18) are currently being investigated by the NSW EPA. Areas of potential and known PFAS contamination are located near the project, at Heatherbrae (200m away) and Tarro (300m away). These sites are not located within the construction footprint and modelling for the project shows groundwater flows away from the project, decreasing the risk of PFAS occurrence in the construction footprint. As described in **Chapter 11** (surface water and groundwater quality), predicted groundwater drawdown resulting from temporary construction dewatering for the project is not predicted to interact with the areas of known or potential PFAS contamination. Notwithstanding, PFAS has been noted as a medium risk within the construction footprint. A surface water and groundwater monitoring program would be carried out prior to construction to determine if any construction management is required within the construction footprint. Transport will continue to consult with the EPA if PFAS poses a risk during the construction of the project in Tarro and Heatherbrae. Management of this risk will also be included in the Contaminated Land Management Plan (CLMP) for the project.	Prior to construction/ construction	**Chapter 11** (surface water and groundwater quality) **Chapter 16** (soils and contamination)

27.4 Summary of project impacts and management measures

This section provides a summary of the impacts of the project that could not be avoided. These impacts are discussed in detail in **Chapter 7** (traffic and transport) through to **Chapter 22** (safety and risk).

27.4.1 Key impact avoidance

Many potential impacts have been avoided through the project development process which included input from key stakeholders. The project has a detailed history of investigating and considering alternatives to achieve the project objectives and to avoid or minimise adverse impacts to the environment (refer to **Chapter 4**). The initial planning for the project saw several alternate routes and options abandoned due to potential environmental impacts or risks, particularly impacts associated with high value biodiversity areas.

As a result of the project development process, the project has avoided many environmental impacts and now achieves the following:

- Avoiding and minimising direct impacts to floodplain wetlands (west of Woodlands Close) and the Hunter Wetlands National Park, including a viaduct across the Hunter River floodplain (instead of an embankment) to avoid impacts to floodplain wetlands and associated biodiversity
- Avoiding major fragmentation of habitat by aligning the project near existing infrastructure and development
- Avoiding impacts to remnant vegetation, potential habitat for threatened species, connectivity impacts and a population of *Grevillea parviflora* subsp. *parviflora* by removing the link road at Tomago from the design
- Avoiding substantial upstream flooding impacts by replacing an embankment with a viaduct across the Hunter River floodplain. The inclusion of the viaduct in the design also avoided substantial impacts to drainage capacity, flood storage and conveyance upstream in the swamp area in Hexham and substantial local afflux
- Reducing substantial groundwater impedance and level impacts from soft soil activities, which would be required to support an embankment, through the inclusion of the viaduct in the design
- Minimising impacts to undisturbed Aboriginal heritage areas in the Black Hill landform by aligning closely with existing infrastructure and previously disturbed areas
- Avoiding severance of land either side of the project by locating the viaduct across the Hunter River floodplain.

The project has, through its design and construction methodology, sought to minimise environmental impacts. Further refinement of the design including consideration of community issues through the EIS exhibition process may further reduce and, if possible, avoid impacts.

Potential impacts would also be further avoided and minimised, where possible, through the implementation of the management measures complying with the performance outcomes identified in **Chapter 7** (traffic and transport) to **Chapter 22** (safety and risk).

27.4.2 Key project impacts

The EIS has assessed the potential environmental impacts which may occur because of the project and recommends measures to manage these impacts (refer to **Chapter 24** (summary of environmental management measures)). **Table 27-3** provides a summary of potential major impacts of the project that could not be avoided and the measures proposed to manage these impacts.

Table 27-3 Summary of key project impacts and management measures

Summary of key impacts	Construction/ operation	Management measure
Traffic and transport (refer to **Chapter 7**)		
Changes to access arrangements during construction and operation	Construction/ operation	While property access will be maintained at all times, any changes to access arrangements or alternative accesses that are necessary during construction would be completed in consultation with the landowner. Property access physically affected by the project will be reinstated to at least an equivalent standard, in consultation with the landowner. Transport will continue to liaise with landowners during subsequent stages of design to confirm access arrangements during construction and operation.
Construction traffic impacts on road network performance, including delays, increased travel times, road closures and detours, and parking impacts	Construction	A Traffic Management Plan (TMP) will be prepared and implemented as part of the CEMP to manage construction impacts. Consultation with emergency services, including the NSW Police, Rural Fire Service and Fire and Rescue NSW would be undertaken during detailed design and construction to ensure emergency access is maintained during construction.
Noise and vibration (refer to **Chapter 8**)		
Noise and vibration impacts at surrounding sensitive receivers from work during standard construction hours	Construction	A Construction Noise and Vibration Management Plan (CNVMP) will be prepared and implemented as part of the CEMP. The CNVMP will include measures to be implemented during construction to minimise noise and vibration impacts, including measures such as restrictions on working hours, respite periods, temporary noise barriers and location and use of vibration generating equipment. Where feasible, implementation of operational noise mitigation would be carried out within 12 months of commencement of construction.
Noise and vibration impacts at surrounding sensitive receivers from work outside of standard construction hours	Construction	An Out of Hours Work Procedure will be included as part of the CNVMP. The procedure would include scheduling of noise intensive or high noise impact work to evening periods where feasible, use of alternative plant, notification and consultation requirements, use of temporary noise barriers, respite periods and offers of reasonable and temporary alternative accommodation.
Increase in operational road traffic noise at surrounding sensitive receivers	Operation	Operational noise and vibration mitigation measures would be identified in an Operational Noise and Vibration Review during detailed design. A reasonable and feasible assessment will then be carried out in accordance with Transport's Noise Mitigation Guideline to determine the final noise mitigation options for the project (which may include noise barriers, noise walls, at-property treatments, or a combination of these).

Summary of key impacts	Construction/ operation	Management measure
Biodiversity (refer to **Chapter 9**)		
Impacts to threatened flora, fauna habitat, wetlands & aquatic habitat and reduction of the footprint of endangered ecological communities beyond those assessed and offset in this EIS	Construction	A Biodiversity Offset Strategy has been prepared that outlines how Transport intends to offset the impacts of the project. A Flora and Fauna Management Plan (FFMP) will also be prepared in accordance with the 'Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects' (RTA 2011) and implemented as part of the CEMP to address terrestrial and aquatic matters. Creek corridors will be revegetated with native riparian vegetation suitable for the local area. Aquatic protection measures will be implemented during construction in accordance with Guide 10: Aquatic habitats and riparian zones of the 'Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects' (RTA 2011) and where practicable, Section 3.3.2 Standard precautions and mitigation measures of the 'Policy and guidelines for fish habitat conservation and management Update 2013' (DPI 2013a). Procedures for protection of aquatic fauna associated with dredging or piling areas would be outlined in the FFMP.
Fragmentation of native vegetation and habitat corridors	Construction	
Hydrology and flooding (refer to **Chapter 10**)		
Impacts on surrounding land, infrastructure, property, business operations and future development due to increases in flood levels and changes to flood behaviour	Construction	A Flood Management Plan (FMP) will be prepared to detail specific measures to reduce the potential for flooding impacts during construction. Consultation will be carried out with landowners impacted by flood affects from the project which exceed the flood management objectives (afflux, change in flood hazard, change in time of inundation) about reasonable and feasible management measures. This may involve further flood modelling during detailed design to assess the impacts to property.
Surface water and groundwater quality (refer to **Chapter 11**)		
Surface water quality impacts during construction and operation	Construction/ operation	A Construction Soils and Water Management Plan (CSWMP) would be prepared and implemented as part of the CEMP and will outline measures to manage soil and water quality impacts associated with the construction work, including contaminated land. Surface water quality measures, including temporary sediment basins, permanent water quality basins and grassed swales, have been included in the project design. A surface water and groundwater quality monitoring program will be implemented during construction and operation of the project.

Summary of key impacts	Construction/ operation	Management measure
Aboriginal heritage (refer to **Chapter 12**)		
Impact to Aboriginal archaeological heritage items during construction	Construction	Extensive consultation and investigations have been completed with the Aboriginal community. Environmental management measures, including archaeological salvage excavation, surface collection and exclusion fencing, are described in Chapter 9 of the Aboriginal Cultural Heritage Assessment Report (**Appendix L**).
Construction impact to previously unidentified Aboriginal archaeological heritage items	Construction	An Aboriginal Cultural Heritage Management Plan (ACHMP) will be prepared for construction which will include an unexpected finds procedure.
Socio-economic (refer to **Chapter 13**)		
Temporary impacts to businesses during construction	Construction	Access will be maintained to businesses and properties during construction of the project, including rail infrastructure facilities. Where temporary access changes are proposed, these will be agreed with the affected business or property owner. A Community Communication Strategy will be prepared for the project to facilitate communication with the community and stakeholders including relevant Government agencies, Councils, adjoining affected landowners and businesses, residents, motorists and other relevant stakeholders that may be affected by the project.
Soils and contamination (refer to **Chapter 16**)		
Soil erosion, impacts from acid sulfate soils and offsite sedimentation during construction	Construction	A CSWMP will be prepared for the project, including a Salinity Management Plan, an Acid Sulfate Soils Management Plan (ASSMP), and erosion and sediment control plans (ESCPs) to manage potential soil impacts during construction of the project.
Impacts resulting from contaminated material, including asbestos and the former mineral sands processing site at Tomago during construction	Construction	A Remediation Action Plan prepared and implemented in consultation with the NSW EPA and approved by a NSW EPA accredited site auditor for the former mineral sands processing facility. A Contaminated Land Management Plan (CLMP) and procedures will be developed and implemented for the project as part of the CEMP.

27.4.3 Environmental management plan framework

The implementation of environmental management measures during detailed design, construction and operation of the project would minimise any potential adverse impacts arising from the proposed work on the surrounding environment. The management measures related to construction would be captured in a CEMP and associated sub-plans. The CEMP would provide a framework for establishing how these measures would be implemented and who would be responsible for their implementation.

The CEMP would be prepared and would be reviewed and certified by Transport prior to the commencement of any on-site work. The CEMP would be a working document, subject to ongoing change and updated as necessary to respond to specific requirements.

Sub-plans to be prepared for the project include but may not be limited to:

- Traffic Management Plan (TMP)
- Construction Noise and Vibration Management Plan (CNVMP)
- Flora and Fauna Management Plan (FFMP)
- Flood Management Plan (FMP)
- Construction Soils and Water Management Plan (CSWMP)
  - Salinity Management Plan
  - Acid Sulfate Soils Management Plan (ASSMP)
  - Erosion and Sediment Control Plans (ESCPs).
- Aboriginal Cultural Heritage Management Plan (ACHMP)
- Contaminated Land Management Plan (CLMP)
- Non-Aboriginal Heritage Management Plan (NAHMP)
- Air Quality Management Plan (AQMP)
- Waste Management Plan (WMP)
- Sustainability Management Plan (SMP)
- Bushfire Management Plan.

During operation, the project's environmental performance would be managed under Transport's existing Environmental Management System (EMS) (or similar) for asset maintenance prepared in accordance with the AS/NZS ISO 14000 Environmental Management System series. This EMS has been developed to be consistent with the broad environmental objectives and policies set out in the Transport EMS. Transport is committed to managing its impacts on the environment and carrying out its activities to avoid, minimise or mitigate environmental impacts. Accordingly, any project-specific operational environmental management practices and procedures will be incorporated into the existing EMS.

27.5 Performance outcomes

The project design has been prepared in consideration of the 'desired performance outcomes' provided in the SEARs. These desired performance outcomes outline the broader objectives to be achieved by Transport in the design, construction and operation of the project. **Table 27-4** outlines how each performance outcome will be achieved by the project.

Table 27-4 Design performance outcomes and project outcome

Relevant SEARs desired performance outcome	Project outcome
General SEARs	
1. Environmental Impact Assessment Process The process for assessment of the proposal is transparent, balanced, well focussed and legal.	• The planning approval process for the project is transparent and legal as the process was developed in accordance with and followed the relevant approval frameworks and legislation • The assessment of key issues has considered both the benefits and the impacts of the project to present a balanced assessment. The SEARs for the project guide the EIS and help provide an assessment framework that maintains clarity and focus in the document.
2. Environmental Impact Statement The project is described in sufficient detail to enable clear understanding that the project has been developed through an iterative process of impact identification and assessment and project refinement to avoid, minimise or offset impacts so that the project, on balance, has the least adverse biophysical, social and economic impact, including its cumulative impacts.	• Adverse biophysical, social and economic impacts, including cumulative impacts, have been assessed and, where possible, the project has been refined to avoid, minimise or offset these impacts (refer to **Chapter 4** and **Chapter 24** (summary of environmental management measures)).
3. Assessment of Key Issues* Key issue impacts are assessed objectively and thoroughly to provide confidence that the project will be constructed and operated within acceptable levels of impact. *Key issues are nominated by the Proponent in the CSSI project application and by the Department in the SEARs. Key issues need to be reviewed throughout the preparation of the EIS to ensure any new key issues that emerge are captured.	• All key issues identified by the Department in the SEARs for the project were assessed objectively and thoroughly by specialists in accordance with the relevant SEARs for each key issue (refer to **Chapter 7** (traffic and transport) to **Chapter 23** (cumulative impacts)) • The benefits and impacts associated with each key issue have been assessed to provide an objective and balanced assessment.
4. Consultation The project is developed with meaningful and effective engagement during project design and preparation of the EIS.	• Community and stakeholders were regularly engaged during development of the project and preparation of the EIS, and have informed the design process (refer to **Chapter 6**).

Relevant SEARs desired performance outcome	Project outcome
Key issue SEARs	
1. Transport and Traffic Network connectivity, safety and efficiency of the transport system in the vicinity of the project are managed to minimise impacts. The safety of transport system customers is maintained. Impacts on network capacity and the level of service are effectively managed. Works are compatible with existing infrastructure and future transport corridors.	• Free flowing dual carriageway conditions are provided • Improved road network efficiency and reliability with associated travel time improvements across the road network. Travel time is expected to improve by seven to nine minutes along the M1 Pacific Motorway corridor upon opening of the project (refer to **Chapter 7** (traffic and transport)) • Improved connectivity and accessibility along the National Land Transport Network (NLTN) as a result of the interchanges at Tarro, Tomago and Heatherbrae directly accessing the project • Improved safety outcomes in the study area would be achieved through a reduction of traffic volumes on the existing road network, improvement of pedestrian access at the Hunter Region Botanic Gardens and Masonite Road, and improvement to cyclist connectivity and crossing points • The project would be compatible with existing infrastructure and future transport corridors. The project would provide a free flowing high standard, access-controlled motorway that integrates with the NLTN.
2. Noise and Vibration – Amenity Construction noise and vibration (including airborne noise, ground-borne noise and blasting) are effectively managed to minimise adverse impacts on acoustic amenity. Increases in noise emissions affecting nearby properties and other sensitive receivers during operation of the project are effectively managed to protect the amenity and wellbeing of the community.	• Management measures, including minimum working distances and respite periods, will be implemented in accordance with the relevant criteria from the Construction Noise and Vibration Guideline (Roads and Maritime Services 2016b) and Noise Criteria Guideline (Roads and Maritime Services 2015c) and a CNVMP will be prepared • The number of maximum noise level events experienced by residential receivers would be reduced compared to the existing background noise environment • About 10 per cent of receivers experience a decrease in traffic noise when the project is operational compared to existing road traffic noise levels • Operational noise mitigation measures such as quieter pavement surfaces, noise barriers and at-property noise treatments would be provided where required to minimise impacts.
3. Noise and Vibration – Structural Construction noise and vibration (including airborne noise, ground-borne noise and blasting) are effectively managed to minimise adverse impacts on the structural integrity of buildings and items including Aboriginal places and environmental heritage. Increases in noise emissions and vibration affecting environmental heritage as defined in the *Heritage Act 1977* during operation of the project are effectively managed.	• Construction noise would not have adverse impact on the structural integrity of buildings and items • The nearest affected heritage listed structures would not be affected by vibration intensive plant and equipment associated with the proposed construction activities. Where buildings or structures are considered sensitive to vibration, appropriate vibration criteria would be determined after detailed inspections have been completed • If required, blasting will be managed in accordance with relevant standards and guidelines and a Blast Management Plan will be developed to identify any potentially affected noise and vibration sensitive sites including heritage buildings • There are no Aboriginal places, as defined under the relevant legislation, planning instruments or heritage lists, within or next to the construction footprint and surface and subsurface artefacts are not subject to potential noise or vibration impacts. The project would not have any noise and vibration impacts on Aboriginal places or items.

Relevant SEARs desired performance outcome	Project outcome
4. Biodiversity The project design considers all feasible measures to avoid and minimise impacts on terrestrial and aquatic biodiversity. The delivery of offsets and/or supplementary measures required for the project is assured and which are equivalent to any remaining impacts from its construction and operation.	• The project has been designed to avoid and minimise direct impacts to floodplain wetlands and associated biodiversity through options selection and design of a viaduct over the Hunter River and associated floodplain • Selection of an alignment that minimises fragmentation of habitat and aligns with existing infrastructure and development • Disturbance of vegetation resulting from the construction of ancillary facilities has been minimised through the selection of ancillary facility locations where land has been previously cleared and disturbed • All residual impacts associated with the project will be offset in accordance with the Framework for Biodiversity Assessment (FBA). A Biodiversity Offset Strategy (refer to Appendix I of the Biodiversity Assessment Report (**Appendix I**) has been prepared that outlines how Transport intends to offset the impacts on the project.
5. Flooding The project minimises adverse impacts on existing flooding characteristics. Construction and operation of the project avoids or minimises the risk of, and adverse impacts from, infrastructure flooding, flooding hazards or dam failure.	• The project avoids substantial upstream flooding through the inclusion of a 2.6km viaduct instead of an embankment across the Hunter River floodplain • An FMP will be prepared for the project and will detail the processes for flood preparedness, materials management, weather monitoring, site management, flood incident management, and flood response during construction • The project would provide an alternative to the existing road network with a minimum 1 in 20 year flood immunity, improving flood immunity along the M1 Pacific Motorway corridor and reliability of the corridor for local, intra-state and inter-state movements.
6. Soils The environmental values of land, including soils, subsoils and landforms, are protected. Risks arising from the disturbance and excavation of land and disposal of soil are minimised, including disturbance to acid sulfate soils and site contamination.	• Five high risk and six medium risk Areas of Potential Contamination Risk (AOPCR) have been identified within the construction footprint. The high risk AOPCRs are associated with asbestos waste at Tarro and Tomago, the former mineral sands processing facility at Tomago, potentially impacted Hunter River Sediments and at locations where construction works may interact with acid sulfate soils. A CLMP would be prepared to manage these high and medium risks • A site-specific Remediation Action Plan would be prepared and implemented for the former mineral sands processing facility at Tomago • Construction would be carried out in accordance with the CSWMP. The CSWMP will identify all reasonably foreseeable risks relating to soil erosion and water pollution associated with carrying out the activity and describe how these risks will be managed and minimised during construction • ESCPs will be prepared and implemented prior to construction commencing and updated regularly during the construction period to suit specific site characteristics • An ASSMP will be prepared prior to construction of the project to outline how the acid sulfate soils will be handled, tested, treated and reused during construction to minimise impacts to the environment.

Relevant SEARs desired performance outcome	Project outcome
7. Water – Hydrology Long term impacts on surface water and groundwater hydrology (including drawdown, flow rates and volumes) are minimised. The environmental values of nearby, connected and affected water sources, groundwater and dependent ecological systems including estuarine and marine water (if applicable) are maintained (where values are achieved) or improved and maintained (where values are not achieved). Sustainable use of water resources.	• The project avoids permanent drawdown of the various groundwater resources during operation as the groundwater level would not be above the surface water level of the proposed permanent water quality basins • The project may result in a moderate increase to the rate, volume and velocity of stormwater discharged downstream of the project. Potential changes to stormwater discharges during construction are expected to follow the same trend of increased rates, volumes and velocity. Monitoring of these impacts is proposed for the areas immediately surrounding the project stormwater discharge locations. The requirement to provide further upgrades to existing drainage systems will be considered at detailed design • Groundwater flows, water levels, or supply capacity of the Tomago Sandbeds Catchment Area drinking water supply will not be impacted by project construction or operation as sediment and water quality controls in this location will be lined to prevent groundwater interactions • Impacts to groundwater levels and flow due to the project are expected to be negligible to minor and would be limited to the vicinity of the construction footprint. Changes to groundwater levels or flow are not anticipated to materially affect any groundwater dependent ecosystems, baseflows, or existing groundwater users • By providing a viaduct instead of an embankment across the Hunter River floodplain, the project has avoided substantial upstream flooding impacts, groundwater impedance and level impacts • Groundwater produced during project construction through temporary construction dewatering or via wick drains would be re-used where suitable for dust suppression and fill conditioning as a measure of sustainable use of the groundwater resource.
8. Water – Quality The project is designed, constructed and operated to protect the NSW Water Quality Objectives where they are currently being achieved, and contribute towards achievement of the Water Quality Objectives over time where they are currently not being achieved, including downstream of the project to the extent of the project impact including estuarine and marine waters (if applicable).	• Modelled pollutant loads to waterways would generally be lower than current nutrient and toxicant levels within the waterways during the operation of the project (with the implementation of water quality controls). The general improvement in water quality from existing conditions works toward achieving the NSW Water Quality Objectives • Impacts to water quality during construction would be minimised through the implementation of water quality control measures, including temporary sediment basins (where runoff will be captured and treated prior to discharge), erosion and sediment controls and water quality monitoring • Impacts to water quality during operation would be minimised through the implementation of permanent water quality basins and grassed swales, as well as drainage infrastructure and scour protection to avoid erosion and sedimentation impacts to downstream receiving environments • The project has been designed and water quality measures have been applied to minimise impacts to the Tomago Sandbeds Catchment Area in consultation with Hunter Water Corporation. Pavement drainage in this area has been designed to discharge road runoff away from drinking water catchments to prevent any potential pollution impacts to the Tomago Sandbeds. Permanent water quality basins in this area will also be lined to prevent groundwater interaction.

Relevant SEARs desired performance outcome	Project outcome
9. Climate Change Risk The project is designed, constructed and operated to be resilient to the future impacts of climate change.	• Risk to the project as a result of climate change has been assessed, with flood risk being the key issue. Hydrological and hydraulic assessments would be carried out for any design changes applied during detailed design and would consider the climate change related flood risks to the project and flood impacts from the project.
10. Urban Design The project design complements the visual amenity, character and quality of the surrounding environment. The project contributes to the accessibility and connectivity of communities.	• The project's design has been developed in recognition of existing natural, built and community values • Character and quality of the environment are improved by reducing congestion and freight movements in existing road corridors and urban centres, enhanced town centre amenity in Heatherbrae because of reduced traffic • The project provides enhanced accessibility and connectivity to the existing road network and adjacent communities.
11. Visual Amenity The project minimises adverse impacts on the visual amenity of the built and natural environment (including public open space) and capitalises on opportunities to improve visual amenity.	• Adverse impacts on the visual amenity of the built and natural environment have been minimised by locating the project as much as possible within or near to existing road corridors and infrastructure • Opportunities for new views over the open Hunter River floodplain landscape will be established, enhancing the experience for motorists and cyclists with improved orientation and wayfinding • Landscaping carried out as part of the project, including vegetation planting, will assist in integrating the project within the landscape setting.
12. Socio-economic, Land Use and Property The project minimises adverse social and economic impacts and capitalises on opportunities potentially available to affected communities. The project minimises impacts to property and business and achieves appropriate integration with adjoining land uses, including maintenance of appropriate access to properties and community facilities, and minimisation of displacement of existing land use activities, dwellings and infrastructure. Effective engagement is undertaken with stakeholders during project design and delivery.	• Direct impacts on land use and property from the project have been minimised as the project mainly passes within or near to existing road corridors and infrastructure • The project would improve access, transport connections and journey reliability, reducing congestion and travel times, and would enhance road safety and driving conditions due to the provision of a motorway standard of road • All acquisitions and associated property adjustments will be carried out in accordance with the requirements of the *Land Acquisition (Just Terms Compensation) Act 1991* and the Land Acquisition Reform 2016 in consultation with landowners • Property owners and businesses will experience minimal disturbance during construction and operation of the project, with ongoing engagement and involvement during construction.

Relevant SEARs desired performance outcome	Project outcome
13. Heritage The design, construction and operation of the project facilitates, to the greatest extent possible, the long-term protection, conservation and management of the heritage significance of items of environmental heritage and Aboriginal objects and places. The design, construction and operation of the project avoids or minimises impacts, to the greatest extent possible, on the heritage significance of environmental heritage and Aboriginal objects and places.	**Aboriginal heritage** • Aboriginal stakeholder engagement was carried out during development of the project and involved engaging Aboriginal stakeholders for the project site surveys, test excavations, five Aboriginal Focus Group meetings and various other consultation • Management measures, including archaeological salvage excavation, surface collection and exclusion fencing during construction are proposed to manage impacts on Aboriginal heritage • No ongoing impacts to Aboriginal heritage are expected during operation. **Non-Aboriginal heritage** • Management measures including dilapidation surveys, barrier fencing, archival photo recording, archaeological salvage excavation, geophysical survey and archaeological test excavation are proposed to manage impacts on non-Aboriginal heritage items • The project would have a major impact on one heritage item, a minor impact on one heritage item and negligible impacts on seven heritage items.
14. Air Quality The project is designed, constructed and operated in a manner that minimises air quality impacts (including nuisance dust and odour) to minimise risks to human health and the environment to the greatest extent practicable.	• The project has been designed to mainly pass within or near to existing road corridors or through rural areas which would minimise the amount of dust, odour and other emissions in residential areas during construction • Dust, odour and other emissions during construction would be effectively managed through the implementation of the AQMP • Roads would be less congested with the project than without the project, meaning that the 'with project' scenario is more carbon efficient and would produce fewer tonnes of carbon dioxide equivalent per vehicle kilometres travelled than the 'without project' scenario • Operation of the project does not result in any exceedances of the NSW EPA air quality impact assessment criteria for relevant pollutants or key air toxics.
15. Waste All wastes generated during the construction and operation of the project are effectively stored, handled, treated, reused, recycled and/or disposed of lawfully and in a manner that protects environmental values.	• Wastes generated during construction would be reused within the construction footprint and recycled to minimise waste where possible • The project will manage waste in accordance with relevant NSW EPA guidelines, and the WMP • Operational waste and ongoing resource use during operation is anticipated to be minimal. All operational waste management would comply with regulations set out in the POEO Act and Waste Regulation.
16. Sustainability The project reduces the NSW Government's operating costs and ensures the effective and efficient use of resources. Conservation of natural resources is maximised.	• Through alignment with the Environmental Sustainability Strategy and with Transport's Sustainability Policy, the project promotes efficient use of natural resources where feasible and avoids waste spoil on the project • An SMP (or similar framework) for the project will be developed and implemented during detailed design and construction, detailing measures to meet the project's sustainability objectives and targets.

Relevant SEARs desired performance outcome	Project outcome
17. Safety and Risk The project avoids, to the greatest extent possible, risk to public safety. The project is designed, constructed and operated to be resilient to the future impacts of climate change.	Construction risks to public safety, such as bushfire risk, are effectively managed through the implementation of a Bushfire Management Plan and consultation with emergency services.

27.6 Project justification and conclusion

27.6.1 Overview of project need

The Pacific Highway and New England Highway between the M1 Pacific Motorway at Black Hill and Raymond Terrace form part of the NLTN. The NLTN is a key freight route which facilitates substantial interstate freight movements between NSW, Victoria and Queensland, and particularly freight movements between Sydney, the Hunter region, northern NSW and Queensland.

The project is in one of the most highly trafficked areas of the road network in the region and is more heavily congested than adjacent high standard sections of the M1 Pacific Motorway and Pacific Highway corridor. Key issues along the M1 Pacific Motorway, Pacific Highway, and New England Highway corridors applicable to the project include:

- High traffic volumes on the New England and Pacific Highways, the M1 Pacific Motorway and John Renshaw Drive
- Lack of capacity and congestion on highly-trafficked routes
- Major delays, primarily between Beresfield, Tomago and Hexham, caused by intersection arrangements and merge/diverge locations
- Road safety
- Restrictions on heavy vehicle movements
- Accessibility for freight to major nearby existing and future employment areas
- Flood immunity of existing road corridors.

The project would help integrate the needs of the Hunter region's road network with those of the broader NLTN. By providing one of the last major upgrades required to complete a free flowing dual carriageway route between Sydney and Brisbane, the project would improve traffic efficiency and congestion due to the interaction of National, interstate, regional and local traffic, connectivity between key residential and employment areas, road safety and flood immunity.

27.6.2 Biophysical, economic and social considerations

The EIS has been prepared with regard to the key issues associated with the project and the integration of biophysical, economic and social considerations. Overall, the project would deliver a large number of benefits and opportunities including:

- Improving travel time and road network efficiency for freight and commuters on the National Land Transport Network at the key strategic junction of the M1 Pacific Motorway, the New England Highway and the Pacific Highway. Travel time is expected to improve by seven to nine minutes along the M1 Pacific Motorway corridor upon opening of the project
- Providing improved long term route reliability along the M1 Pacific Motorway corridor, particularly in relation to congestion reduction, flood immunity and high demand holiday peak travel
- Improving road safety for all road users by providing a motorway standard bypass of the existing congested road network
- Improving conditions for pedestrians and cyclists by reducing traffic volumes along the existing arterial road network, excluding the Pacific Highway at Hexham
- Providing more efficient access to facilitate economic growth for the Lower Hunter and key regional employment areas such as the Port of Newcastle, Newcastle Airport, Tomago, Beresfield and Black Hill.

It is recognised that there will be negative environmental and social impacts resulting from the construction and operation of the project and these are documented in the impact assessments included in **Chapter 7** (traffic and transport) to **Chapter 25** (environmental risk analysis).

Key impacts of the project are associated with:

- Biodiversity, including the clearance of vegetation (including threatened flora and fauna habitat)
- Noise impacts to sensitive receivers during construction and operation
- Minor increases in flood impacts to properties during construction and operation
- Impacts on both Aboriginal and non-Aboriginal cultural heritage
- Direct impacts associated with property or businesses being affected by acquisition and associated changes to access arrangements.

While some negative environmental and social impacts have been identified, management measures to mitigate any potential longer-term adverse impacts have been considered and included in **Chapter 24** (summary of environmental management measures).

27.6.3 Ecologically Sustainable Development

Development that improves the total quality of life, both now and in the future, is known as Ecologically Sustainable Development (ESD). These principles improve quality of life in a way that maintains the ecological processes on which life depends and have been an integral consideration throughout the development of the project.

Sustainable development requires the effective integration of economic and environmental considerations in decision-making processes.

The four main principles supporting the achievement of ESD are:

- **Precautionary principle**: The precautionary principle deals with reconciling scientific uncertainty about environmental impacts with certainty in decision-making. This was applied from the early consideration of options to eliminate options that would have resulted in significant impact to high value biodiversity areas. A precautionary approach was applied to identify constraints to each of the route options. The EIS has also taken the precautionary principle with regards to assessing traffic, flooding, noise and

vibration impacts arising from the project by considering the worst case with regards to impacts from construction and operation of the project

- **Inter-generational equity**: Inter-generational equity introduces a temporal element with a focus on minimising the distribution of costs to future generations. Route selection considered the impacts on all road users and the environment to balance impacts against the project requirements and cost, ensuring that the actions of this generation do not compromise the quality of life for future generations. The project would ensure road benefits including decreased travel time, improved road safety, and increased connectivity are realised by current and future generations across the region. If the project was not carried out, travel times would continue to increase on the Pacific and New England Highways, intersections would experience further congestion, crashes would likely increase, and there would be no improvements to flood immunity or holiday peak travel times. These impacts would continue to affect current generations and future generations. The implementation of management measures (refer to **Chapter 24** (summary of environmental management measures)) would ensure the principle of inter-generational equity is met, by reducing or avoiding impacts to health, diversity and productivity of the environment as much as possible, for the benefit of future generations
- **Conservation of biological diversity and ecological integrity**: Biological diversity and ecological integrity has been a fundamental consideration of design development. Consideration of route alignments eliminated options that would have resulted in significant impact to high value biodiversity areas, including wetlands north and south of the Hunter River. Route selection for the project focused on conserving biological diversity and ecological integrity by using constraints mapping and known biological and ecological data to target avoiding impacts where possible. Where these impacts are unavoidable, all reasonable steps have been taken to minimise impacts
- **Improved valuation and pricing of environmental resources**: The principle of internalising environmental costs into decision-making requires consideration of all environmental resources which may be affected by the carrying out of a project, including air, water, land and living things. The EIS contains a number of management measures aimed at minimising pollution and waste during project development, and offsetting biodiversity impacts.

27.6.4 Cumulative impacts

Potential cumulative impacts during construction and operation of the project have been detailed in **Chapter 23** (cumulative impacts). Consideration of projects being simultaneously and consecutively constructed included several approved and proposed developments consisting of a mix of commercial and industrial developments, and power, rail and road infrastructure projects.

During construction, the project is likely to have some overlap in construction timeframes with several other developments (as identified in **Chapter 23** (cumulative impacts)) which would have potential cumulative impacts across the construction footprint. For most key issues, the cumulative impacts of the project would be minor or negligible. It is expected, however, that cumulative impacts on biodiversity would be moderate. Further, cumulative impacts on Aboriginal heritage are expected to vary across the construction footprint, with major cumulative impacts expected for lower altitude areas at the fringe of Hexham Swamp and moderate cumulative impacts for higher altitude areas at Black Hill and the Tomago Sands area.

During operation, the project is anticipated to generate positive cumulative impacts by improving traffic efficiency, travel times and reliability across the road network. In assessing cumulative impacts, the project has considered the short to medium term impacts of major development proposals near the project (most notably the employment-driving developments proposed in the Emerging Black Hill Precinct) including impacts associated with traffic volumes, noise and air quality.

To manage the cumulative impacts of the project, consultation would be carried out with relevant stakeholders to increase the overall awareness of project timeframes and impacts. The construction contractor will review cumulative impacts before the start of construction and every six months during construction. Any new cumulative impacts will be identified, addressed appropriately and reported as part of the CEMP.

27.6.5 Conclusion

The existing NLTN between Black Hill to Raymond Terrace is a combination of John Renshaw Drive, the New England Highway and the Pacific Highway. Generally, it provides two lanes in both directions with six controlled intersections and speed limits ranging from 60 kilometres per hour to 90 kilometres per hour. Construction of the project would address the increasing congestion and travel times along the Pacific and New England highways, delays at intersections and merge points, and the delays experienced during holiday peak travel times. The project would also provide an alternative to the existing road network with a minimum 1:20 year flood immunity and a motorway standard road that would reduce crash rates along the M1 Pacific Motorway, New England Highway and the Pacific Highway.

The project would complete one of the last remaining major upgrades required to facilitate significant interstate freight movements between NSW, Victoria and Queensland. Additionally, the project would support freight servicing regional commercial and industrial activities, the Port of Newcastle, and interstate movements, resulting in local, regional and national economic benefits.

The project is in accordance with a number of key strategic planning and policy documents including but not limited to NSW State Infrastructure Strategy 2018-2038 (Infrastructure NSW 2018), Future Transport Strategy 2056 (Transport for NSW 2018a), and NSW Freight and Ports Plan 2018-2038 (Transport for NSW 2018b).

The preferred option and concept design for the project was identified and refined through an extensive assessment and review process which has been ongoing since 2004. The preferred option and concept design best meet the project objectives, has been thoroughly evaluated against the key performance criteria of function, environment and socio-economic considerations and ultimately provides value for money.

Key environmental issues have been examined throughout the design development process. Consultation has been carried out with affected community and stakeholders to identify impacts at an early stage, and where possible, avoid, minimise or identify appropriate management measures to be adopted. This has resulted in a number of design changes that have minimised many of the potential impacts.

The EIS has assessed the potential environmental impacts of the project and identified potential impacts on a range of nearby receivers, including property and business owners, and the natural environment. Although many potential impacts have been avoided or minimised through design and project development, some residual impacts are still applicable. The key impacts caused by the project include biodiversity, noise and flooding impacts, however, a range of management measures will be implemented to manage the impacts of the project and ensure that the project complies with relevant policy and guidelines.

The project is considered appropriate, justified and in the public interest as the negative impacts are outweighed by the long-term benefits of improved road safety, improved travel times and overall road network benefits for all road users by providing a free-flowing, high standard motorway in this section of the NLTN.

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M1 Pacific Motorway extension to Raymond Terrace

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28. References

Acid Sulfate Soil Management Advisory Committee (ASSMAC), 1998. *Acid Sulfate Soil Manual.*

AGL, 2019. *Newcastle Power Station Project Environmental Impact Statement.*

ANZECC, 1990. *Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration.*

ANZECC/ARMCANZ, 2000. *National Water Quality Management Strategy Australian and New Zealand Guidelines for Fresh and Marine Water Quality*. Australian and New Zealand Environment and Conservation Council, Agriculture and Resource Management Council of Australia and New Zealand.

ANZG, 2018. *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*. Australian and New Zealand governments and Australian state and territory governments. Canberra ACT, Australia. Available at: **www.waterquality.gov.au/anz-guidelines**.

Atlas of Living Australia, 2020. *Biodiversity database*. Available at: **https://www.ala.org.au/**.

Australia ICOMOS, 2013. *The Burra Charter: The Australia ICOMOS Charter for Places of Cultural Significance 2013*. Burwood, Vic, Australia ICOMOS Incorporated.

Australian Bureau of Meteorology, 2020a. *Groundwater Dependent Ecosystems Atlas*, Available online at: **http://www.bom.gov.au/water/groundwater/gde**.

Australian Bureau of Meteorology, 2020b. *Climate Statistics – Newcastle University (#061390)*. Available online at: **http://www.bom.gov.au/climate/averages/tables/cw_061390.shtml** Accessed August 2020.

Australian Bureau of Meteorology, 2020c. *Australian Groundwater Explorer*. Bureau of Meteorology. Available at: **http://www.bom.gov.au/water/groundwater/explorer/**. Accessed August 2020.

Australian Bureau of Statistics (ABS), 2016a. *2016 Census of Population and Housing: Socio-economic Indexes for Areas*. Available online at: **www.abs.gov.au.**

Australian Bureau of Statistics (ABS), 2016b. *2016 Census of Population and Housing: Worker Population Profile* Available online at: **www.abs.gov.au***.*

Australian Geomechanics Society, 2007. *Guideline for Landslide Susceptibility, Hazard and Risk Zoning for Land Use Planning*. Australian Geomechanics Vol 42 No 1 March 2007.

Australian Government, 2012. *National Ports Strategy.*

Australian Government, 2013. *National Land Freight Strategy*.

Australian Government, 2018a. *Charter: National Water Quality Management Strategy*, Department of Agriculture and Water Resources, Canberra.

Australian Government, 2018b. *National Waste Policy 2018*.

Australian Government, 2019. *National Waste Policy Action Plan 2019*.

Australian Institute for Disaster Resilience, 2017. *Australian Disaster Resilience Handbook 7, Managing the Floodplain: A Guide to Best Practice in Flood Risk Management in Australia.*

Australian Radiation Protection and Nuclear Safety Agency (ARPANSA), 2008. *Management of Naturally Occurring Radioactive Material (NORM) Radiation Protection Series Publication No. 15*, Australian Radiation Protection and Nuclear Safety Agency, Yallambie, VIC.

Australian Radiation Protection and Nuclear Safety Agency (ARPANSA), 2014. *Fundamentals for Protection Against Ionising Radiation, Radiation Protection Series F-1*, Australian Radiation Protection and Nuclear Safety Agency, Yallambie, VIC.

Australian Radiation Protection and Nuclear Safety Agency (ARPANSA), 2015. *Radiation Protection of the Environment, Guide G-1*, Australian Radiation Protection and Nuclear Safety Agency, Yallambie, VIC.

Australian Radiation Protection and Nuclear Safety Agency (ARPANSA), 2017., *Guide for Radiation Protection in Existing Exposure Situations, Radiation Protection Series G-2*, Australian Radiation Protection and Nuclear Safety Agency, Yallambie, VIC.

Australian Standard, 1997. *AS4282-1997 Control of the obtrusive effects of outdoor lighting*, Standards Association of Australia, Homebush.

Australian Standard, 2001. *AS 2601-2001 The demolition of structures*.

Australian Standard, 2006. *AS 2187.2:2006 Explosives - Storage and use - Part 2 Use of explosives*.

Australian Standard, 2016. *AS 2107:2016 Acoustics - Recommended design sound levels and reverberation times for building interiors.*

Australian Standard/New Zealand Standard, 2005. *AS/NZS 1158.1.1:2005 Lighting for roads and public spaces.*

Australian Transport Council, 2011. *National Road Safety Strategy 2011–2020*.

Austroads, 2017a. *Guide to Traffic Management Part 3: Traffic Studies and Analysis.*

Austroads, 2017b. *Cycling aspects of Austroads guides.*

Ball J, Babister M, Nathan R, Weeks W, Weinmann E, Retallick M, Testoni I, (Editors), 2019. *Australian Rainfall and Runoff: A Guide to Flood Estimation, Commonwealth of Australia*.

Barnett, B., Townley, L.R., Post, V., Evans, R.E., Hunt, R.J., Peeters, L., Richardson, S., Werner, A.D., Knapton, A.. Boronkay, A., 2012. *Australian groundwater modelling guidelines*, National Water Commission, Canberra.

Bell, S.A.J. & Driscoll, C., 2006. *Vegetation of the Tomago and Tomaree Sandbeds, Port Stephens, New South Wales: Management of Groundwater Dependent Ecosystems. Part 1 – Vegetation Classification*. Unpublished Report to Hunter Water, Eastcoast Flora Survey, September 2006.

Birdlife Australia, 2013. Swift Parrots and Regent Honeyeaters in the Lower Hunter Region of New South Wales: An Assessment of status, Identification of High Priority Habitats and Recommendations for Conservation, Victoria.

BMT WBM, 2012a. *Newcastle City Wide Floodplain Risk Management Study* and *Plan*, Newcastle City Council.

BMT WBM, 2012b. *Hexham Train Support Facility Flood Impact Assessment, Appendix G of EIS,* QR National NSW Train Support Facility.

BMT WBM, 2017. *Williamtown Salt Ash Floodplain Risk Management Study* and *Plan*, Port Stephens Council.

British Standard (BSI), 1993. *British Standard BS 7385: Part 2-1993 Evaluation and measurement for vibration in buildings Part 2: Guide to damage levels from groundborne vibration.*

City of Newcastle, 2018a. *Community Strategic Plan Newcastle 2030*, City of Newcastle.

City of Newcastle, 2018b. *City of Newcastle Bushfire Prone Land Map.*

City of Newcastle, 2020. *City of Newcastle Local Strategic Planning Statement.*

Coffin, A., 2007. From roadkill to road ecology: A review of the ecological effects of roads. Journal of Transport Geography, 15(5), pp.396-406.

Commonwealth Scientific and Industrial Research Organisation (CSIRO), 2020. *Australian Soil Resource Information System (ASRIS) database.* Available from: https://www.asris.csiro.au/ (accessed June 2020).

Department of Agriculture, Water and the Environment (DAWE), 2020. *Protected Matters Search Tool*. Available online at: **https://www.environment.gov.au/epbc/protected-matters-search-tool Accessed August 2020**.

Department of Environment and Climate Change (DECC), 2006. *Assessing Vibration: a technical guideline.*

Department of Environment and Climate Change (DECC), 2007a. *Fauna Corridors for Climate Change. Landscape selection process: key altitudinal, latitudinal ad coastal corridors for response to climate change. Hunter Central River Catchment Management Authority*, Department of Environment and Climate Change, Sydney.

Department of Environment and Climate Change (DECC), 2007b. *Practical Consideration of Climate Change.*

Department of Environment and Climate Change (DECC), 2008. *Managing Urban Stormwater: Soils and Construction Volume 1* (Landcom, 2004) *and Volume 2 (A. Installation of Services; B. Waste Landfills; C. Unsealed Roads; D. Main Roads; E. Mines and Quarries).*

Department of Environment and Climate Change (DECC), 2009a. *Interim Construction Noise Guideline (ICNG)*.

Department of Environment and Climate Change (DECC), 2009b. *Guidelines for the Implementing the Protection of the Environment Operations (Underground Petroleum Storage Systems) Regulation 2008.*

Department of Environment and Conservation (DEC), 2004. *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities* (Working Draft), Department of Environment and Conservation, Hurstville.

Department of Environment and Conservation (DEC), 2005. *Approved Methods for Sampling and Analysis of Air Pollutants in NSW*. Prepared by the NSW Department of Environment and Conservation, now EPA.

Department of Environment and Conservation (DEC), 2006. *Technical Framework - Assessment and Management of Odour from Stationary Sources in NSW*. Prepared by the Department of Environment and Conservation, now EPA.

Department of Environment and Conservation (DEC), 2008. *Approved Methods for the Sampling and Analysis of Water Pollutants in New South Wales*, NSW EPA, ISBN 1 74137 051 5, First published in March 2004.

Department of Environment, Climate Change and Water (DECCW), 2006. *NSW Water Quality and River Flow Objectives – Hunter River*.

Department of Environment, Climate Change and Water (DECCW), 2010a. *Aboriginal Cultural Heritage Consultation Requirements for Proponents.*

Department of Environment, Climate Change and Water (DECCW), 2010b. *Guidelines for developments adjoining land and water managed by DECCW.*

Department of Environment, Climate Change and Water (DECCW), 2010c. *NSW Wetlands Policy*.

Department of Environment, Climate Change and Water (DECCW), 2010d. *Floodplain Risk Management Guide: Incorporating sea level rise benchmarks in flood risk assessments.*

Department of Environment, Climate Change and Water (DECCW), 2010e. *Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW*. Sydney.

Department of Environment, Climate Change and Water (DECCW), 2010f. *Due Diligence Code of Practice for the Protection of Aboriginal Objects in NSW*. Sydney, NSW Government.

Department of Environment, Climate Change and Water (DECCW), 2011. *NSW Road Noise Policy (RNP).*

Department of Infrastructure, Planning and Natural Resources (DIPNR), 2004. *Planning Guidelines for Walking and Cycling.*

Department of Land and Water Conservation, 2002. *Site investigations for urban salinity*. Department of Land and Water Conservation, Sydney, NSW.

Department of Planning, 2008. *Acid Sulfate Soils Assessment Guidelines.*

Department of Planning and Environment (DPE), 2011. *Applying State Environmental Planning Policy 33 (SEPP 33): Hazardous and Offensive Development Application Guidelines.*

Department of Planning and Environment (DPE), 2016. *Hunter Regional Plan 2036*. Available at: **https://www.planning.nsw.gov.au/-/media/Files/DPE/Plans-and-policies/hunter-regional-plan-2036-2016-10-18.pdf**.

Department of Planning and Environment (DPE), 2018. *Greater Newcastle Metropolitan Plan 2036*.

Department of Planning, Industry and Environment (DPIE), 2020a. *Surveying threatened plants and their habitats – NSW survey guide for the Biodiversity Assessment Method.*

Department of Planning, Industry and Environment (DPIE), 2020b. *BioNet Vegetation Classification*, NSW Government. Available online at: **https://www.environment.nsw.gov.au/NSWVCA20PRapp/default.aspx**.

Department of Planning, Industry and Environment (DPIE), 2020c. *State Environmental Planning Policy (Coastal Management) 2018 - spatial data set*.

Department of Planning, Industry and Environment (DPIE), 2020d. *BioNet Atlas – the Atlas of NSW Wildlife Threatened Species Profile Database*. Available online at: **https://www.environment.nsw.gov.au/atlaspublicapp/UI_Modules/ATLAS_/AtlasSearch.aspx** Accessed August 2020.

Department of Planning, Industry and Environment (DPIE), 2020e. *NSW Landuse 2017 Dataset.*

Department of Planning, Industry and Environment (DPIE), 2020f. *NSW Net Zero Plan Stage 1: 2020 – 2030.*

Department of Planning, Industry and Environment (DPIE), 2020g. *Environmental Management Plan Guideline for Infrastructure Projects.*

Department of Primary Industries (DPI), 2000. *Mapping the estuarine habitats of NSW – Hunter River (Map 1)*, NSW Government – Industry and Investment. Available at: **https://www.dpi.nsw.gov.au/content/research/areas/aquatic-ecosystems/estuarine-habitats-maps**. Accessed July 2020.

Department of Primary Industries (DPI), 2007. *Key Fish Habitat Maps*. Available online at: **https://www.dpi.nsw.gov.au/fishing/habitat/publications/pubs/key-fish-habitat-maps** Accessed August 2020.

Department of Primary Industries (DPI), 2011. *Land Use Conflict Risk Assessment Guide*, Resource Planning and Development Unit.

Department of Primary Industries (DPI), 2012. *NSW Aquifer Interference Policy: NSW Government policy for the licensing and assessment of aquifer interference activities*, NSW DPI – Office of Water.

Department of Primary Industries (DPI), 2013a. *Fisheries NSW Policy and Guidelines for Fish Habitat Conservation and Management (2013 update)*, Department of Primary Industries.

Department of Primary Industries (DPI), 2013b. *Infrastructure Proposals on Rural Land*.

Department of Primary Industries (DPI), 2014. *Salinity Training Handbook*, Department of Primary Industries, 2014, Yanco, NSW.

Department of Primary Industries (DPI), 2015. *Fisheries Final Report Series | No. 149, Survey of Recreational Fishing in New South Wales and the ACT, 2013/14* .

Department of Primary Industries (DPI), 2016. *Freshwater threatened species distribution maps*. Available online at: **https://www.dpi.nsw.gov.au/fishing/species-protection/threatened-species-distributions-in-nsw/freshwater-threatened-species-distribution-maps** Accessed May 2020 .

Department of Primary Industries (DPI), 2017. *NSW Estuary Prawn Trawl Fishery Assessment*. Prepared for the Department of the Environment and Energy for the purpose of assessment under Part 13 and 13(A) of the Environment Protection and Biodiversity Act 1999.

Department of Sustainability Environment Water Population and Communities, 2013. *Significant Impact Guidelines 1.2 - Actions on, or impacting upon, Commonwealth land, and actions by Commonwealth agencies* .

Department of the Environment (DoE), 2013a. *Koala Habitat Assessment Tool.*

Department of the Environment (DoE), 2013b. *Significant Impact Guidelines 1.1 – Matters of National Environmental Significance*, Australian Government, Canberra.

Department of the Environment (DoE), 2014. *EPBC Act referral guidelines for the vulnerable koala (combined populations of Queensland, New South Wales and the Australian Capital Territory.*

Department of the Environment (DoE), 2015. *National Climate Resilience Adaption Strategy.*

Department of the Environment and Heritage (DoEH), 2006. *Climate Change Impacts and Risk Management – A Guide for Business and Government.*

Department of Urban Affairs and Planning (DUAP), 2001. *Crime Prevention and the assessment of development applications: guidelines under section 79C of the Environmental Planning and Assessment Act 1979*.

Department of Urban Affairs and Planning & NSW Environment Protection Authority, 1998. *Managing Land Contamination: Planning Guidelines SEPP 55 – Remediation of Land.*

Deutsches Institut für Normung (DIN), 2016. *German Standard DIN 4150-3 (2016) Vibration in buildings – Part 3: Effects on structures.*

DISER, 2020. *State and Territory Greenhouse Gas Inventories 2018*. Australian Government Department of Industry, Science, Energy and Resource.

Douglas Partners, 2012. *Preliminary Contamination Assessment, Proposed Train Support Facility, Woodlands Close, Hexham* - Douglas Partners, 2012.

Douglas Partners, 2015. *Preliminary Site Investigation – Contamination and Acid Sulfate Soil Assessment. Proposed M1 Extension to Raymond Terrace (M12RT) Black Hill to Raymond Terrace*. May 2015.

Douglas Partners, 2017. *Geotechnical Investigation Factual Report, M1 Pacific Motorway extension to Raymond Terrace, Black Hill to Raymond Terrace*. October 2017.

Douglas Partners, 2020. *Geotechnical Concept Design Report* (not publicly available).

Eco Logical Australia, 2013. *Lower Hunter Koala Study.*

enHealth, 2012a. *Environmental Health Risk Assessment, Guidelines for assessing human health risks from environmental hazards*, Commonwealth of Australia, Canberra, ACT.

enHealth, 2012b. *Australian Exposure Factors Guide*, Commonwealth of Australia, Canberra, ACT.

enHealth, 2017. *Health Impact Assessment Guidelines*.

ERM, 2019. *Newcastle Power Station: Aboriginal Cultural Heritage Assessment Report. Prepared for AGL.*

ERM, 2020. *Western Harbour Tunnel and Warringah Freeway Upgrade Technical working paper: Air quality*. Prepared by ERM, January 2020.

Fairfull, S. & Witheridge, G., 2003. *Why do fish need to cross the road? Fish passage requirements for waterway crossings*, Department of Primary Industries, Cronulla.

GANSW, 2020. *Designing with Country.*

GeoLink, 2013. *Grey-headed Flying-fox management strategy for the Lower Hunter.*

Gray and Department of Land and Water Conservation, 2000. *Soil and Landscape Issues in Environmental Impact Assessment,* Department of Land and Water Conservation, Sydney, NSW.

HazMat Services, 2016. *RMS Land Off Lenaghans Drive, Black Hill* – Hazmat Services, 2016.

HEPA, 2020. *PFAS National Environmental Management Plan, Version 2.0*, Heads of EPA Australia and New Zealand 2020, February 2020.

Heritage Council of NSW, 2011. *Criteria for the Assessment of Excavation Directors.*

Hunter Water, 2019. *Tomago Sandbeds Fact Sheet*, Hunter Water, Newcastle NSW.

Hunter Water, 2020. *Dam and catchments – Tomago Sandbeds*, Hunter Water, Newcastle NSW. Available online at: **https://www.hunterwater.com.au/our-water/water-supply/dams-and-catchments/tomago-sandbeds** Accessed September 2020.

Infrastructure Australia, 2016. *Australian Infrastructure Plan*.

Infrastructure Australia, 2021. *Infrastructure Priority List*. Available online at: **https://www.infrastructureaustralia.gov.au/publications/Infrastructure_Priority_List_2021**.

Infrastructure NSW, 2018. *NSW State Infrastructure Strategy 2018-2038.*

International Atomic Energy Agency, 2007. *Radiation Protection and NORM residue Management in the Zircon and Zirconia Industries, Safety Reports Series No. 51*. IAEA, Vienna.

IPCC, 2014. Climate Change 2013: *The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1535 pp.

Jacobs, 2016. *Former RZM Site: Detailed Site Investigation,* Jacobs, September 2016.

Jacobs, 2020. *Former RZM Site - Consolidated Human Health and Ecological Risk Management Report.*

Kennedy, S., E. Foley, F. Atkinson and N. Neuendorf, 2014. *Tarro to Beresfield Trunk Water Main Replacement: Aboriginal Cultural Heritage Assessment*, Report prepared for Hunter Water Australia.

Kuginis, L., Byrne, G., Serov, P., Williams, JP., 2012. *Risk assessment guidelines for groundwater dependent ecosystems.* Department of Primary Industries, Sydney.

Landcom, 2004. *Managing Urban Stormwater: Soils and Construction Volume 1* .

Lawson and Treloar, 1994. *Tuggerah Lakes Flood Study.*

Maitland City Council, 2018. Maitland City Council online mapping.

Marcus Lincoln Smith, 2003. *Aquatic Ecology in Environmental Impact Assessment - EIA guideline*, NSW Department of Planning.

Matthei, L.E., 1995. *Soil Landscapes of the Newcastle 1:100,000 Sheet Map,* Department of Land and Water Conservation, Sydney.

National Environment Protection Council (NEPC), 2011. *National Environment Protection (Air Toxics) Measure*, National Environment Protection Council.

National Environment Protection Council (NEPC), 2013. *National Environmental Protection Measure (Assessment of Site Contamination) 1999* (as amended 2013).

National Environment Protection Council (NEPC), 2016. *National Environment Protection Measure for Ambient Air Quality*, National Environment Protection Council, as amended.

National Transport Commission, 2020. *Australian Dangerous Goods Code*.

Newcastle Bush Fire Management Committee, 2018. *Newcastle Bushfire Risk Management Plan 2018-2023*. Available online at: **https://www.rfs.nsw.gov.au/__data/assets/pdf_file/0019/2395/Newcastle-BFRMP.pdf**.

NHMRC, 2008. *Guidelines for Managing Risks in Recreational Water*, Australian Government, 2008.

NHMRC, 2011. *Australian Drinking Water Guidelines,* National Health and Medical Research Council and the Nature Resource Management Ministerial Council, Commonwealth Australia, Canberra.

NSW Department of Industry, 2018. *Guidelines for controlled activities on waterfront land – Riparian corridors*, Natural Resources Access Regulator.

NSW Department of Planning, 2006. *Lower Hunter Regional Strategy*.

NSW Environment Protection Authority, 1995. *Contaminated Sites: Sampling Design Guidelines,* NSW Environment Protection Authority, Sydney, NSW.

NSW Environment Protection Authority, 2014a. *Waste Classification Guidelines,* NSW Environment Protection Authority, Sydney, NSW.

NSW Environment Protection Authority, 2014b. *NSW Acid Sulfate Soils Manual (the ASS Manual) .*

NSW Environment Protection Authority, 2015. *Guidelines on the Duty to Report Contamination under the Contaminated Land Management Act 1997,* NSW Environment Protection Authority, Sydney, NSW.

NSW Environment Protection Authority, 2016. *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW*.

NSW Environment Protection Authority, 2017. *Guidelines for the NSW Site Auditor Scheme, 3rd Edition*.

NSW Environment Protection Authority, 2019a. *Air Emissions Inventory for the Greater Metropolitan Region in New South Wales, 2013 Calendar Year, On-Road Mobile Emissions*.

NSW Environment Protection Authority, 2019b. *NSW Circular Economy Policy.*

NSW Environment Protection Authority, 2020. *Guidelines for Consultants Reporting on Contaminated Land*, NSW Environment Protection Authority, Sydney, NSW.

NSW Government, 2005. *Floodplain Development Manual: The management of flood liable land.*

NSW Government, 2009. *Water Sharing Plan for the Hunter Unregulated and Alluvial Water Sources 2009*, Available online at: **https://www.legislation.nsw.gov.au/view/whole/html/inforce/current/sl-2009-0347***,* accessed August 2020.

NSW Government, 2014a. *Hunter Regional Transport Plan*.

NSW Government, 2014b. *Land Acquisition Information Guide*. Available online at: **https://arp.nsw.gov.au/sites/default/files/Land%20Acquisition%20Factsheet.pdf**.

NSW Government, 2016a. *Hunter Regional Transport Plan Annual Update 2014-15*.

NSW Government, 2016b. *Water Sharing Plan for the North Coast Fractured and Porous Rock Groundwater Sources 2016*, Available online at: **https://www.legislation.nsw.gov.au/view/whole/html/inforce/current/sl-2016-0375**, accessed August 2020.

NSW Government, 2016c. *Water Sharing Plan for the North Coast Coastal Sands Groundwater Sources.*

NSW Government, 2017. *Noise Policy for Industry.*

NSW Government, 2018. *Regional NSW Services and Infrastructure Plan.*

NSW Government, 2019 *Property Acquisition. A Guide for Residential Owners.*

NSW Health, 2007. *Health Impact Assessment: A Practical Guide.*

NSW Health, 2009. *Healthy Urban Development Checklist, A guide for considering health in development policies, plans and proposals, prepared by the Centre for Population Health, NSW Department of Health.*

NSW Heritage Branch, 2009. *Assessing Significance for Historical Archaeological Sites and 'Relics'.*

NSW Heritage Office, 1996. *NSW Heritage Manual.*

NSW Heritage Office, 1998. *Skeletal remains: guidelines for the management of human skeletal remains.*

NSW Heritage Office, 2001. *Assessing Heritage Significance.*

NSW Heritage Office, 2002. *Statements of Heritage Impact guidelines.*

NSW Heritage Office, 2004. *Investigating Heritage Significance (draft guideline)*.

NSW National Parks and Wildlife Service (NPWS), 2020a. *Developments adjacent to NPWS: Guidelines for consent and planning authorities.*

NSW National Parks and Wildlife Service (NPWS), 2020b. *Hunter Wetlands National Park: Plan of Management.*

NSW Procurement, 2018. Aboriginal Participation in Construction (APIC) Policy, June 2018. Department of Finance, Services and Innovation.

NSW Rural Fire Service, 2006. *Planning for Bush Fire Protection.*

NSW Rural Fire Service, 2016. *NSW Bushfire Prone Land Map Tool.*

NSW Treasury, 2020. Draft Aboriginal Procurement Policy, October 2020.

Office of Environment and Heritage (OEH), 1996. *Statements of Heritage Impact.*

Office of Environment and Heritage (OEH), 2011. *Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in NSW*. Sydney, NSW Government.

Office of Environment and Heritage (OEH), 2014a. *Framework for Biodiversity Assessment: NSW Biodiversity Offsets Policy for Major Projects*. Office of Environment and Heritage, Sydney.

Office of Environment and Heritage (OEH), 2014b. *NSW Biodiversity Offsets Policy for Major Projects*. Office of Environment and Heritage, Sydney.

Office of Environment and Heritage (OEH), 2015. *Urban Green Cover in NSW, Technical Guidelines*. Prepared by the NSW Office of Environment and Heritage, State of NSW.

Office of Environment and Heritage (OEH), 2016a. *NSW Guide to Surveying Threatened Plants*. Office of Environment and Heritage, Sydney.

Office of Environment and Heritage (OEH), 2016b. *NSW Climate Change Policy Framework .*

Office of Environment and Heritage (OEH), 2019a. *Annual Air Quality Statement 2018*. Prepared by the Office of Environment and Heritage, now DPIE.

Office of Environment and Heritage (OEH), 2019b. *NSW Government Resource Efficiency Policy*.

Parsons Brinkerhoff, 2012, *Water Quality Assessment - Hexham Relief Roads,* Upper Hunter valley Alliance, April 2012.

Port Stephens Council, 2009. *Bush Fire Prone Land Map*. Available online at: **https://www.portstephens.nsw.gov.au/grow/land-environment-and-heritage/bushfires**.

Port Stephens Council, 2015. *Raymond Terrace and Heatherbrae Strategy 2015-2031*.

Port Stephens Council, 2018a. *Community Strategic Plan 2018-2028: Our place. Our plan.* Available online at: **https://www.portstephens.nsw.gov.au/your-council/policies-forms-publications/integrated-plans**.

Port Stephens Council, 2018b. *Port Stephens Economic Development and Tourism Strategy 2018-2020.*

Port Stephens Council, undated. *Port Stephens Local Strategic Planning Statement.*

Port Stephens Council and Australian Koala Foundation, 2002. *Port Stephens Council Comprehensive Koala Plan of Management (CKPoM)*. Raymond Terrace.

Queensland Government, 2007. *Crime Prevention through Environmental Design*. *Guidelines for Queensland.*

Roads and Maritime Services, 2011a. *Wildlife Connectivity Guidelines for Road Projects.*

Roads and Maritime Services, 2011b. *Procedure for Aboriginal Cultural Heritage Consultation and Investigation* (PACHCI).

Roads and Maritime Services, 2012. *Community Engagement and Communications Manual.*

Roads and Maritime Services, 2013a. *Traffic Modelling Guidelines.*

Roads and Maritime Services, 2013b. *Pacific Highway urban design framework 2013. Urban design vision, objectives and design principles for the upgrade of the Pacific Highway from Hexham to Tweed Heads*.

Roads and Maritime Services, 2013c. *Guideline for the Management of Contamination.*

Roads and Maritime Services, 2015a. *M1 Pacific Motorway extension to Raymond Terrace Discussion Paper – Revised Concept Design.*

Roads and Maritime Services, 2015b. *M1 Pacific Motorway extension to Raymond Terrace State Significant Infrastructure Application Report*.

Roads and Maritime Services, 2015c. *Noise Criteria Guideline (NCG)*, Sydney. Available online at: **https://www.rms.nsw.gov.au/documents/about/environment/noise-criteria-guideline-book.pdf**.

Roads and Maritime Services, 2015d. *Noise Mitigation Guideline (NMG)*, Sydney. Available online at: **https://www.rms.nsw.gov.au/documents/about/environment/noise-mitigation-guideline-book.pdf**.

Roads and Maritime Services, 2015e. *Stockpile Site Management Guideline*, NSW Roads and Maritime Services.

Roads and Maritime Services, 2015f. *Standard Management Procedure: Unexpected Heritage Items*.

Roads and Maritime Services, 2015g. *Roads and Maritime Services Cultural Heritage guidelines.*

Roads and Maritime Services, 2016a. *M1 Pacific Motorway extension to Raymond Terrace Community Consultation Report.*

Roads and Maritime Services, 2016b. *Construction Noise and Vibration Guideline (CNVG)*, NSW Government, Sydney. Available online at: **https://www.rms.nsw.gov.au/business-industry/partners-suppliers/documents/guides-manuals/construction-noise-and-vibration-guideline.pdf**.

Roads and Maritime Services, 2016c. *Noise Criteria Guideline Application Notes*, NSW Government, Sydney. Available online at: **https://www.rms.nsw.gov.au/documents/about/environment/application-notes-noise-criteria-guideline.pdf**.

Roads and Maritime Services, 2016d. *Noise Wall Design Guideline*, NSW Government, Sydney. Available online at: **https://www.rms.nsw.gov.au/business-industry/partners-suppliers/documents/centre-for-urban-design/noise-wall-design-guideline.pdf**.

Roads and Maritime Services, 2016e. *Guideline for Biodiversity Offsets.*

Roads and Maritime Services, 2016f. *Technical Guide: Management of Road Construction and Maintenance Wastes*, NSW Government, Sydney. Available online at: **https://www.rms.nsw.gov.au/documents/about/environment/waste-management-guide.pdf**.

Roads and Maritime Services, 2017a. *M1 Pacific Motorway extension to Raymond Terrace Community Consultation Report.*

Roads and Maritime Services, 2017b. *Motorway design guide: Capacity and flow analysis.*

Roads and Maritime Services, 2017c. *At-Receiver Noise Treatment Guideline.*

Roads and Maritime Services, 2017d. *Acid Sulfate Rock Risk Map*.

Roads and Maritime Services, 2018a. *Design guideline to improve the quality, safety and cost effectiveness of green infrastructure in road corridors*, NSW Government, Sydney. Available online at: **https://www.rms.nsw.gov.au/business-industry/partners-suppliers/documents/centre-for-urban-design/landscape-guideline.pdf**.

Roads and Maritime Services, 2018b. *Traffic control at work sites*, NSW Government, Sydney. Available online at: **https://www.rms.nsw.gov.au/business-industry/partners-suppliers/documents/technical-manuals/traffic-control-at-worksites-manual.pdf**.

Roads and Maritime Services, 2018c. *Noise Model Validation Guideline.*

Roads and Maritime Services, 2019. *Environmental Sustainability Strategy 2019–2023*, NSW Government, Sydney. Available online at: **https://www.rms.nsw.gov.au/documents/about/environment/environmental-sustainability-strategy.pdf**.

Roads and Maritime Services, in draft. *Technical Guide for Climate Change Adaptation for the State Road Network.*

Transport for NSW, 2018a. *Future Transport Strategy 2056*, Transport for NSW, Chippendale.

Rowden, P., Steinhardt, D. and Sheehan, M., 2008. *Road crashes involving animals in Australia. Accident Analysis & Prevention,* 40(6), pp.1865-1871.

Roy, Hudson, and Boyd, 1995. *Quaternary geology of the Hunter delta – an estuarine valleyfill case study* in Sloan and Allman eds. *Engineering geology of the Newcastle-Gosford Region* pp64 – 84 Australian Geomechanics Society.

RTA, 2001. *Environmental Noise Management Manual (ENMM)*, Roads and Traffic Authority of New South Wales, Sydney. Available online at: **https://www.rms.nsw.gov.au/business-industry/partners-suppliers/documents/guides-manuals/environmental-noise-management-manual.pdf**.

RTA, 2002. *Guide to Traffic Generating Developments version 2.2.*

RTA, 2003. *Guideline for Construction Water Quality Monitoring.* Roads and Traffic Authority of NSW, Sydney.

RTA, 2005a. *F3 Freeway to Raymond Terrace Route Options Development Report*.

RTA, 2005b. *NSW Bicycle Guidelines Version 1.2.*

RTA, 2005c. *Guidelines for the Management of Acid Sulfate Materials.*

RTA, 2006. *F3 Freeway to Raymond Terrace Preferred Route Report.*

RTA, 2008. *F3 Freeway to Raymond Terrace Concept Design Report.*

RTA, 2010. *F3 Freeway to Raymond Terrace Concept Design Submissions Report*.

RTA, 2011. *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects*, NSW Roads and Traffic Authority, Sydney.

Scotts, D., 2003. *Key habitats and corridors for forest fauna: a landscape framework for conservation in north-east New South Wales*, NSW National Parks and Wildlife Service, Hurstville.

Serov, P., Kuginis, L. & Williams, JP., 2012. *Risk assessment guidelines for groundwater dependent ecosystems*, Volume 1 – The conceptual framework, NSW Department of Primary Industries, Office of Water, Sydney.

Sinclair Knight Merz, 2013. *Preliminary Site Investigation (PSI): Former RZM site, Tomago, NSW*, July 2013.

State Emergency Service (SES), 2013a. *City of Newcastle Flood Emergency Sub Plan.*

State Emergency Service (SES), 2013b. *Port Stephens Flood Emergency Sub Plan.*

Thomas, M. 2008. *Technical paper 9. Aboriginal Cultural Heritage.* Report to Queensland Transport.

Tourism Research Australia, 2019. Local Government Area Profiles, Newcastle (C), New South Wales; Port Stephens (A), New South Wales; Maitland (C), New South Wales and Cessnock (C), New South Wales.

Transport and Infrastructure Council, 2019. *National Freight and Supply Chain Strategy*, Department of Infrastructure, Transport, Cities and Regional Development.

Transport for NSW, 2013. *NSW Sustainable Design Guidelines Version 3.0*.

Transport for NSW, 2016a. *Noise Wall Design Guideline*, NSW Government, Sydney. Available online at: **https://www.rms.nsw.gov.au/business-industry/partners-suppliers/documents/centre-for-urban-design/noise-wall-design-guideline.pdf**.

Transport for NSW, 2016b. *Shotcrete design guideline. Design guideline to improve the appearance of shotcrete in NSW*, Transport for NSW, Chippendale.

Transport for NSW, 2017a. *NSW Sustainable Design Guidelines Version 4.0.*

Transport for NSW, 2017b. *Water sensitive urban design guideline. Applying water sensitive urban design principals to NSW transport projects*, prepared by the Centre for Urban Design, Transport for NSW, Chippendale.

Transport for NSW, 2018a. *Future Transport Strategy 2056*, Transport for NSW, Chippendale.

Transport for NSW, 2018b. *NSW Freight and Ports Plan 2018-2023*, Transport for NSW Chippendale.

Transport for NSW, 2018c. *Moving More with Less,* Transport for NSW Chippendale.

Transport for NSW, 2018d. *Road Safety Plan 2021*, Transport for NSW, Chippendale.

Transport for NSW, 2018e. *Greater Newcastle Future Transport Plan 2056*, Transport for NSW, Chippendale.

Transport for NSW, 2019a. *Bridge Aesthetics. Design guideline to improve the appearance of bridges in NSW*, Transport for NSW, Chippendale.

Transport for NSW, 2019b. *Standard Management Procedure: Unexpected Heritage Items*. Sydney, NSW Government.

Transport for NSW, 2020a. *Beyond the Pavement 2020 Urban design approach and procedures for road and maritime infrastructure planning, design and construction*, Transport for NSW, Chippendale.

Transport for NSW, 2020b. *Cycleway Finder v3*. Available online at: **https://www.rms.nsw.gov.au/roads/bicycles/cycleway-finder.html**.

Transport for NSW, 2020c. *Environmental Impact Assessment Practice Note – Socio economic Assessment.*

Transport for NSW, 2020d. *Guideline for landscape character and visual impact assessment. Environmental impact assessment practice note EIA-N04, Version 2.2*, prepared by the Centre for Urban Design, Transport for NSW, Chippendale.

Transport for NSW, 2020e. *Transport Environment and Sustainability Policy Framework and Statement*.

Transport for NSW, 2020f. *Social Procurement Workforce Development Resource Guide.*

Transport for NSW, 2021. *M1 Pacific Motorway extension to Raymond Terrace Community and Stakeholder Engagement Plan.*

Transportation Research Board, 2016. *Highway Capacity Manual 2016.*

UK Department of Transport, 1988. *Calculation of Road Traffic Noise (CORTN).*

UK Institute of Air Quality Management (UK IAQM), 2014. *Guidance on the assessment of dust from demolition and construction Version 1.1*.

United Nations, 2015. *United Nations Sustainable Development Goals* .

Weston, J. 2013. *Hexham Relief Roads Project: Test Excavation Report*, Report prepared for KMH Environmental.

WMAwater, 2015. *Hunter River Floodplain Risk Management Study and Plan for Maitland City Council*, Maitland City Council, Sydney.

WorkCover NSW, 2014. *Managing asbestos in or on soil*. WorkCover NSW, Gosford, NSW, March 2014.

World Commission on Environment and Development, 1987. *Our Common Future (the Brundtland Report).*